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Flood and Coastal Erosion Risk Management appraisal guidance

FCERM-AG

March 2010

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The Environment Agency. Out there, making your environment a better place.

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Foreword

The FCERM-AG has been produced by the Environment Agency. It provides best practice implementation guidance on appraisal and supports the Defra Policy Statement on Appraisal (June 2009).

The previous Flood and Coastal Defence Project Appraisal Guidance (FCDPAG) was published between 1999 and 2001. Since that time, the approach has changed from one focused on flood defences and coast protection to the management of risk. This change has been driven by Government policy (including the cross-Government programme on Making Space for Water), by flooding such as that seen in 2007 and the risks from climate change that are likely to increase the risk of flooding and coastal erosion that threatens our coastal communities. Other influences include the need to work better with natural processes, seek alternative sources of funding and partnerships for more efficient ways of working. This new guidance embraces these changes and the need to maximise benefits from the solutions we deliver.

Working together with communities and other partners this guidance will drive forward appraisals that will help deliver innovative, adaptive and integrated flood and coastal erosion risk management solutions that can also meet social, environmental and economic objectives.

Acknowledgements

This guidance document has been prepared by the Environment Agency with significant assistance from Risk & Policy Analysts (RPA) and Royal Haskoning and the help and support of the Steering Group (David Cotterell, John Corkindale and Bernard Ayling). Key contributors include:

- Environment Agency (Ruth Johnston, Jo Murphy, Karl Fuller, Wendy Brooks, Sue Reed, Duncan Huggett, Andy Slaney and Emma Hayes);
- Natural England (Rob Cathcart and Tim Collins);
- Defra (Allen Risby, Paul Murby, Elizabeth Passmore, Nick Haigh); and
- Welsh Assembly Government (WAG).

The guidance has also benefited from feedback and comments from many others during its development including local authorities, internal drainage boards, professional partners and consultants. Those who attended the workshops on an early draft of the guidance have our particular thanks. All the help and comments have allowed us to develop the guidance into a stronger document that will enable Flood and Coastal Risk Management to continue to ensure a robust approach is taken to investment appraisal, founded on best practice, to deliver effective and more sustainable solutions that can meet the challenges presented by our changing environment.

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1. Introduction to the FCERM appraisal guidance

1.1 The role of the FCERM Appraisal Guidance

This guidance is a technical document primarily aimed at those who undertake and review appraisals. It will also be of interest to those affected by flood or coastal erosion risk.

Use of this guidance is a requirement for all publicly funded Flood and Coastal Erosion Risk Management strategies and projects developed by operating authorities. The role of this guidance is to provide the user with the information needed (or links to that information) to complete a FCERM appraisal in line with government policy. The policy context is set in Defra's policy statement (Defra, 2009) for England or as amended for use in Wales by the WAG Ministerial Statement Feb 2007.

The guidance aims to help users undertake efficient appraisals and encourages experience and knowledge to be applied at all stages. It has been designed based on the following key principles and to help practitioners to:

- undertake appraisals that reduce the threat to people and their property and deliver the greatest environmental, social and economic benefits in line with the Government's sustainable development principles;
- engage through an open and transparent process with those affected by flooding, erosion or their management activities to enable full account to be taken of social, environmental and economic issues and to build trust with local communities;
- identify what level of information and effort is needed. The guidance recognises that proportionality is needed in the effort expended on addressing uncertainty within appraisals;
- identify and assess solutions that could provide benefits wider than just those associated with managing the risk of flooding or erosion;
- identify who benefits and who loses from a particular solution and where contributions could fund delivery;
- promote approaches which reflect both national and local priorities;
- identify and assess sustainable, adaptable and flexible solutions that work with natural processes;
- understand how change (including climate change) could affect future flood and erosion risk and how to identify and appraise options that enable adaptation to changing risk; and
- promote partnership working to deliver wider benefits.

The guidance describes how to undertake an appraisal that meets these key principles. It does not cover the prioritisation of projects as it is not a core part of appraisal itself. Information about prioritisation, the use of Defra outcome measures (in England) or prioritisation in Wales can be obtained separately from Defra, the Environment Agency or WAG.

1.2 The intended audience

The guidance is targeted at all operating authorities. Other interested parties may wish to use the guidance to see how specific issues are addressed and how the aspects of projects they are concerned with are taken account of as part of the decision-making process.

Figure 1.1 sets out the chapters of the guidance that may be of interest to particular types of user. However, the chapters are not standalone and must be read in conjunction with all other chapters.

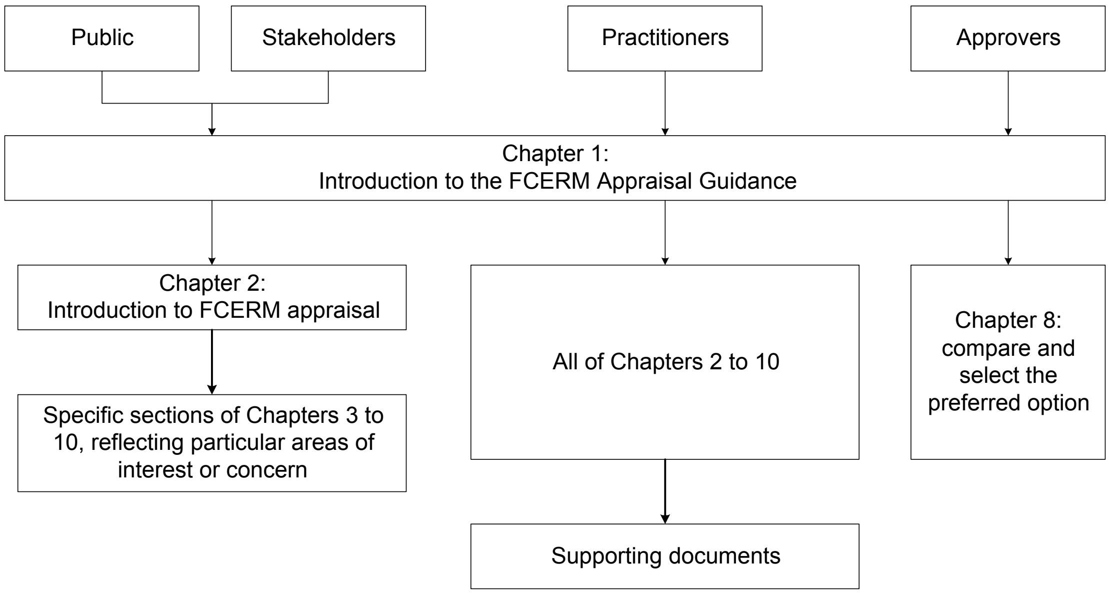


Figure 1.1 Chapters of the guidance of interest to different users

1.3 Developing the guidance

This guidance, the Flood and Coastal Erosion Risk Management-Appraisal Guidance) replaces the five Flood and Coastal Defence Project Appraisal Guidance (FCDPAG, known as PAG) volumes plus the supplementary notes to PAG. The information previously contained within the FCDPAG series has been updated, taking into account:

- recent changes in Government policy (including Defra's appraisal policy statement (Defra, 2009) and Making Space for Water (Defra, 2004; 2005), Welsh Assembly Government Ministerial Statement on Priorities for Future Flood Risk Investment (Feb 2007) and updates to the HM Treasury Green Book (Green Book supplements[1]));

[1] http://www.hm-treasury.gov.uk/data_greenbook_supguidance.htm.

- the need for greater integration to more effectively implement strategic environmental assessment (SEA), environmental impact assessment (EIA), Water Framework Directive (WFD), and the Floods Directive;
- changes in emphasis following recent flood events including the results of the Pitt Review:
- growing understanding of the need to adapt to climate change (drawing on Foresight Future Flooding and the HM Treasury/Defra supplementary Green Book guidance on accounting for the effects of climate change);
- increased recognition of the need to work with others to deliver solutions that provide the best value for money and which can deliver more by bringing in funding from other sources;
- the findings of Defra research (such Defra, 2007 on developing an evidence base for improving appraisal guidance); and
- consultation events organised by Defra.

As a result of much of the above, new tools and techniques have been developed to help improve appraisal. The FCERM-AG brings in these new tools and techniques to provide guidance on why, when and how to do appraisal. It is supported by a range of other documents providing more detailed guidance on specific issues (supporting documents). Figure 1.2 shows how it is structured and highlights the supporting documents available to inform specific aspects of the appraisal.

Figure 1.2 also shows that the appraisal process is organised around the following model, in line with the general approach set out in the Treasury Green Book and Defra's policy statement. It is important to remember though that appraisal is not linear. It should be an iterative process with feedback loops (as shown by the arrows linking the different stages of the appraisal process) where options are developed and discarded throughout the appraisal:

Define → Develop, describe and value → Compare and select → Feedback

Each chapter within the guidance represents a step in the appraisal process:

- **Define**:
  - Chapter 3: understand and define the project;
  - Chapter 4: set objectives; and
  - Chapter 5: identify the type of project and baseline.
- **Develop, describe and value**:
  - Chapter 6: identify, develop and short-list options; and
  - Chapter 7: describe, quantify and value costs and benefits.
- **Compare and select**:
  - Chapter 8: compare and select the preferred option; and
  - Chapter 9: prepare outputs.

- **Feedback**:
  - Chapter 10: monitoring, evaluation and feedback.

1.4 The living draft and feedback

The FCERM-AG has been tested through focused practitioner testing workshops and wide industry review of the draft to ensure it is a useful and informative document. To allow for further feedback during initial use of the guidance, it is presented as a living draft for review. The review period lasts until 31 December 2010.

As a living draft we would very much welcome your comments and experiences in order to develop the guidance for final publication.
Please send your feedback to the Environment Agency at the address below at any time up until 31 December 2010.

AppraisalGuidanceFeedback@environment-agency.gov.uk

After 31 December 2010, we will consider and review all the feedback we receive and the final FCERM-AG will be published on the Environment Agency website.

1.5 Application to England and Wales

The new FCERM-AG updates and replaces the Defra published Project Appraisal Guidance (PAG) and should be used by operating authorities to support their FCERM appraisal as follows:

In England
- all new projects commencing after publication of the FCERM-AG.
- ongoing appraisals that will be submitted for approval in support of applications for grant funding after 31 August 2010.
- Where the previous PAG is being used operating authorities should satisfy themselves that the appraisal recommendations would not be changed as a result of using the new guidance.

In Wales
- during the ‘Living Document’ period this guidance is to be used by Environment Agency Wales on all Welsh Assembly Government (WAG) funded FCERM projects for new and ongoing projects as set out for England.
- other operating authorities in Wales should continue to use the current PAG series supported by any specific additional or updating material provided by WAG. However operating authorities may find material in the FCERM-AG useful to their appraisals and are also invited to provide any feedback.
- WAG will provide further details once the final FCERM-AG is published.

Chapter 1:
Introduction to the FCERM appraisal guidance

Chapter 2:
Introduction to FCERM appraisal

DEFINE

Chapter 3:
Understand and define the project

Chapter 4:
Set the objectives

Chapter 5:
Type of project and baseline

DEVELOP

Chapter 6:
Develop options

Chapter 7:
Describe, quantify and value costs and benefits

COMPARE AND SELECT

Chapter 8:
Compare and select the preferred option

Chapter 9:
Complete appraisal report

Chapter 10:
Monitoring, evaluation and feedback

Supporting documents

Tools to support appraisals:

See supporting documents

- FCERM-AG Economic Appraisal Spreadsheets
- Appraisal Summary Table (AST) including a worked example
- Multi-Criteria Analysis (Scoring and Weighing) guidance
- Handbook: Economic Evaluation of Environmental Effects
- Defra Supplementary Guidance:
  - Treatment of agricultural land
  - Risk to people guidance
  - Treatment of climate change impacts accompanying Q&A
  - Interim Guidance Note taking account of Defra's policy on socio-economic equity and appraisal of human-related intangible impacts of flooding
  - Revisions to Economic Appraisal Procedures arising from the New HM Treasury "Green Book"
- Engagement
- PAR/StAR Templates
- Climate change
- Environmental assessment
- Natural processes
- Carbon
- Multi-Coloured Manual (from FHRC)
- Multi-Coloured Handbook (from FHRC)

Financial

See supporting documents

- Financial Memorandum
- Memorandum Grant in Aid
- Approvals process
- Outcome measures
- Contributions Policy (and guidance)

Policy:

- Making Space for Water (Government Strategy)
- Defra policy statement
- Treasury Green Book

Figure 1.2 Structure of this guidance with supporting documents (it is not possible to identify all the tools and policies that exist to support FCERM appraisal. The tools and documents shown in Figure 1.2 are illustrative of those that would be relevant to most appraisals).

1.6 Structure of the chapters

Chapter 1 (this chapter) gives an introduction to the guidance.

Chapter 2 provides an introduction to appraisal for FCERM and describes how recent changes in legislation and government policy affect approaches to appraisal. It presents the opportunities open to practitioners to take account of recent policies and Directives and to develop solutions that integrate the needs of people and the environment by working with communities and natural processes. Chapter 2 also sets out the principles of appraisal and why appraisal is needed.

Chapters 3 to 9 provide the detailed 'how to' guidance. The chapters are organised around a tiered structure to enable users with different levels of experience to obtain guidance that reflects their specific needs. Instead of page-by-page guidance, the chapters have been developed to help you to find the level of detail that you need without having to read through information that may not be relevant for your project.

Each chapter follows the same structure using different coloured boxes to aid navigation, as shown in Figure 1.3.

- **Key principles** behind the appraisal tasks set out in each chapter
- **Inputs**: links to information and outputs from other processes and to supporting documents that will have been undertaken in advance of (or alongside) the tasks required in each chapter
- **Expert summary**: provides a summary of key appraisal tasks that may be needed with any specific rules that normally apply. This level of guidance is for those who regularly undertake appraisals and can be used once you are familiar with the contents of the main guidance
- **Main guidance**: discussion of how to do the tasks identified in each chapter. This level of guidance is for those who undertake appraisals infrequently or have limited experience. This is the main focus of the guidance and should be referred to in the first instance
- **Explanatory guidance**: explanation on why the key tasks may be required and explanation of approaches required to complete the tasks. This level of guidance is for those with no or little experience or where a user needs to refresh their understanding on why each task may be needed
- **Outputs** needed to complete the step or complete it to the level of detail required to move to next step allowing for iteration during the appraisal and proportionality of effort

Figure 1.3 Structure of Chapters 3 to 9

Chapter 10 sets out approaches to evaluation, covering monitoring evaluation of the appraisal and feedback to large scale plans. The chapter also describes approaches to reviewing strategy appraisals to help determine whether it is necessary to revise and update the appraisal.

1.7 Navigation and use of the electronic version

1.7.1 Use of the electronic version

The guidance has been developed for use as an electronic version. The advantage of using the electronic version is that you can use bookmarks and hyperlinks to move around the document.

1.7.2 Hyperlinks

Hyperlinks are shown as blue coloured text and underlined (for example, click here to hyperlink to start of 1.5). Clicking on the hyperlinks will take you directly to a specific section of text or figure within a chapter, send you to another chapter within the guidance or send you to a supporting document.

1.7.3 Navigation flowchart

Figure 1.2 sets out the structure of the guidance. Figure 1.4 develops Figure 1.2 into a navigation flowchart by including the tasks required in each chapter. You can use the flowchart to hyperlink to any of the chapters within the guidance. The flowchart helps you to:

i. identify where you are in the guidance (shown by an orange coloured box); and
ii. move between chapters as you undertake an appraisal, including moving back to previous chapters where there is a need for iteration.

Although Figure 1.4 does not show the supporting documents, links (and hyperlinks where appropriate) to them are included within the chapters.

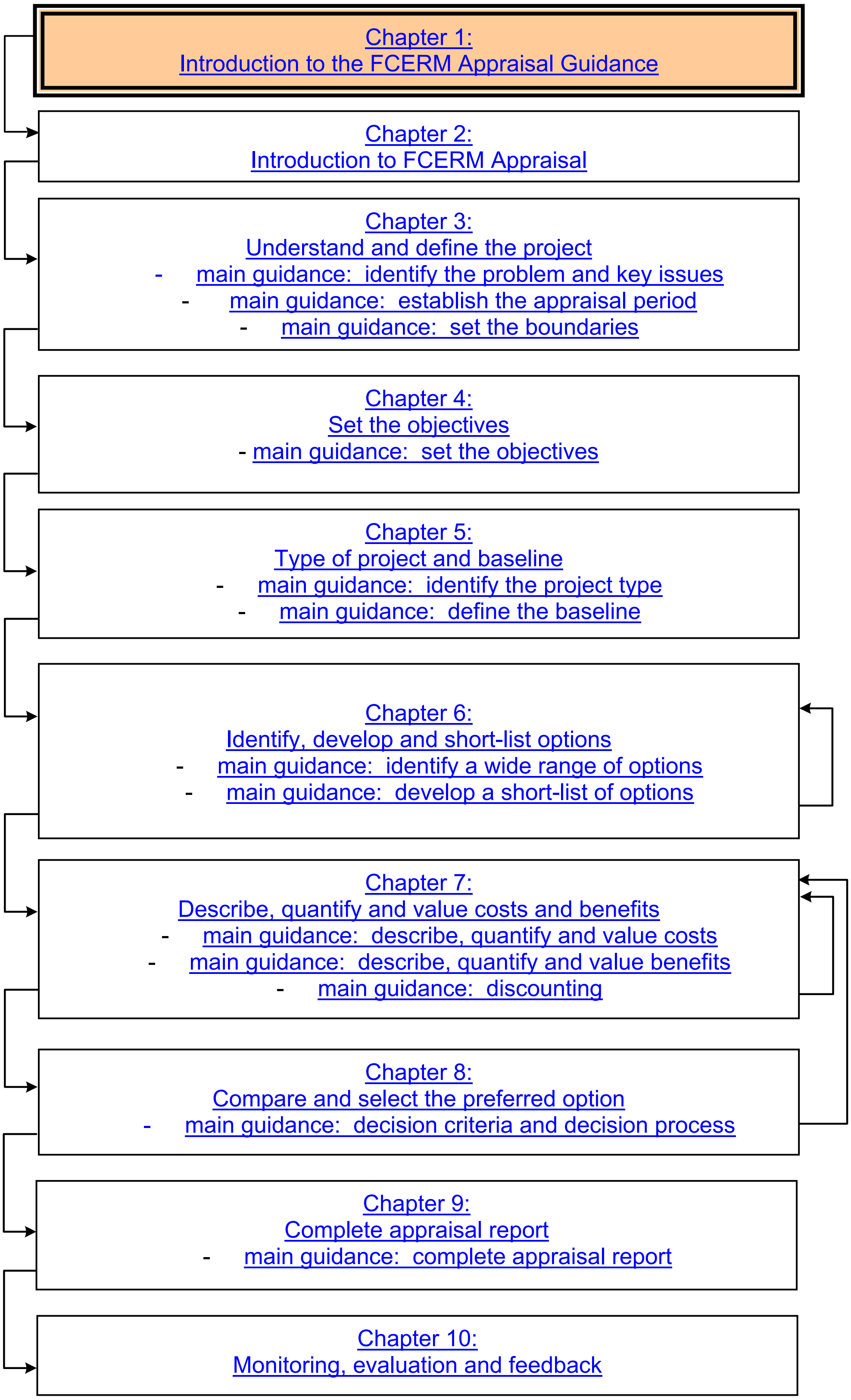


Figure 1.4 Navigation flowchart

2. Introduction to FCERM Appraisal

2.1 Driving forces behind appraisal

2.1.1 Making Space for Water

Since publication of the FCDPAG series, there has been a new strategic direction for flood and coastal erosion risk management encapsulated in the first Government Response on Making Space for Water published by Defra (2005). Significant flooding in 1998, 2000, 2005, 2007 and 2009 also highlighted the need for comprehensive, integrated and forward-thinking approaches to managing flood and coastal erosion risks in England and Wales.

The government's strategy for flood and coastal erosion risk management for England (Making Space for Water, MSfW) identifies that sustainable development should be firmly rooted in all flood and coastal erosion risk management decisions and operations (Defra, 2004). This means that full account should be taken of the social, environmental and economic consequences of flooding and erosion and any proposed solutions to these problems through a transparent appraisal approach that engages people in the decision-making process. The need to adequately include social and environmental consequences is also communicated in the WAG Ministerial Statement (Feb 2007) for Wales.

In addition, the government's response to the consultation on MSfW (Defra, 2005) identified that updated appraisal guidance is needed to reflect the strategic and policy principles of MSfW. Development of the FCERM appraisal guidance in the light of this strategy provides the opportunity to also reflect the change in emphasis when managing flood and coastal erosion risk. This includes aiming to:

- work with natural processes;
- adapt to future risk and changes (for example, due to climate change);
- work with others to deliver better, more sustainable solutions which can deliver wider objectives and maximise benefits for people, businesses and the environment.

2.1.2 Defra's Flood and Coastal Erosion Risk Management policy statement

To meet the aims of MSfW, Defra issued appraisal policy guidance in the form of a policy statement in June 2009 (Defra, 2009). This restates the aim of government to manage risks in a sustainable way, by employing an integrated portfolio of approaches which reflect both national and local priorities, so as to:

- reduce the threat to people and their property; and
- deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles.

2. Introduction to FCERM Appraisal

2.1 Driving forces behind appraisal

The approaches set out in this guidance to support the delivery of sustainable flood and coastal erosion risk management appraisals as defined by Defra's policy statement are summarised in Table 2.1.

Table 2.1 Delivering sustainable flood and coastal erosion risk management appraisal

Requirements of sustainable appraisal (based on Defra, 2009)	Approaches set out in this guidance
Reinforces the context of appraisal within a holistic strategic planning framework based on whole catchments and shoreline process units	Considers the need for a joined-up approach to flooding and coastal erosion and promotes whole catchment and coastal shoreline approach through links to SMPs, CFMPs, River Basin Management Plans and Regional Habitat Creation Programmes
Delivers solutions that maximise the benefits for society as a whole	Takes account of more impacts, including those on critical national infrastructure, to ensure that the full effects of flooding and erosion can be taken into account during decision-making
Contributes to building a strong, stable and sustainable economy	
Takes account of the environment and potential effects that policies and projects could have on the goods and services that it provides to society. Opportunities to enhance the natural environment and improve its capacity to perform ecosystem services should be identified	Provides more guidance on describing, quantifying and valuing economic, environmental and social costs and benefits to help capture more of the consequences (both positive and negative) that are caused by flooding and coastal erosion
Takes account of the need to adapt to future risks	Uses a risk-based approach to appraisal that requires assessment of both present and future risks
Highlights the importance of a risk-based approach to appraisal taking account of key factors such as climate change and impacts on critical national infrastructure	
Disaggregates the costs and benefits so that it is clear which sections of society are paying for and gaining from different options	Allows those who would benefit from an option and those who would be affected negatively to be recorded. This information can then be used to encourage provision of third party contributions and to help develop options that provide benefits that go beyond flood and coastal erosion risk management
Enables people to understand the choices, and why certain options are preferred	Identifies the options, costs and benefits of a project more clearly, encourages stakeholder involvement in the appraisal process and during decision-making
Encourages working with others to deliver wider benefits	including the need to work with others as appropriate throughout project appraisal by building this into the appraisal process using the Stakeholder Engagement Plan as a guide
Makes best use of science and incorporate new and innovative thinking	Including new tools and techniques such as ecosystem services and scoring and weighting, and encourages more sustainable solutions that work with natural processes
Emphasises the importance of sustainable development and the need for the use of techniques such as multi-criteria analysis and ecosystem services approaches to better capture social and environmental issues	integrating opportunities to work with natural process and develop multi-functional projects through the use of environmental assessment processes to develop solutions

2.2 Roles and responsibilities in FCERM

2.2.1 The role of government

The government aims for the best outcomes for society as a whole and allocates funding to provide the greatest overall benefit to society. Competition for money is fierce, not just between different flood and coastal erosion risk projects, but between all demands for spending by the government and its agencies.

In the UK, there is no legal right to any particular standard of protection from flooding or coastal erosion or provision of flood warning. However there are high public expectations of protection. Project appraisal determines whether the benefits of flood and coastal erosion risk management outweigh the costs and, hence, if it is worthwhile spending the money from the taxpayers' perspective.

2.2.2 The role of HM Treasury

HM Treasury provides the funding for FCERM. This means that all projects to be funded from public money have to include a project appraisal in line with the requirements of the Treasury Green Book (HM Treasury, 2003). The Green Book sets out the techniques and issues that should be considered when carrying out assessments of programmes, plans and project. As a result, it influences what can (and cannot) be included in economic appraisal and drives the approaches set out in this, FCERM, guidance.

Projects above a delegated threshold (currently £100 million whole life costs) also require HM Treasury (and Defra) approval at the outline business case and full business case stages. A project appraisal report, based on an appraisal in line with this guidance, will be necessary to support this.

2.2.3 The role of Defra

The Government, through Defra, provides the majority of funding for flood and coastal erosion risk management activities for England in the form of Grant in Aid (GiA) administered by the Environment Agency. Defra is also involved in approval of studies, strategies and projects with whole life costs above the delegated limit. The principles of Defra's policy statement (Defra, 2009) cover risk from all sources (flooding from river, sea, groundwater and surface water, and coastal erosion) and investment in flood and erosion management.

Defra is also responsible for developing government policy on flood and coastal erosion risk management, and in particular for developing new legislation. In addition, Defra may set outcome measures and targets from time to time to gain a better understanding of delivery.

2.2.4 The role of the Welsh Assembly Government

The Welsh Assembly Government (WAG) is responsible for developing government policy on flood and coastal erosion risk management for Wales. In addition WAG sets priorities for funding to ensure that investment is targeted in a fair and sustainable way.

The Welsh Assembly Government provide the majority of funding for flood and coastal erosion risk management activities for Wales in the form of grant in aid (GiA). They can allocate this funding to the Environment Agency or to local authorities to undertake works.

2.2.5 The role of the Environment Agency

The Environment Agency has the main responsibility for managing risk from flooding from main rivers and the sea as well as a supervisory role for all types of flooding and coastal erosion.

In England, the Environment Agency has a delegation from the Secretary of State to approve and pay grant aid for flood risk management projects and studies undertaken by local authorities and internal drainage boards and coastal erosion projects and studies undertaken by maritime local authorities up to the value of £100 million whole life costs. Use of this guidance and the Defra policy statement on appraisals that support funding applications aids the approval process by providing a consistent framework.

Because the Government's grant in aid is not enough to pay for all flood and erosion risk management work which has a benefit-cost ratio greater than 1, the Environment Agency in England needs to prioritise projects to determine which should be implemented in a programme of investment. The Environment Agency currently uses Defra's outcome measures to help develop the investment programme and enable performance monitoring. However, outcome measures do not form part of the individual project appraisal or determination of the preferred option. Further information on outcome measures and prioritisation can be found on the Environment Agency website.

The appraisal is intended to identify the most cost beneficial solution to the problem and the justification for the most appropriate and preferred option. It is important to note that funding and affordability should not unduly influence this process to avoid early compromise in options identification. Affordability and different sources of funding may however influence the final options choice and investment decision.

2.2.6 The role of local authorities and internal drainage boards

Local authorities may undertake works on flood and sea defences where they are not the responsibility of the Environment Agency or internal drainage boards (IDBs). Maritime local authorities may also carry out works which protect against coastal erosion. IDBs carry out measures in respect of inland flooding in specified districts with special drainage needs.
The roles and responsibilities of local authorities and IDBs may change as a result of the Flood and Water Management Bill.

2.2.7 The role of other organisations

Other organisations such water and wastewater companies, electricity providers, Network Rail, those with responsibility for roads, the emergency services and the Met Office also have responsibilities in delivering FCERM.

Table 2.2 summarises the roles and responsibilities of all organisations in delivering FCERM.

Table 2.2 Roles and responsibilities for FCERM

	Organisation				
Responsibility	**HM Treasury, Defra, CLG, WAG**	**Environment Agency**	**Local authorities and IDBs**	**Water companies, non-utility reservoir owners, other utilities and transport infrastructure**	**Emergency services, Met Office**
Strategic planning	Policy development (Treasury, WAG, Defra) Funding (Treasury, WAG, Defra) Approval of projects above the delegated limit (Treasury, WAG, Defra)	CFMP, SMP	SMP (LAs) SWMPs	Contributor	
Capital and Revenue Investment Planning		Main river, sea flooding, coastal erosion Approval of projects	Ordinary watercourses, coastal erosion	Sewers, reservoirs	-
Capital Projects Delivery		Main river, Sea flooding,	Ordinary water courses, surface water and groundwater Coastal erosion	Sewers, reservoirs	-
Operational Asset Management	-	Main River, Sea flooding (may include riparian owners)	Ordinary watercourses etc as above	-	-
Development control (link to PPS25 and TAN15)	Development of PPS25 (CLG), TAN15 (WAG)	Contributor	Lead (LAs) Contributor (IDBs)		
Planning Incident Response Planning	-	Joint lead	Joint lead	Critical infrastructure	Joint lead (Emergency Services, Met Office)
Flood Forecasting & Warning	-	Lead	Contributor	-	Contributor (Met Office)
Mapping Flood Risk & Data Management	-	Main rivers, coast	Surface water	-	Contributor (Met Office)

Source: Environment Agency

2.2.8 Third parties

The approach set out in this guidance supports the development of multi-functional projects and methods for identifying and working with potential third party contributors through:

- coverage of all sources of flooding and erosion which means that organisations have to work together to manage flood or erosion risk;

- better integration of the requirements of legislation, in particular through environmental appraisal, to ensure that a wider range of impacts (positive and negative) are taken into account during appraisal;
- the use of ASTs to identify who wins and who loses;
- allowing objectives from policies and plans to be explicitly considered when appraising flood and coastal erosion risk management solutions; and
- allowing consideration to be given to sources of funding other than GiA, for example, developer contributions.

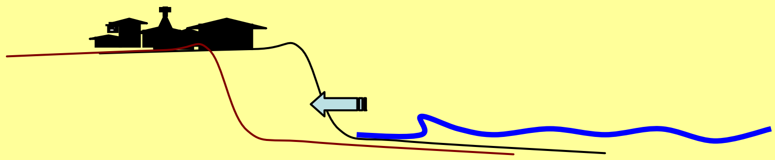
2.3 The requirements of FCERM appraisal

2.3.1 Adopt a risk-based approach

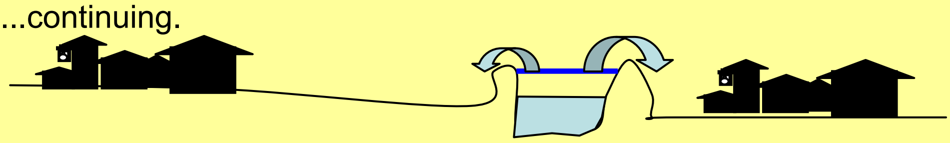
Project appraisal for flood and coastal erosion risk management uses a risk-based approach. This means that both the probability (likelihood) and the consequences (positive and negative impacts) of flooding and erosion are taken into account. Inevitably, there will be uncertainty associated with identifying the probability and consequences of a risk; this can be tested in sensitivity analysis.

Basic risk approach: risk = probability x consequence

i) A town called A is located on the top of a cliff over looking the North Sea. The consequence is the loss of properties and community. The probability of loss depends on the rate and variation in rate of erosion: Year 1- unlikely, Year 20 - possible, Year 30 - very likely.



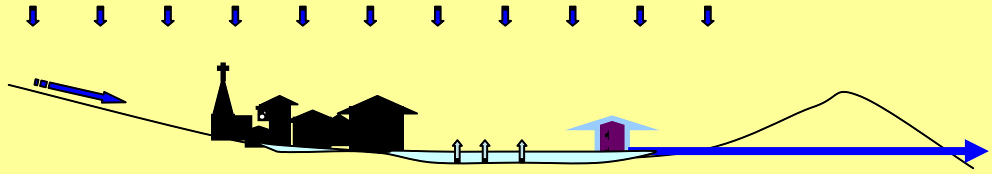
The time based **risk** is to the property, not the risk of erosion.
ii) A town called B spans a large river. It is protected by linear embankments and walls. During high flow events the town is subject to flooding over walls and embankments. The consequence is damage to properties and the function of the town. The probability depends on the frequency of events that would result in overtopping of defences: Year 1 - 10%, Year 20 - 10%, Year 30 - 10% ...continuing.



The frequency based **risk** is to damage to the property, not the risk of overtopping.

iii) A town called C is in a low-lying area of fresh water marshes that are drained. Extensive drainage ditches and a pumping station protect the town. The danger is that, during a significant rainfall event, the pumping station will not be able to remove the water fast enough to prevent flooding of property and agricultural land. The consequence is damage to property and agriculture. The probability depends on the intensity of rainfall, the capacity of the pumps, and the possibility that the pumps fail or block, and, therefore, the frequency of occasions when water level rises to a level that damages occurs.

Year 1 - 10% or 50% x probability of pump failure, Year 20 - 10% or 50% x probability of pump failure, Year 30 - 10% or 50% x probability of pump failure …continuing.

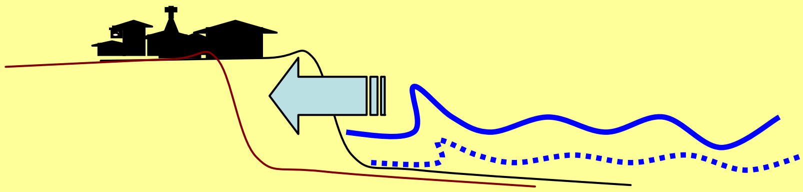


The frequency/event based **risk** is to damage to the property and use of the area, not of failure of the pumps to remove the water or intensity of rainfall.

Risk continually changes over time (for example, due to climate change) such that the mechanisms through which risk occurs needs to be regularly reviewed.

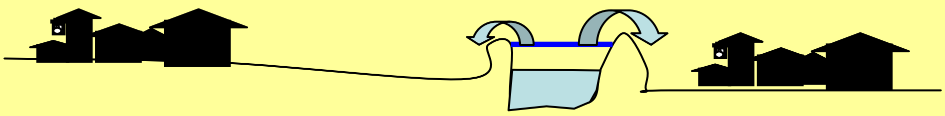
Basic risk approach: source of risk increases

i) Town A is still located on the top of a cliff over looking the North Sea. The consequence is still the loss of properties and community. However, due to improved monitoring of the effects of sea level rise the rates of erosion are shown to be increasing. The probability is that loss will occur sooner.
Year 1- unlikely, Year 20 - likely, Year 30 - inevitable.



The consequence remains the same, the probability increases as does the risk.

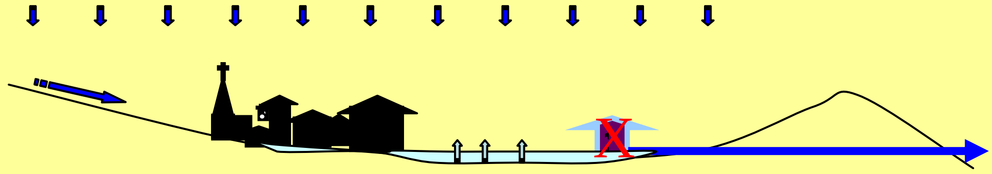
ii) Town B spans a large river. It is still protected by linear embankments and walls. During high flow events the town is subject to flooding over walls and embankments. Increased rainfall results in increased probability of overtopping: Year 1 - 10%, Year 20 - 20%, Year 30 - 40% ...continuing.



The consequence remains the same, the probability of damage increases as does the risk.

iii) Town C is still in a low-lying area of fresh water marshes that are drained. Extensive drainage ditches and a pumping station protect the town, but the pumps need replacing. Increased rainfall increases the probability that the volume of water entering the area exceeds the capacity of the pumps. The probability that the pumps fail increases with time. The area affected under any given event may increase.

Probability of damage: Year 1 - 10% or 50% x possible failure of pumps, Year 20 - 20% or 75% x probable failure of pumps, Year 30 - 40% or 100% x inevitable failure of pumps.



The consequence may increase with increased depth of flooding or total failure of the pumps, the probability of damage increases as does the extent of damage; the risk increases as a result of all these.

2.3.2 Adopt a proportionate approach

There is finite money available and this money needs to be focused on delivery rather than on appraisal. Appraisal needs to be sufficiently detailed to robustly justify the actions proposed and a consistent approach ensures that national funding is targeted at the most appropriate projects.

Appraisals for all projects should be proportional to the amount of information needed to choose a preferred option. The amount of information that is required will depend on the project (including whether it is a strategy or a scheme), its size and complexity:

- less information is needed where one option is clearly preferred over the others. Where there are complex trade-offs between options, more detailed information is likely to be required. In both cases, though, it is essential that the appraisal process is transparent and that the preferred solution is justifiable to stakeholders, reviewers and approvers;

- at the early stages of appraisal, summary data are usually sufficient. As the appraisal proceeds, data are usually refined to become more specific and accurate. It is important that the effort applied at each step is proportionate to the time and resources available and that additional data are only collected where they help in identifying a preferred option;

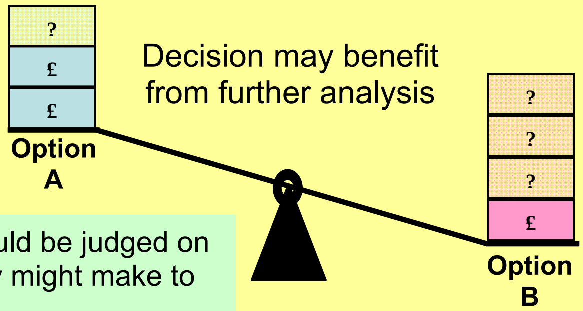
- once the choices between options are clear, then there is no further justification for the addition of any further detail. For example where two options have very similar average benefit-cost ratios and it is clear that for all other social and environmental objectives one significantly outweighs the other, then the choice of options will not be served by any further refinements of the economic analysis; and

- identify when information can be used to best advise, guide and inform the decision-making to avoid excessive data collection or abortive work.

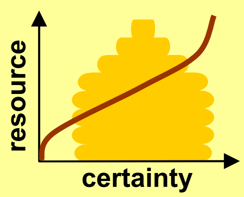
One of the skills needed for good project appraisal is deciding when enough information has been collected to make a robust and defensible decision. This is usually where collecting more information will not make a significant difference to the decision. In addition, it is essential to demonstrate this clearly and openly to those that may be affected by the decision.

Assessment of Proportionality

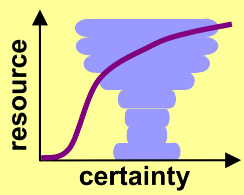
Appraisal is about making choices.
It is not necessarily about reducing uncertainty



The need for further investigation should be judged on the difference addressing uncertainty might make to the choice



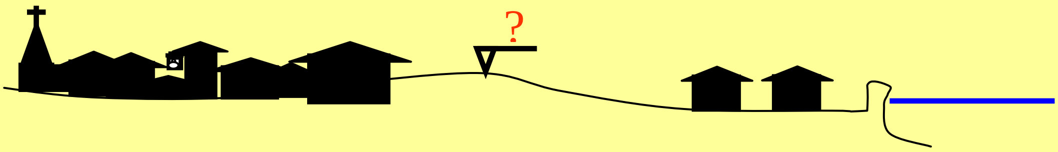
Consideration needs to be given to the improvement in knowledge for additional effort.
Data collection should have a clear purpose to improve decision-making



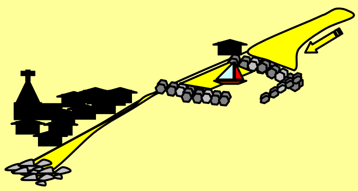
There may be opportunity for additional data collection, consultation or analysis if this subsequently supports detailed design.

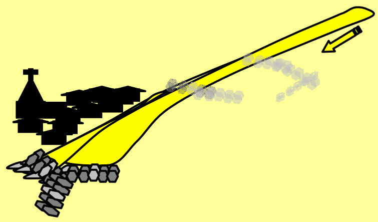
Examples of when and where to focus effort

i) Town G has developed in two areas of lower lying land separated by a ridge. The main town lies behind the ridge, with few properties to the front. In assessing potential solutions, the level of the ridge, in relation to water levels and flood risk, is more critical to decision-making than determining the threshold levels of all properties within the main part of the town. There may be significant saving in time and resource in establishing this level first.



ii) In Village F, an expert geomorphological assessment of sediment drift may be as useful as detailed modelling in determining the opportunity for withdrawing from maintaining defences in the harbour, at strategy level. If subsequent scheme options include the possibility for further defence of the village then modelling may be required.





iii) It may be more cost-effective to undertake a full ground investigation during an appraisal if it is clear that the probable solution will require such an investigation regardless of the specific scheme chosen.

iv) If it is clear that refurbishment of a pumping station is justified to maintain business as usual, there may be little point in investigating a broad range of other options in detail.

2.3.3 Work within the hierarchy of FCERM decision-making

Project appraisal should be undertaken within the hierarchy of higher level policy and strategic directions, including shoreline management plans (SMPs), catchment flood management plans (CFMPs) and strategies (where they exist). SMPs and CFMPs set high level policy; strategies take a more detailed perspective of how policy can be delivered locally; and schemes or on-going maintenance aim to deliver this on the ground. All projects should be compliant with legislation and policies. It would typically be expected for more detailed studies to follow the strategies or policies identified in the higher level studies, however this should be kept under review as new information may necessitate a review. In addition, information (including, for example, objectives and descriptions of the impacts) available from other plans and policies should be used to inform the appraisal. This reduces the need to repeat work already undertaken as well as integrating appraisals from policies through strategies to schemes.

Figure 2.1 shows how SMPs or CFMPs, strategies and schemes are linked within the hierarchy of decision-making. The figure also shows that each SMP/CFMP can lead to a number of strategies and, potentially, directly to schemes. Similarly, a number of schemes may be derived from any one strategy. Within this hierarchy, decisions or the implication of higher level decisions have to be made or examined. The figure also shows how the hierarchy of decision-making expands when other processes, plans and policies are taken into account.

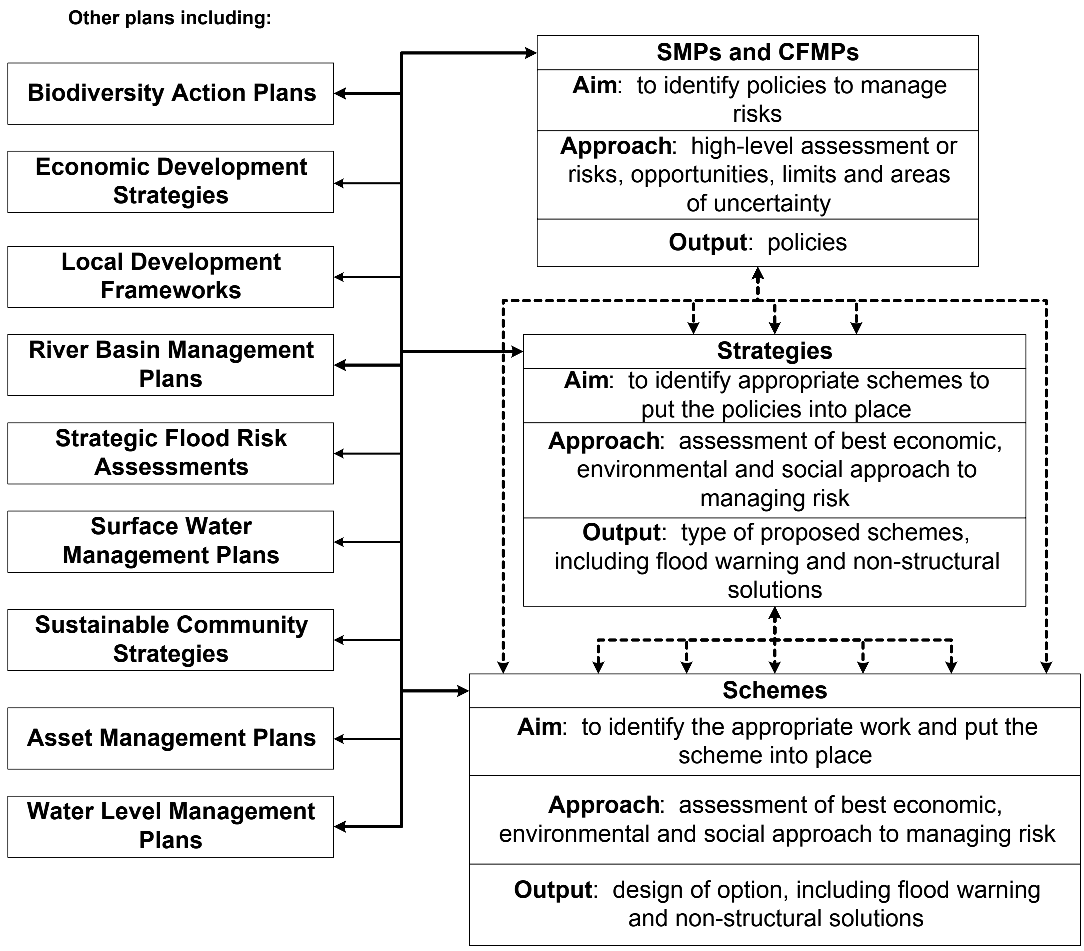
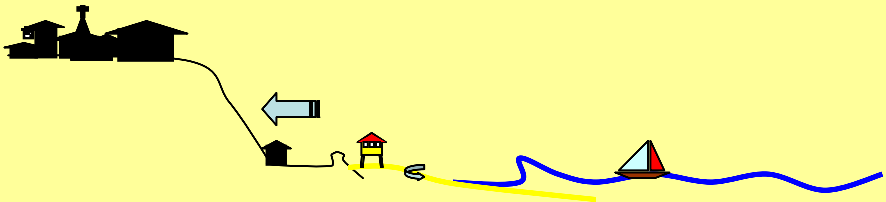


Figure 2.1 Hierarchy of decision-making with links to other processes, plans and policies

Basic risk approach: issues relating to defence systems

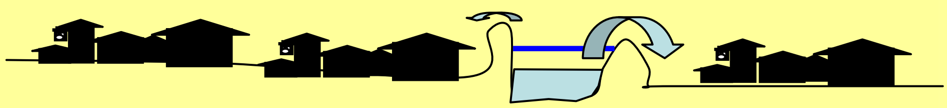
i) Town A has grown. The sea front has developed. The cliff, which remains of geological importance, has been stabilised. There is a promenade and sea wall with a popular tourist beach. There are important facilities, shops and beach huts along the promenade. The town relies on tourism to support economic regeneration within the town. The beach erodes and is recharged with sand on a regular basis. The tourism is at risk due to erosion of the beach, the sea wall and promenade is in danger of undermining and increased overtopping, this would result in erosion of the cliff and potential loss of properties within the town.



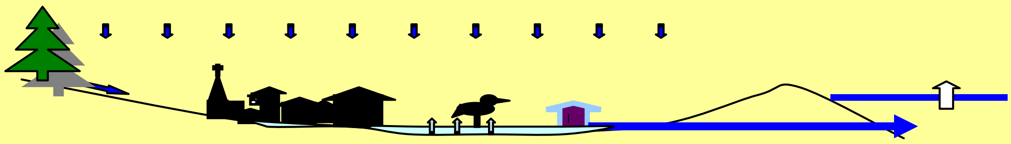
Hazard	**Probability**	**Consequence**
Loss of beach	Erosion rate	Loss of tourism - reduced use of promenade, impact on town
Overtopping of sea wall	Increased wave energy	Damage to use of promenade - impact on town.
Loss of seawall	Failure mechanism	Loss of use of promenade – impact on town.
Erosion of cliff	Erosion rate	Loss of town, benefit to geological exposure.

The probability of damage affects different areas of risk at different times, with both sequential and direct damages occurring.

ii) Town B has grown. Development has occurred within the flood risk area. The probability of flooding from one bank has reduced (due to raising of the height of the defences) but this increases the frequency of flooding to the other bank, with increased probability of damage. The probability of flooding to the left bank has decreased but the overall consequences of flooding have increased. The level of overall risk may remain the same but the balance of risk to different areas including who gains and who loses has changed, together with the overall spatial values of the area.



iii) Town C is still in a low-lying area of fresh water marshes that are drained. Changes in land use have reduced runoff from the higher ground and a Water Level Management Plan is in place to enhance the nature conservation integrity of the marshes, with implications for the pumping regime. The defence scheme to Town B (above) increased flow levels in the adjacent channel resulting in the need for increased pump capacity to deal with rainfall affecting Town C.



The source of flooding has changed, the pathways for management of flooding have changed and there are constraints on the management of flooding. The consequences of flooding may affect both the town and the conservation value.

2.3.4 Work with others throughout the appraisal process

Working with others (individuals, a group of individuals, communities, organisations or political entities) is critical to good appraisal and must be done from the start. In particular it provides opportunities to:

- establish common understanding and ownership of the problem;
- develop partnership working; and
- deliver multiple objectives.

Effective appraisal is shaped by the engagement process and must be integral to the development and implementation stages of a project from inception. Engaging those ‘at risk’, interested in or affected by the decision in the decision-making process creates understanding if not acceptance of the decisions to be made. Public participation forms a key part of the environmental assessment process. The Regulations governing environmental impact assessment and strategic environmental assessment stress the importance of early and effective engagement to build trust with those involved with and affected by the project appraisal process.

Experience shows that successfully accepted solutions are those where the views, local knowledge and concerns of stakeholders have been taken into account as part of the project appraisal process. Planning, preparation and management of flood and coastal erosion risk should therefore be holistic, integrating people as well as the environment and economics into the heart of decision-making.

There may also be opportunities for partnership working to identify approaches for managing coastlines, estuaries and river catchments that are much wider than the narrow remit of flood and coastal erosion risk management. Such approaches could lead to more sustainable solutions that would not be feasible when limited to flood or erosion risk management benefits alone. Partnership working will also enable others to contribute towards the cost of the solution, enabling wider benefits to be delivered or protection against a risk that could not secure government funding.

Considering how other policies and other objectives could be delivered alongside flood and coastal erosion risk management could result in:

- risks being avoided (for example, through planning controls);
- multiple benefits being delivered including wider community benefits;
- enhancing the delivery of environmental benefits;
- adaptation being put into place (again through planning policies and land management);
- ownership of the problem and social responsibility for managing the risk; and
- resilience and flood awareness being promoted.

Working with other organisations to deliver a broader range of policies also provides opportunities for joint funding of projects.

2.3.5 Integrate environmental assessment

Environmental assessment underpins the delivery of sustainable solutions that take account of our natural and built environment and the intrinsic, social and economic benefits they afford. It allows the pressures and changes resulting from flood risk management to be evaluated promoting positive solutions which will enhance the environment and mitigate adverse impacts through sustainable design. Environmental assessment meets the legislative requirements put in place to protect our environment, promoting the need to work with natural processes, adapt to a changing climate and conserve valuable environmental assets.

A key part of the process is to engage with people and the environment in which they live. When integrated into project appraisal as part of the environmental assessment process the views and concerns of people engaged with the project can be taken into account as part of iterative decision-making. This will result in solutions which are accepted and owned by the community having positive feedback for the environment as a whole into the future.

Environmental assessment can be undertaken at a strategic level using strategic environmental assessment (SEA) (for example catchment flood management plans, shoreline management plans and flood risk management strategies). At the scheme level, an environmental impact assessment (EIA) may be a legislative requirement, but the principles of EIA should can be applied to all projects where good practice determines that environment and sustainability should be taken into account as part of the decision-making process.

Environmental assessment whether statutory EIA or non-statutory is an important tool to avoid, reduce and potentially offset any adverse effects on the environment as a result of action. It can be used to identify opportunities to enhance the environment. It can also be used to support the delivery of other required consents and licenses needed to implement the scheme and to demonstrate compliance with other key pieces of legislation applying to the site in question.

Strategic environmental assessment (SEA)

SEA is a critical tool in the appraisal process. It is used to understand the environmental implications of options and to help steer decisions towards those that minimise adverse environmental effects and provide the opportunity to realise environmental benefits. SEA ensures appropriate consideration is given to the environment during the development of plans and programmes. It helps decision-makers take better (more sustainable) decisions during plan-making. SEA is based on European Directive (2001/42/EC), which has been transposed into the Environmental Assessment of Plans and Programmes Regulations (England and Wales) SI 2004 No. 1633 and for Wales SI No. 1656.

Environmental impact assessment (EIA)

EIA is used at the project level to:

- assess the environmental implications of actions to be taken;
- contribute to the design to minimise the adverse effects;
- identify additional measures that may be required to further reduce adverse effects; and
- identify opportunities for providing environmental benefits.

EIA is based on a European Directive (EC Directive 85/337/EEC amended by EC Directive 97/11/EC and Article 3 of Directive 2003/35/EC), which has been transposed into English and Welsh law through a number of Regulations. Those most relevant to flood and coastal erosion risk management activities primarily fall under[2]:

- The Town and Country Planning (environmental impact assessment) (England and Wales) Regulations SI 1999 No. 293, as amended by SI 2000/2867, SI 2006/3295 and 2008/2093 and, in Wales, 2008 No. 2335 (W.198) Town and Country Planning, Wales The Town and Country Planning (environmental impact assessment) (Amendment) (Wales) Regulations 2008;
- environmental impact assessment (land drainage works) Regulations SI 1999/1783, as amended by SI 2005/1399 and SI 2006/618; and
- The Marine Works (environmental impact assessment) Regulations SI 2007/1518.

[2] The regulations and amendments shown are correct to December 2009.

Requirement for formal environmental impact assessment will need to be determined prior to or at the outset of the project.

Key legislative requirements related to the Environmental Assessment process

Much of the work undertaken as part of Environment Assessment will form the basis for assessing compliance with key pieces of legislation in place to protect, conserve or enhance the environment. The most relevant of those for flood and coastal erosion risk management relate to the water environment or species dependent upon water. In some cases, additional assessment and documentation will be needed; this will be identified during the project definition and objective setting stage.

Key legislative requirements related to the Environmental Assessment process:

- **Water Framework Directive**: The aim of the Water Framework Directive (WFD) (2000/60/EC) is to protect the ecological quality of all inland and coastal waters. Any changes that could occur due to flood and coastal erosion risk management activities must take account of the legal obligations to prevent deterioration of the status of water bodies and those actions which prevent water bodies achieving their environmental objectives as set out in the River Basin Management Plans. Environmental assessment should consider these objectives and should seek to deliver measures within the RBMPs on an opportunistic basis.

- **European Birds and Habitats Directives**. The main aim of the Habitats Directive is to promote the maintenance of biodiversity by requiring member states to take measures to maintain or restore natural habitats and wild species at favourable conservation status, introducing robust protection for those habitats and species of European importance. The Birds Directive aims to provide long-term protection and conservation of all bird species naturally living in the wild. In applying measures, member states are required to take account of economic, social and cultural requirements and regional and local characteristics. Appraisal should identify potential impacts (both positive and negative) of flood and coastal erosion risk management options on designated sites and protected species noting that legal requirements must be met for sites or species designated under the Birds and Habitats Directives.

- **European Directive on the Assessment and Management of Flood Risks** (the Floods Directive): The purpose of the Floods Directive (2007/60/EC) is to establish a framework for the assessment and management of flood risks, with the aim of reducing negative consequences for human health, the environment, cultural heritage and economic activity. The Directive aligns with the environmental objectives of the Water Framework Directive. The Floods Directive is being transposed into UK law (in England and Wales). The Floods Directive requires areas at significant flood risk to be identified (through preliminary flood risk assessments), flood hazard maps and flood risk maps to be prepared and flood risk management plans to be developed. Project appraisal needs to be consistent with the requirements of these products such that environmental and social impacts should always be included.

2.3.6 Include all the components of a good FCERM appraisal

The key components of FCERM appraisal and where they are covered in this guidance is shown in Table 2.3.

Table 2.3 Components of good appraisals and where they are covered in the guidance

Component	FCERM AG Chapters
A clearly identified problem	Chapter 3: Understand and define the project
Objectives that capture both strategic and local requirements	Chapter 4: Set the objectives
A well-defined baseline	Chapter 5: Type of project and baseline
A wide range of options, including structural and non-structural	Chapter 6: Identify, develop and short-list options
Options that are developed through consideration of their costs and benefits	Chapter 7: Describe, quantify and value the costs and benefits
Options that are refined through comparison of the costs and benefits, sensitivity analysis and assessment of uncertainties Selection of a preferred option	Chapter 8: Compare and select the preferred option
Preparation and submission of an appraisal report	Chapter 9: Complete appraisal report
Feedback from the appraisal to assist with learning for future appraisals and to feed into other processes	Chapter 10: Monitoring, evaluation and feedback

Project appraisals that include these components will provide effective solutions supported by reliable technical, economic and environmental evidence.

Poor project appraisal can cost significantly more than estimated or result in significantly lower benefits. It could also cause unforeseen social, economic and environmental impacts.

A clearly identified problem

All appraisals must start with a clear understanding of the risks, taking account of current and predicted future social, environmental and economic issues. The problem must be identified without bias towards any preconceived outcome. The question to answer when identifying the problem is ‘what are you trying to do?’ not ‘how you will do it?’.

Case study examples of good and bad practice
The problem:
BAD PRACTICE: The appraisal defined the problem as the low level of the defence not the high frequency of flooding to properties. The focus of the appraisal was on raising the level of the existing wall, excluding other options.

BAD PRACTICE: Among other problems the study identified the uncertainty as to future ‘defence’ policy (rather than risk management), resolving this guided decisions as to future investment in the area.

Objectives that capture both strategic and local requirements

Objectives need to be stated clearly and linked to the problem. They should be set using information from other processes, plans and policies (including SMPs, CFMPs and strategies) and through engagement with key stakeholders and project partners. This enables opportunities to be identified to deliver wider benefits and all perspectives on the work to be considered creating understanding and support for the project.

Case study examples of good and bad practice
Strategic and local objectives:
BAD PRACTICE: A lack of detailed engagement with the local community resulted in failure to identify the importance of a slipway in providing access to the shoreline. The solution of managed realignment failed to take account of how access might be provided, leading to public opposition.

GOOD PRACTICE: A broader definition of objectives encouraged thought about including habitat enhancement within an engineered scheme.

A well-defined baseline

All impacts (positive and negative) caused by an option are measured as a change from the baseline. It is essential, therefore, that a well-defined baseline is set. This should be described taking account of current risks and future changes in risk to provide whole life impacts (positive and negative) and benefits for the comparison of the do-something options.

In most cases the baseline will be do-nothing (defined as taking no action whatsoever; where there are existing assets, do-nothing assumes that no further maintenance or repair work is undertaken). This is because there is no legal right to any particular standard of protection from flooding or coastal erosion.

Case study examples of good and bad practice
The baseline:
BAD PRACTICE: The baseline condition did not take into account all forms of flooding with the solution therefore only addressing flooding from one source, leaving the area open to the flooding from a secondary source, which was then trapped by the new defences.

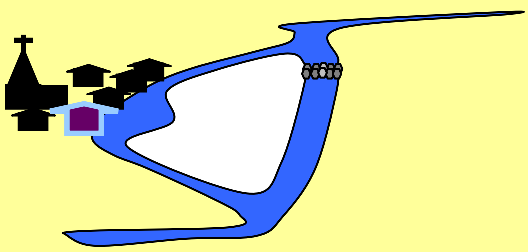
GOOD PRACTICE: The appraisal included an assessment of whole life cost of maintaining adjacent structures. A more cost-effective strategic approach was developed.

A wide range of options, including structural and non-structural

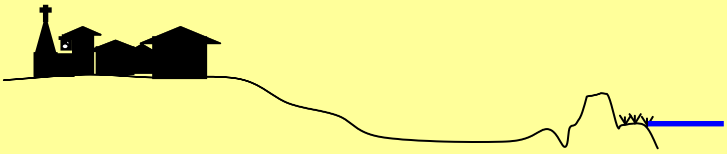
A wide range of approaches for managing the risks should be identified. It is important, though, that the options are realistic and appropriate to the type of project being assessed (for example, strategy versus scheme).

Options that increase flood or erosion risk, keep risk relatively constant and (or) reduce risk over time need to be considered. Adaptation to changing risk is an important consideration when identifying options and it is preferable to work with, rather than against, natural processes wherever possible. Options such as withdrawal of funding for defences may also be appropriate but may need to be accompanied by actions to help communities and the environment adapt to changing conditions.

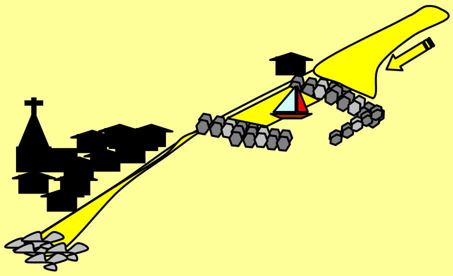
Opportunity of No Active Intervention and withdrawing maintenance of defences
i) A small village D is centred around a historic mill and is occasionally subject to flooding during high water levels. The mill leat gains water through a diversion from the main river channel using a weir. The project assessed the behaviour and concluded that now the mill was no longer operational the weir structure was redundant but continued to divert water towards the village. The appraisal recommended the removal of the weir, rehabilitating the natural channel and reducing the risk to the village. This caused the leat to run dry. The environmental impact, caused through this, was mitigated by the improvement of habitat and natural processes in the main channel.



ii) A town E built on high land by an estuary. The town is surrounded by agricultural grazing marshes. The marshes are protected by deteriorating river embankments. Withdrawal was a recommended option as the value of the grazing land was not high and the inundation of the marsh would provide future habitat as the land reverts to saltmarsh and mud flats. The land was bought from the farmer and banked for use as compensation habitat.



iii) Village F is on the coast, its past glory as a fishing village is long past but the small harbour remains and is in poor condition. Its future lies with tourism and its beach is important. There are still some fishermen who launch from the beach within the harbour but the harbour structures now stop sediment supply to the village sea front. The harbour also protects one property. A natural headland downdrift of the village provides opportunity to retain a larger beach. Withdrawing maintenance to the harbour provides opportunity to naturally replenish the beaches in front of the village, allowing the shoreline to set back could still provide a beach for boat launching. Consideration would need to be given to impacts on the residents of the property at risk and use the harbour.



Options that are developed through consideration of their costs and benefits

As a minimum requirement every project should consider the costs of the options and the impacts (both positive and negative) they may cause. As well as improving the quality of the appraisal, the information collected should be recorded in an Appraisal Summary Table:

- **Appraisal Summary Tables** (ASTs) allow the positive and negative impacts associated with flood and coastal erosion risk to be recorded, along with the benefits and opportunities of proposed solutions to manage those risks, and any assumptions made. The AST can be used to identify who may be affected and who may benefit from the solutions that are being appraised.

Recording information in ASTs identifies who benefits and who loses. This information can help identify potential contributors and alternative funding streams.

Proportionality is very important. It is essential to balance the time and resources required to develop the options through consideration of the costs, and benefits with the influence of those costs and benefits on the choice of preferred option.

Many of the impacts, particularly social and environmental consequences of an option are difficult to value in money terms. If these impacts are omitted from the appraisal, they are valued at £0. Identifying the best option, therefore, requires careful consideration of social and environmental issues alongside economic and technical ones.

It is possible to take account of all impacts when choosing between options, including those that have not been valued in monetary terms. Approaches, such as ecosystem services or scoring and weighting, are available for use where the non-monetised benefits are significant to the choice of preferred option:

- **Environmental valuation handbook** focuses specifically on the economic (monetary) value of environmental effects associated with FCERM schemes and is based on the principle of ecosystem services; and

- **Scoring and weighting** is an approach used to infer a value in monetary terms for those impacts that cannot be directly measured in monetary terms. The approach is based on multi-criteria analysis (MCA). Scores and weights are assigned to impacts to reflect their relative significance. These scores and weights are used to generate 'implied' monetary values, so-called because the values are implied from the scores and weights that have been assigned.

However, if an impact is unlikely to affect the choice of preferred option then time and resources should not normally be spent investigating it. It is also important to identify whether it is appropriate to value impacts in money terms.

It is the impacts that are difficult to value in monetary terms that are often of most interest and relevance to the local communities and stakeholders affected by or interested in the decision. Comprehensive appraisal will not always avoid conflicts but it does show how all concerns and issues have been considered and it can be explained why a decision has been made, even if it is not supported.

Case study examples of good and bad practice
Take account of full range of impacts (positive and negative) and who would be affected:
BAD PRACTICE: Defence options focussing solely on the reduction in risk resulted in a loss of value to the frontage being protected.

GOOD PRACTICE: Involvement of planners, local businesses and consultees led to a scheme attracting alternative funding streams.

Case study examples of good and bad practice
Proportionality:
BAD PRACTICE: Detailed modelling of water levels was undertaken when the critical issue was the condition, not the level, of the defence.

GOOD PRACTICE: The cost of a detailed contingent value survey was estimated to be more than twice the cost difference between options. The option selection was made through simple consultation without further economic justification.

Options that are refined through comparison of the costs and benefits

Project appraisal is an iterative process where options go through a cycle of being developed, reviewed and refined to identify a preferred solution that is robust and sustainable, as shown in Figure 2.2. This approach means that the appraisal team learns about the costs and benefits of the options as it progresses. As well as being able to take account of new information as it becomes available, an iterative approach allows options to be revised, and perhaps combined, to end up with better options than before. An iterative approach allows you to close off unrealistic options, but take forward specific benefits from such options for consideration as part of subsequent options.

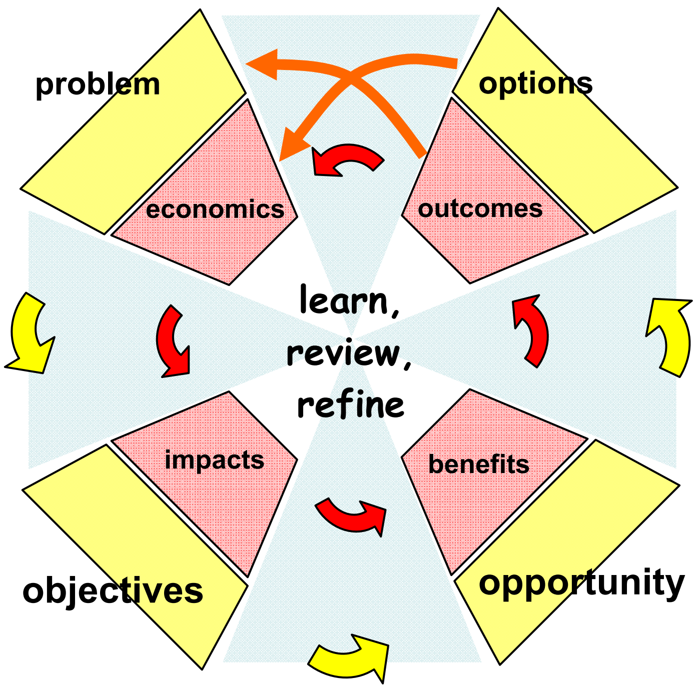


Figure 2.2 The process of learning, reviewing and refining

Case study examples of good and bad practice
Refinement of options:
BAD PRACTICE: A series of options was identified and the assessment of costs and benefits undertaken. The results were used to choose the best option.

GOOD PRACTICE: A series of options was identified and the assessment of costs and benefits undertaken. The options were then compared, with options combined to maximise the benefits that could be delivered (including wider benefits through engagement with, and funding from, planners, local businesses and consultees).

Options that are refined through sensitivity analysis and assessment of uncertainties

It is essential that future changes in flood and coastal erosion risk are assessed. This includes, for example, climate change, population change, development and regeneration. This will help identify options that are more adaptable to future uncertainty, promoting robust and resilient solutions.

Where possible future changes are assessed as likely to be significant it may be appropriate to further consider the various scenarios. One approach that can be used to take account of future change, such as the effects of climate change, is called 'Real Options Analysis'. It is based on the use of decision trees to map out sequences of actions, decision points and events throughout the timescale of a project. Real Options Analysis is additional to the usual appraisal process as it requires the value of flexibility to be taken into account. More information on how to apply Real Options Analysis can be found in HM Treasury (2009) and the climate change supporting document.

Case study examples of good and bad practice
Uncertainty and future risks:
BAD PRACTICE: Reshaping a shingle bank after overtopping led to increasing long term vulnerability of sudden inundation.

GOOD PRACTICE: Options were tested under different scenarios leading to a more robust solution.

Selection of a preferred option

Good decisions come from considering the economic, environmental, social and technical issues that affect the choice of the solution, together with proper consideration of risk and uncertainty. By balancing these issues, including those that cannot be easily valued in monetary terms, the most viable solution should be identified.

Whatever the decision (do something new, sustain existing, change existing or do-nothing) it must be made in a clear, justifiable and transparent manner based on sufficient information, such that it can be understood by, if not accepted by, those affected.

Case study examples of good and bad practice
Selection of a preferred option:
BAD PRACTICE: The choice of preferred option was based on the average benefit-cost ratio, choosing from a series of options, in a mechanistic manner with no other factors being considered.

GOOD PRACTICE: The preferred option was identified by comparing options that had been combined and refined to deliver a solution with multiple benefits and contributions from local sources (with discussions with local people, councils and businesses used to explore the potential to deliver more).

Preparation and submission of an appraisal report

The appraisal report needs to provide a clear and comprehensive record of the appraisal process and a well argued justification for the selection of the preferred option for any project. Templates are provided (for a strategy and scheme) to aid report preparation and, once reviewed and agreed, should be made public.

Feedback from the appraisal to assist with learning for future appraisals and to feed into other processes

A complete evaluation of a project is only usually practical at the end of its useful life where the performance has been monitored throughout its life. As this period is usually very long, it is not always practical. To enable learning of lessons (positive or negative) and a limited assessment of how well the spend on FCERM is delivering its objectives, it is good practice to carry out partial evaluations following each stage of the project, including once the appraisal has been completed and the appraisal report written.

The points at which project evaluation are desirable include:

- **post-appraisal evaluation** to verify that the appraisal meets pre-set quality criteria;
- **post-implementation evaluation** to assess the accuracy and robustness of the risks, costs and benefits predicted in the appraisal;
- **monitoring** associated with consents and licences and to inform future risk management activities through managed adaptive processes; and
- **feedback of information** to other processes, policies and strategies so they can be updated or maintained.

2.4 Different types of project

2.4.1 Making the appraisal process more efficient

To help achieve more efficient appraisals projects have been categorised into one of five types: three of which use cost-benefit analysis (CBA) and two that use cost-effectiveness analysis (CEA). The type of project then determines which appraisal steps are required and to how much detail, making the overall appraisal process more proportionate to the information needed to make a decision. Figure 2.3 shows the five types of project and the key differences between them.

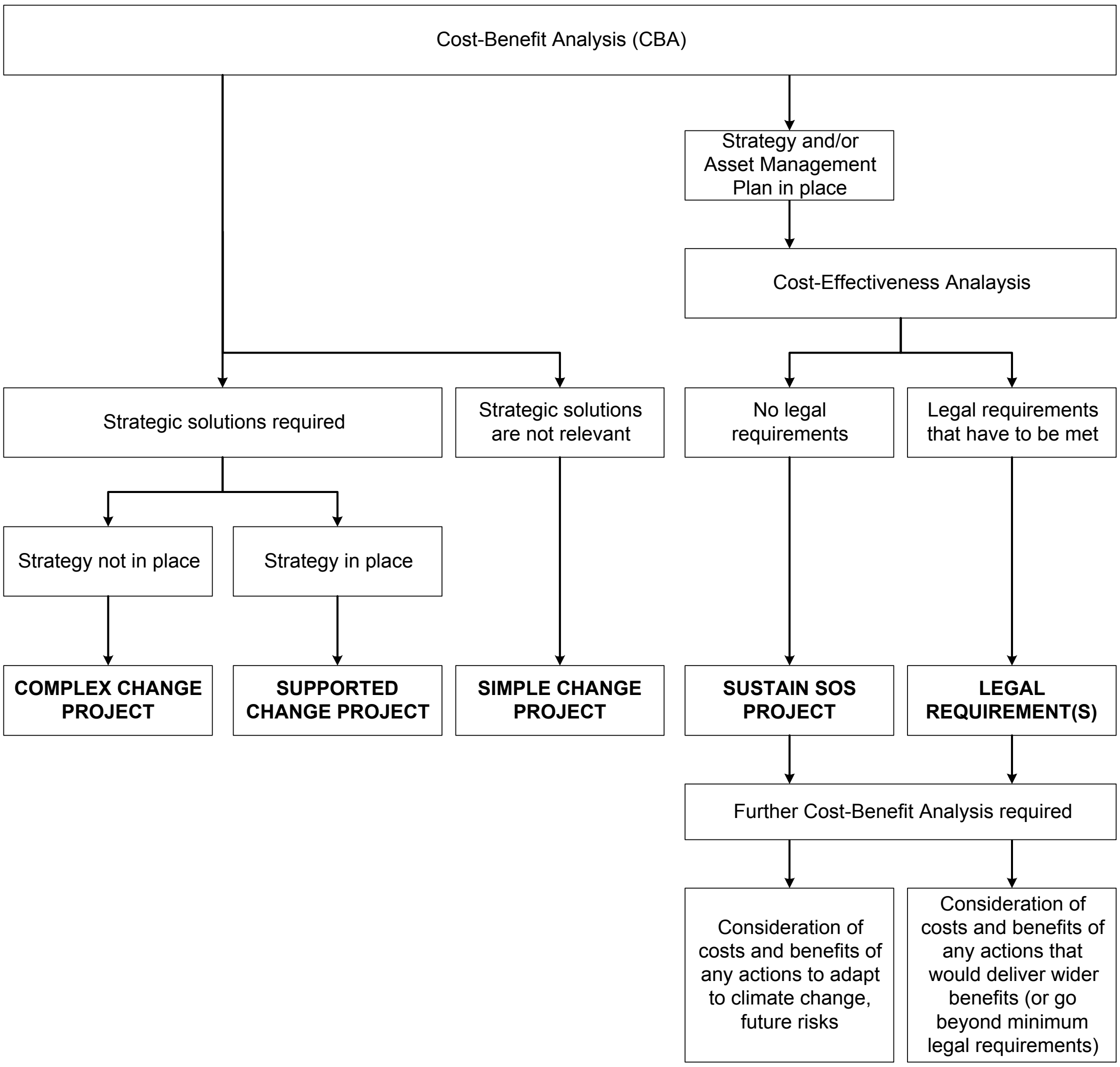


Figure 2.3 The five types of project

2.4.2 Cost-benefit analysis and cost-effectiveness analysis

In line with Defra's policy statement, appraisal is used to show that the benefits of projects outweigh the costs and therefore justify Government investment in flood and coastal erosion risk management. To do this, most FCERM appraisals are undertaken using CBA. CBA uses a do-nothing baseline. It involves assessment, in monetary terms, of as many as possible of the costs and benefits of options. However, those impacts that cannot be expressed in monetary terms must also be taken into account during decision-making. The results of the CBA can then be used to show that taxpayers' money is being invested in those projects that will deliver the greatest benefits for society as a whole.

CEA is a process that compares the costs of alternative ways of meeting the minimum legal requirement or approach recommended by a CBA. CEA is used where:

- there is a minimum legal requirement that has to be met. Defra's policy statement also requires the benefits of the legal requirements to be identified and described so that the benefits of meeting the legal requirement or doing more than the legal minimum can be understood; or
- cost-benefit analysis has already been undertaken and has shown that a project is economically worthwhile and the appraisal now being undertaken is to find the most cost-effective method of implementing the option or approach recommended by the cost-benefit analysis. This helps to ensure that the appraisal is proportionate to the problem being assessed and the level of information needed to make a robust decision.

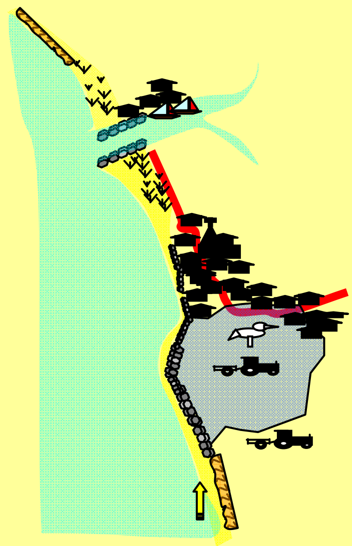
2.4.3 Projects using CBA

Complex change project

A complex change project is a project that examines options at the strategic level or implements a strategic solution but where there is no agreed strategy in place. Complex change projects require a strategic approach to be developed to address the extent, integration or interconnection of different areas.

Examples of Complex Change Projects

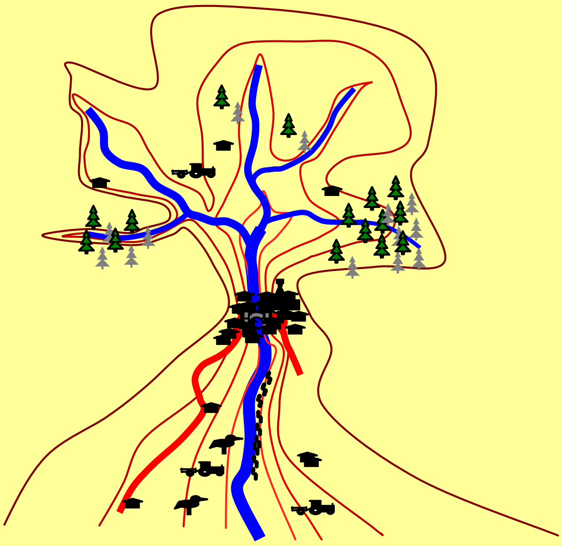
i) Town H is an important regional centre, situated on high ground with an estuary just to the north. The mouth of the estuary has been developed as a harbour with a village developed around the harbour. To the south of the town is low lying agricultural land and higher ground further north with eroding cliffs. The general sediment drift is from south to north. Both the harbour structures and the flood defence to the south control sediment drift. The low lying land to the south is a bird reserve and there are properties and the main road to the town within the flood plain. The town is defended by a sea wall and the beach in front is maintained by groynes. In the appraisal of the management of the area there are many interrelated issues that have to be taken into account. These include ecological values, tourism, agriculture, harbour use and the risk of erosion to the town. The extent of the strategic approach has to be



Examples of Complex Change Projects

defined at a suitably broad level and the various interests identified, along with the interdependencies between such issues – the benefit the town receives in terms of the harbour structures retaining the beach, the dependency of the harbour village of these structures and the potential long-term impact of the defence to the low lying land on sediment drift; - the economic benefits brought to the town by the bird reserve and the harbour, the importance of retaining a beach both as a defence and a tourist attraction. The product of the complex change project should resolve these issues in defining an overall approach to sustainable management of interests and risk management.

ii) Town I has developed to either side of a river, gradually constraining the river channel through defences. Upstream of the river is generally agricultural land with a relatively steep catchment area fed by several tributaries. Downstream is a wider flood plain, with defences to agricultural land. There are issues of forestry and agricultural practice. The down stream area is important for its bank-side footpath and its ecological value. A main road runs through the town with a bridge over the river. In the appraisal of the management of the area there are again many interrelated issues that have to be taken into account. Strategic level options have to include management of flow through the entire catchment area, balancing the impacts of controlling flow from the upper catchment, to widening the channel through the town and the impact on flood risk this might have on the downstream area. The complex change project would need to consider the whole area in defining a sustainable approach to management potentially of the whole catchment.



Supported change project

A supported change project is where the broader scale problem has already been clearly identified and an FCERM approved strategy is in place to address the problem, showing the benefits that will be delivered. The problem at the scheme level is identifying the most effective manner to deliver the intent of the strategy. In this case, it is necessary to ask ‘what is the most effective delivery of the strategy?’ and to test whether the cost or impacts (if considered in more detail) might have influenced the decision at the strategy level.

A supported change project draws on the data and results presented in the strategy such that the effort and resources required for the appraisal are reduced.

Examples of Supported Change Projects

i) In the case of Town H (see above), a long term strategy has been developed that includes setting back the flood defence to the south of the town but continuing to manage the erosion risk to the town centre. The main aim, defined by the strategy, is to maintain a beach in front of the town. This was justified through an economic appraisal carried out as part of the strategy, taking account of the amenity and tourism benefits, and this was based on an approach continuing to maintain the timber groynes. The strategy also identified the need to maintain the harbour entrance structures in support of the intent to retain a beach in front of the town, as well as protecting the harbour village. Possible alternatives were highlighted by the strategy but these were not developed further. The groynes are in poor condition and need to be replaced. The subsequent supported change project considers how best to deliver the strategic aims. Options might range from beach recharge, offshore or nearshore structures, timber or rock groynes or combination of these. In considering these options possible realignment of defences to the northern end of the town also needed to be considered to achieve a beneficial alignment through to the Harbour. This latter consideration develops on the overall intent of the strategy, although in detail moving away from the strategic policy of Holding the Line. The baseline appraisal of do-nothing is taken from the strategy and might only be re-visited in detail if the costs for maintaining the beach and seawall were found to exceed that estimated by the strategy.

ii) In the case of Town I (see above), the strategy identified that management should be built up from a combination of set back defences within the town, including redesign of the bridge, and construction of a flood storage reservoir within one of the tributaries. The intent of the strategy was to balance flows so as to minimise the impact on flood defences down stream. The supported change project appraisal confirmed the benefit in changing the alignment of the river through the town but, due to detailed issues found that the full benefit of upstream storage could not be realised. Further examination had to be given to potential damages downstream and the need, or otherwise of local improvement to defences in this area.

Simple change project

Simple change projects are required where a solution is needed to meet the specific requirements of a small area, where strategic solutions are not relevant and a standalone project can be undertaken.

There may also be instances where the development of some strategies for complex areas with many interrelating pressures and influences may be a long-term process potentially over a number of years. During this time there may be a need to protect lives or assets if they are not to be exposed to unacceptable risks. However, such works will normally be of limited extent and costs proportionate to the immediate problem.

To progress these projects in advance of the approved strategy it will be necessary to produce a Framework for Action as a vehicle to deliver these projects. It will be necessary to agree the Framework with interested parties (including those involved in the preparation of the Strategy) and to carry out a full appraisal.

In all cases the projects undertaken under a Framework for Action will typically be interim works, often appraised over a shorter timescale and must not prejudice any long-term solutions being developed as part of the strategy.

A simple change project either does not require a strategic approach or cannot wait for development of a long-term strategy such that a quicker, smaller scale focus is appropriate. It is important to note that simple change projects do not imply simple or straightforward appraisals.

Examples of Simple Change Projects

i) Town H has been hit by a major winter storm. The reveted flood defence to the south of the town was damaged, with risk of breach. Within the emerging strategy the medium-term policy with respect to this defence is for removal of the structure and setting back the defence in this area to protect property and the road behind. The aim of setting back the defence is to re-establish a more naturally functioning coastline. The intent is still to manage flood risk to the area behind. It is assessed that the forward line of the defence will not really impinge on coastal processes for some 20 to 30 years; this is being monitored. The simple change project might need to examine the possibility of adapting management in line with the longer term strategy intent more immediately as a potential option, but would primarily focus on the need to re-establish the integrity of the existing defence locally. Works to achieve this may be developed under a Framework for Action, spanning the gap before the strategy policy was implemented.

ii) Within a local area of Town I there have been two occasions, recently, when flooding has occurred in the high street. There has been no long-term history of significant flooding in this area and it is outside the predicted flood plain of the main river. The cause of flooding and the benefits of a scheme were assessed in a simple change project. This found that there were no significant impacts on flood risk management elsewhere in the town and that a small scheme increasing the capacity of a culvert and walls through the car parks could be constructed to directly protect the high street. This could be progressed independently of any strategy. However, there was a need to examine fully the benefits of undertaking works.

2.4.4 Projects using CEA

Sustain Standard of Service (SoS)

Sustain SoS projects deliver activities needed to continue the agreed standard of service of an existing asset or group of assets. They look at how best to maintain the system given that individual components of the system will often have different residual lives, where the benefits of maintaining that system have been demonstrated using cost-benefit analysis. Typically projects might include the refurbishment of assets or replacement of components of larger assets that have reached their design life. The emphasis is in drawing benefit from an existing system or asset, optimising the use of sunk costs and keeping the appraisal costs proportionate to the scale and impact of decision-making required.

The decision to Sustain the current SoS is based on a series of Control Thresholds (see Does your project meet *all* the requirements for a Sustain SOS? in Chapter 5) and information taken from sources such as the SMP/CFMP, strategy and asset management plan (AMP). Asset management plans should provide information on the costs and benefits of withdrawing maintenance and continuing to maintain the assets. Where this information is available, it can be used to support a Sustain SOS appraisal. The Control Thresholds are used to minimise the risk that the wrong decision is taken by limiting the situations when Sustain SOS can be used.

Sustain SoS projects require an appraisal to show the effectiveness of maintaining an existing asset where the benefit of maintaining the defence system[3] as a whole has already been demonstrated (for example, through the AMP or strategy). As such the scope of the appraisal is typically limited to assessing only those specific options that could sustain the SoS using cost-effectiveness analysis based upon whole life costs.

It is important that the whole term ‘Sustain SoS’ is used as the definition is different to that of a ‘sustain’ option (as used in CFMPs, for example). The inclusion of SoS means that the project will provide the same design levels (such as defence height, pumping regime or minimum beach level) but ***does not*** allow for the effects of future changes such as changes in river flows or sea level rise. This is because Sustain SoS projects only relate to maintenance of assets to maximise their residual life.

[3] Where a defence system is defined as the combination of all the assets required and/or used to provide the current level of flood and/or coastal risk management.

Examples of Sustain SoS projects could include:

- a defence system comprising earth embankments and a pumping station. This defence system protects 840 properties and 85 ha of agricultural land. While the average residual life of most components of the system is more than 25 years, the electrical supply and control gear of the pumping station are more than 20 years old and need to be replaced to maintain a reliable, safe and cost-effective system. Replacement of the electrical supply and control gear could be assessed as a Sustain SoS project.

- a 9km linear defence composed of 8.5km of earth embankments and concrete wall with residual lives in excess of 25 years and a 0.5km length of steel pile wall that is heavily corroded. The steel pile wall has reached its minimum acceptable condition grade and is predicted to fail in the short-term (within 5 years) if it is not replaced. Replacement of the steel piled wall to maintain the existing asset could be assessed as a Sustain SoS project.

There may be potential to adapt the asset so it is able to take account of climate change. Any such adaptations should be considered, although it will be necessary to assess the costs and benefits of the adaptations and, hence, whether they are likely to be worthwhile. This is done using cost-benefit analysis. A CBA would also be used when assessing the benefits of delivering wider objectives through partnership working.

Examples of Sustain SoS projects that look at potential for adaptation could include:

Replacement of the electrical supply and control gear could be undertaken at the same time as widening the inlet on a pumping station. This would maximise the potential of the pumping station to adapt to longer and more intensive periods of rainfall. The costs of widening the inlet would need to be balanced against the potential benefits, but also the costs associated with widening the inlet when there are no efficiency gains to be made.

Replacement of a steel pile wall could be assessed as a Sustain SoS project. There is the potential to investigate the potential for embankments to be raised to reflect the potential increase in risk from sea level rise. If it is found that the embankments could be raised without the need for substantial reconstruction, it may be beneficial to consider increasing the crest level of steel pile wall when it is replaced and increasing the height of the embankment at a later date, when necessary. This would reduce the risk that the steel pile wall would have to be replaced again due to sea level rise before the life of the replacement wall is reached. The costs of the investigation would have to be balanced against the risk that the steel pile wall would have to be replaced again in the near future due to sea level rise.
Works to reduce the effect of rabbits and moles burrowing into an embankment would be assessed as a Sustain SoS project. The local council has asked whether a footpath could be provided along the crest of the embankment to create a circular estuary walk. The local council is willing to part-fund the footpath creation work. The additional costs of providing the footpath would need to be compared with the benefits.

Projects to fulfil legal requirements

Projects that are required to fulfil legal obligations can typically be divided into:

- ***legal requirements that drive the need for a project***: there are two types of legislation here:
  - legislation with ‘general’ application, such as the Habitats and Birds Directives or Water Framework Directive; and
  - specific legislation, including local legal agreements, such as navigation acts for specific rivers.
- ***legal requirements that place duties or obligations on the project***: these can be sub-divided into:
  - duties that stem from legislation such as Health & Safety or Town and Country Planning; and
  - obligations that arise from contractual agreements, such as contracts between an operating authority and a water company to provide adequate water levels for abstraction by pumps.

Defra policy also requires that the benefits of meeting the legal requirements are identified, described and, where possible and appropriate, quantified and valued in monetary terms. Information on the benefits will be used to help understand who is gaining or losing from the programme of work, and to help demonstrate that the programme provides good value for money.

It is also important to consider whether there may be efficiency gains from providing wider benefits beyond those linked to the minimum legal requirements. The costs and benefits of providing the wider benefits would need to be appraised. This means that any incremental increases in investment beyond that to achieve the obligation will require a cost-benefit analysis.

3. Understand and define the project

3.1 Key Principles: Understand and define the project

This is a very important stage in the appraisal process and is needed in order to develop successful solutions.

All appraisals should start with the development of a clear understanding of the problems that are to be tackled, taking account of current and predicted future technical, social, environmental and economic issues. The **focus** should be **on the risks** and **how those risks could change** over the timescale of the project. This means that the problem should be described in terms of:

- probability of flooding and erosion;
- how probability could change and the drivers of change (taking account of climate change (see climate change supporting document), population change, development and regeneration);
- consequences of flooding and erosion (positive and negative); and
- how the consequences could change over time and why.

All sources of flood (rivers, sea, groundwater, surfacewater) and erosion risk would normally be included.

It is **essential** that the problem is not defined in such a way that it prejudges the solution. This is about defining the problem (why the project is needed) not the solution.

Engagement is a key part of understanding and defining the project and the approach and mechanisms should be clearly set out in a Stakeholder Engagement Plan (SEP). It is important to involve key stakeholders and potential project partners during identification of the problem. This should reduce the number of project delivery issues as the appraisal progresses. Early involvement of other organisations will help identify the wider issues and provide the basis for obtaining funds to achieve wider objectives.

Figure 3.1 shows where you are in the appraisal process (orange coloured box). Follow the hyperlinks to move back to previous chapters of the guidance if you need to revisit previous tasks. Clicking on a hyperlink to another chapter takes you directly to the start of that chapter (to the key principles). Clicking on a hyperlink to a section within Chapter 3 takes you to the main guidance.

3. Understand and define the project

3.1 Key principles

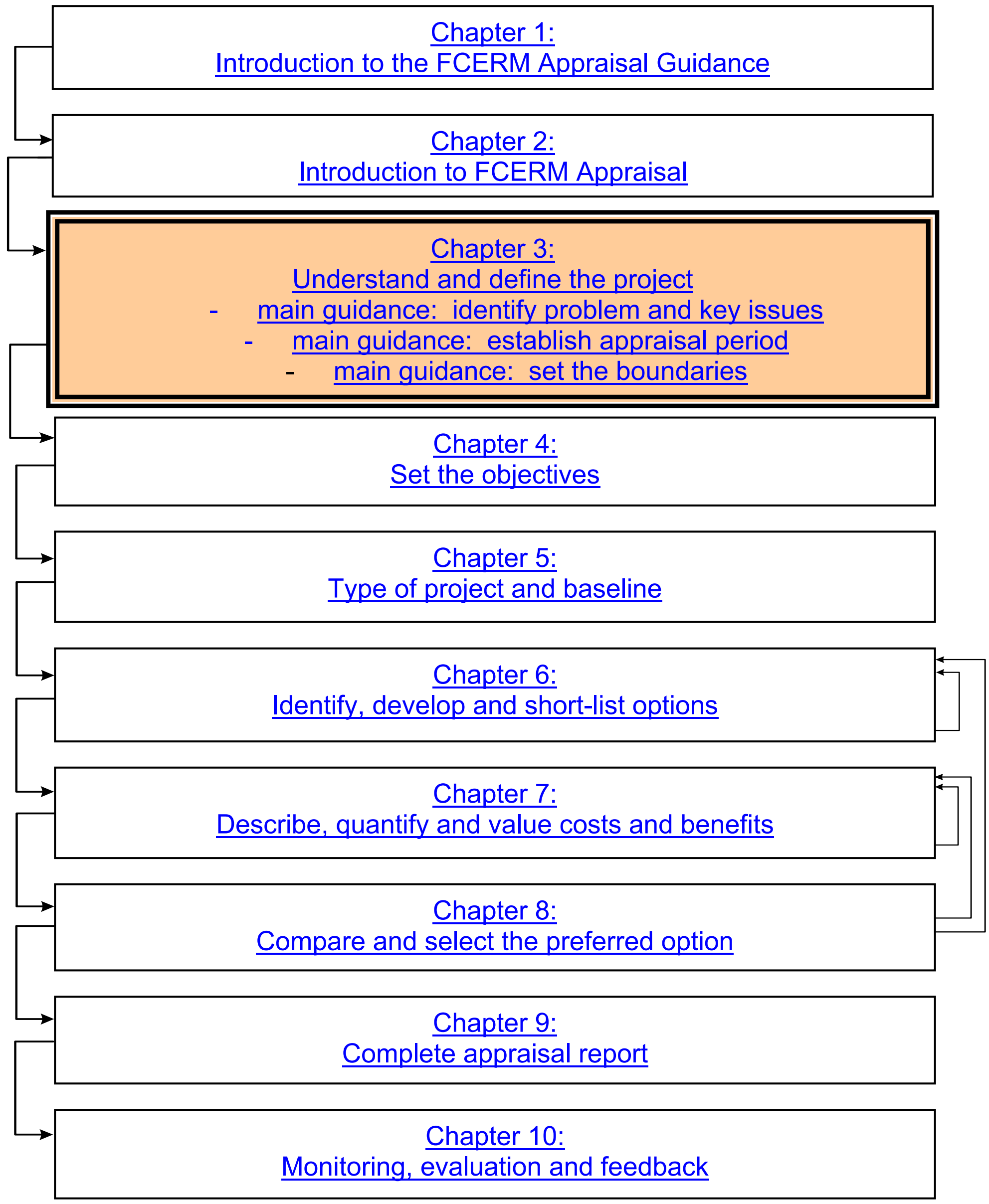


Figure 3.1 Navigation flowchart

3.2 Inputs to understand and define the project

The need for a project

Higher level plans (CFMPs, SMPs), strategies or Asset Management Plans, or flooding or erosion will have identified that there is a risk that may need to be managed. This step will help you identify the scope of the project and to describe the problem.

Working with others

A Stakeholder Engagement Plan (SEP) would normally be developed at this stage in the project identifying the purpose of engagement and the level of engagement required. The plan should be developed in draft and finalised during objective setting where the objectives for the project will be confirmed.

The SEP will provide the framework for managing the engagement process with the aim of building trust with local communities, ensuring that expectations of stakeholders are managed and that new opportunities for enhancement are identified throughout the project appraisal process.

During the first stages of engagement, the perceptions and attitudes in relation to the problem will begin to emerge. These will shape the remaining engagement process and help to identify some of the constraints and opportunities. This process may also uncover potential partners who may contribute information, data or resources (including funding) to the project.

Environmental assessment

Usually, the first step in environmental assessment is to collate information about the site and potential scale of the project. This will allow environmental constraints and opportunities to be identified and feed into the identification of key issues for the project. This process reflects the overall project stage of aiming to understand and define the problem. For SEA this process is covered by the Scoping Stage which focuses on identifying relevant environmental issues that could influence, or be influenced by, the plan being developed.

It is important at this stage for both statutory and non-statutory environmental assessment to identify key stakeholders (to be included in the SEP) and undertake early consultation where this will inform the understanding of key issues. Engagement should be undertaken in line with the draft SEP.

The environmental assessment should inform the setting of boundaries for the project, particularly in relation to natural processes where information is gained about the functioning of the site. The boundaries of the environmental assessment may vary according to the zone of impact and requirements of different receptors. The project boundary should not be confused with the boundaries of the environmental assessment.

Known survey requirements for protected species with seasonal constraints on survey periods should be highlighted during the project definition stage to ensure windows of opportunity are captured.

3.3 Identify problem and key issues

3.3.1 Expert summary: Identify problem and key issues	
Identify the problem Read more	Identify the problem (why a project is needed) by clearly describing the risk (probability and consequence), the cause of the risk (for example, failure of defences, and sea level rise) and associated timing. Identify and describe the key economic, environmental and social assets that could be impacted. **It is essential that the problem is not defined in such a way that it prejudges the solution**.
Identify how much engagement is required Read more	Identify the level of engagement that is required based on the scale and complexity of the project.
Link back to the SMP or CFMP (and strategy) Read more	Link the problem back to the definition of the policy in the SMP or CFMP (or the problem identified in the strategy, where applicable).
Sources of data	Data can be obtained from records held by operating authorities, through discussions with the operational personnel and engagement with stakeholders. Key sources to use when identifying and describing the problem include: • SMPs or CFMPs and strategies (where available): including data used in describing the problem and policy proposed; • high-level and strategic plans: for example, data used in developing policies, assessing impacts, or making recommendations and management plans and operations; • records of previous floods and historical erosion rates: including previous events, causes and consequences, and trends; • management activities and practices: previous interventions (if any), including maintenance, monitoring, role of natural processes and flood warning; • physical processes: coastal processes, river processes, natural processes, models developed in previous studies, trends, considering how these may support technical development, testing of options and environmental assessments; and

3.3.1 Expert summary: Identify problem and key issues	
Read more	• social and environmental data: information relating to all environmental receptors (undertaken as part of environmental assessment process).
Check data quality and relevance Read more	Assess relevance of data (whether they are up to date and linked to your project area), robustness of data (based on reliability of data source or collection), coverage (if they cover the issues faced) and the level of detail (broad-brush versus specific).
Collection of new data Read more	Only collect more data where this is needed to describe the problem. Determine if it is necessary to collect additional data now. It may be preferable to wait until you have a better understanding on whether collecting additional data would improve decision-making. Where there are known survey requirements for protected species, this may affect the project appraisal duration and sequencing and should therefore be flagged as early as possible. It may be beneficial to commence survey work in advance of the standard project appraisal process in some circumstances.
Record uncertainties Read more	It is important to record any uncertainty associated with the above variables as this could affect the potential success of solutions proposed to address the problem. The level of uncertainty within a dataset can also be used as factor when considering whether or not to collect more data.
Set the quality criteria for the project Read more	Use the problem to set quality criteria: • state why the project is required; • identify how you will measure whether the project has been successful; • bring in quality criteria from the stakeholder engagement plan (why you are undertaking engagement and the purpose of engagement); and • bring in quality criteria from the environmental assessment. These quality criteria will be used at the end of the appraisal to assess whether the appraisal has achieved what is required (see Chapter 10: Monitoring, evaluation and feedback).
Identify constraints Read more	Identify key constraints that could affect the potential options that could be implemented to manage the risk and if or how these constraints may interact. These should include consideration of constraints imposed by legal obligations.

3. Understand and define the project

3.3 Identify the problem and key issues

3.3.1 Expert summary: Identify problem and key issues	
Identify opportunities	Identify opportunities to deliver wider benefits (economic, environmental or social). Early involvement of potential project partners can help outline opportunities associated with delivering opportunities through partnership working. It is useful to explore at this stage, whether and what scale of funds are likely to be available from other sources.
Read more	**Move to establish appraisal period** OR Check you have completed the expected outputs

3.3.2 Main guidance: Identify problem and key issues	
Identify the problem Read more	Identification of the problem should include a realistic assessment of the risk and the causes of risk. Figure 3.2 shows the type of issues that should be discussed.
Risk and uncertainty Read more	Risk and uncertainty are very often used interchangeably in options appraisal. However, they are different in that risk comprises two components (probability and consequence) and uncertainty is the degree of confidence you have in the measurement of risk (probability or consequence). It therefore follows that in the options appraisal it is necessary to take risk and uncertainty into account.
Take account of future change in risk Read more	Any reasonable changes in the risks in the future (due to sea level rise, increased river flows, gradual deterioration of defences or pumping stations, or occurrence of blockages, breaches or collapses of culverts, for example) also need to be included. This information is used to identify and describe where and when the damages are predicted to increase. There may also be increasingly positive consequences associated with increased flooding or erosion.

3.3.2 Main guidance: Identify problem and key issues

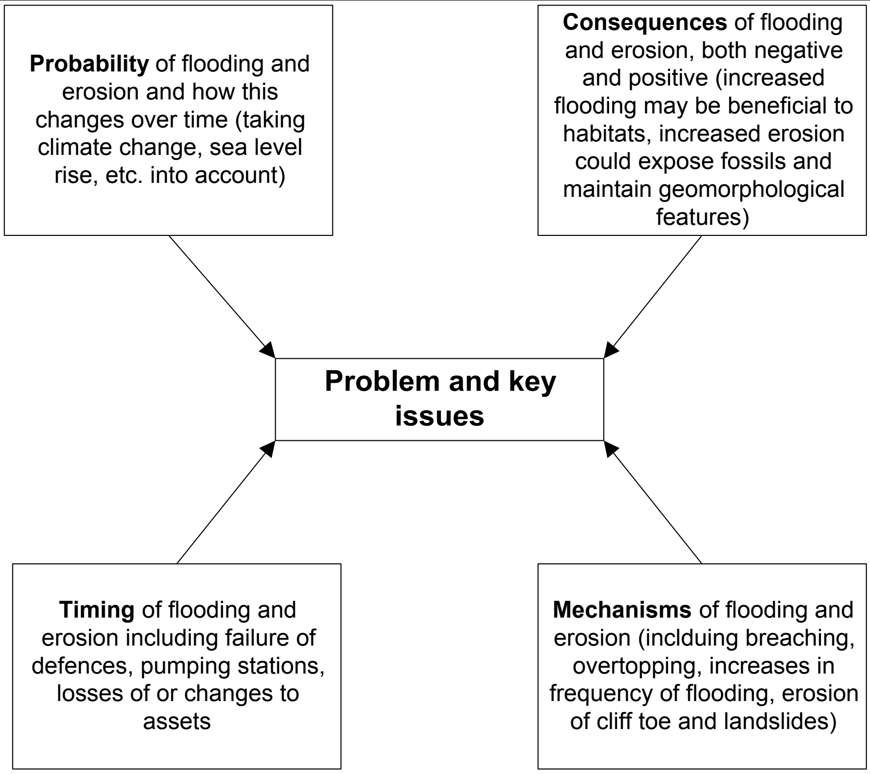


Figure 3.2 Issues to consider when describing the problem

Do not prejudge the solution
Read more

It is essential that the problem is not defined in such a way that it prejudges the solution (see examples of problems and an example of a poorly defined problem).

Example problems

Example problems:
1. There are 200 properties at risk of flooding from the River Zed with an annual probability of flooding greater than 0.05. The properties at risk are mainly residential but they also include retirement homes, a local hospital and a sewage treatment works. The current flood defences are in a poor state and there is concern that they could fail within the next 5 years. The CFMP has a policy for the larger area to take no further action to reduce flood risk. However, local action might be triggered by the identification of critical infrastructure.

2. Biodiversity on a vegetated shingle bank is reducing due to reprofiling works used to maintain the shingle bank as a defence. There is concern that the conservation value of the shingle bank is being reduced considerably and rare species could be lost within 5-10 years. The SMP proposed hold the line for this area, but at a large

3.3.2 Main guidance: Identify problem and key issues	
Read more	scale. Local assessment of the issues suggests a more adaptive approach, allowing the shingle bank to achieve a more natural profile and to roll-back, may be required at the local scale. In both cases there would be scope for engagement with local stakeholders to determine the most acceptable manner in which to address the risk.
Set the quality criteria for the project Read more	Use the description of the problem to explain why the project is needed. Using the example above, the reason why the project is needed is: 1. *to manage the risk of flooding from the River Zed* 2. *to maintain or enhance biodiversity on the shingle bank* You can then use the description of why the project is needed and your understanding of the engagement risk to define why and how you will undertake and use the results of engagement.
Identify how much engagement is required	An assessment of the level of engagement that is required should be undertaken to help define the purpose of engagement (see also the supporting document on engagement). This will help determine the purpose of the engagement process linked to the overall objective of the project. As the project is defined, the corresponding level of engagement should be documented in a Stakeholder Engagement Plan to be finalised during the objective setting process. It is important to ensure that the amount of engagement being undertaken is appropriate to the scale and complexity of the project.
Work as a project team	Appraisals are usually best undertaken by a team. This allows the team to test ideas as they progress through the understanding of the problem. It also allows iteration of the assessment of impacts, the options and the choice of the preferred option. The results are better appraisals that identify a solution that provides greater value for money. The breadth of experience included within the team will affect how the appraisal is undertaken, but there can be trade-offs in terms of costs and time.
Involve potential partners in describing the	Involvement of potential project partners at an early stage can help outline opportunities to mitigate any additional costs associated with delivering opportunities through partnership working. It is useful to explore when describing

3.3.2 Main guidance: Identify problem and key issues	
problem Read more	the problem, whether and what scale of funds are likely to be available from other sources.
Sources of data Read more	Key sources of data to use when identifying and describing the problem are: • SMPs, CFMPs and strategies (where available); • high-level and strategic plans; • records of previous floods and historical erosion rates (conditions, causes and consequences); • management activities and practices; • physical processes; • data from local people and stakeholders; and • social and environmental data.
SMPs, CFMPs and strategies	SMPs or CFMPs will have collected information on the economic, environmental and social assets at risk, the defences or coast protection works that are in place and identified preferred policies. The SMP or CFMP will also have engaged with stakeholders and you may be able to draw some information from the results. Early links need to be made with SMPs or CFMPs and strategies (where applicable) as they may have already identified key issues and broad solutions (in CFMPs these are called generic responses). It is essential to link the problem back to the policy as defined in the SMP or CFMP (and for schemes, to the description of the strategy, where available) to ensure continuity is not lost. Any conflicts between the description of the problem for your project and the recommendation of the SMP or CFMP (or strategy) will need to be highlighted and reconciled before you can progress further. To resolve the conflict you should consider: • whether identification of the problem has highlighted new issues that were not known during development of the SMP, CFMP or strategy that, if they had been known, may have changed the proposed policy; • whether the policy relates to a much wider area and consideration of a small, specific part of the policy unit suggests a different policy may be preferred; and • whether your problem definition is likely to lead to a solution that would jeopardise implementation of the CFMP/SMP policy. You should record actions taken to reconcile the differences between the SMP/CFMP (or strategy) and the

3.3.2 Main guidance: Identify problem and key issues	
	problem described with justification for the differences. You may need to agree this (for example, with the project executive, project board or approver) before proceeding further. The reasons for the difference in the problem, once agreed, should also feed back to the SMP or CFMP at the end of the appraisal (see Chapter 10: Monitoring, evaluation and feedback).
High-level and strategic plans	High level and strategic plans that are likely to include useful data and information are: • river basin management plans (RBMPs); • local development frameworks (LDFs); • strategic flood risk assessments (SFRAs); • drainage plans and surface water management plans (SWMPs); • biodiversity action plans (BAP), habitat action plans (HAPs); • regional habitat creation programmes (RHCPs); • water level management plans (WLMPs); • management or restoration plans for SACs, SPAs and SSSIs; • environmental stewardship maps; • wetland vision mapping (showing potential areas for wetland creation); • plans from owners and operators of critical national infrastructure (such as water/wastewater companies, electricity providers, transport infrastructure operators (National Rail, Highways Agency), Primary Care Trusts); • community or local authority flood plans; and • sustainable community strategies and economic development strategies. The environmental assessment (particularly SEAs) involves reviewing plans and programmes to determine how they affect the project. This review may provide you with the information needed when identifying the problem. High-level plans may also contain data that can help establish the appraisal period or set the boundaries. Some of these plans agree policies which may affect the development of options. It is essential that this information is not lost as it will affect which options are appropriate (see identify constraints). Objectives, issues and solutions may also have been identified in high-level and strategic plans. These should be included when setting the objectives (Chapter 4).
Read more	

3.3.2 Main guidance: Identify problem and key issues	
Data on physical processes	Data on physical processes is needed when describing the risk and how risk might change and also in understanding the consequences of change. The data can also be used to help identify whether the problem is local or strategic. Actual data requirements will depend on your project but could include data and analysis on: • tides; • waves; • currents; • coastal/geomorphological processes; • rainfall; • river flow regimes; and • sediment movement. **Example data on physical processes** i) average daily conditions may be relevant for impact assessment in addition to conditions under extreme events. ii) net drift of sediment in an area may be from north to south. Local variation due to variation in wave climate may expose areas to episodic risk or different opportunities for management. Opportunities and constraints when combining or separating analysis for different purposes should be considered at an early stage.
Data on previous floods and historical erosion rates	Data on previous floods and historical erosion rates is important when identifying and describing trends. Data on historical events should include information on the consequences and the causes of the event (including wind directions, waves, tide or river levels, rainfall amount and intensity, river flows and groundwater levels). A factual summary of the historical account or evidence of risk (what has happened in the past and what the consequence has been), will be useful when you are describing the problem. It is important to capture how the defences, culverts, sluices, pumps and other risk management assets performed. Take account of any impacts caused by ice, blockages or collapses, breaches, and failures during operation. Any emergency responses that were undertaken to prevent or limit consequences should also be identified. This information can then be used to set the context for changes in risk predicted into the

3.3.2 Main guidance: Identify problem and key issues	
	future. Historical Trend Analysis can also be useful when analysing impacts of physical processes on environmental parameters (primarily ecology).
Data on management activities	Information on management activities may be important when describing the consequences. It can include: • activities undertaken following significant events (such as emergency raising of low spots or local temporary protection measures that may have affected the extent of the impacts and the damages); • maintenance and operational management practices associated with the current level of performance; • management activities associated with critical infrastructure (nationally and locally); and • the role of natural processes in management.
Data from local people and stakeholders Read more	Data and information will be available from individuals and organisations living or working in the area. Anecdotal information could also help explain causes and consequences of risk, and could provide a context for analyses. Remember though that perception of risk does not always coincide with technical assessments. Careful consideration and understanding of local perceptions and attitudes will be required if the final outcome is to gain support and confidence. This is an important part of engagement with local communities and stakeholders. Major constraints upon the options to be considered (such as legal requirements) and potential opportunities they could provide should also be stated.
Social and environmental data Read more	Data may be collated through existing local forums and groups, particularly monitoring data. Data on physical processes and hydromorphology will provide the foundation for assessing the baseline (see 5.4: define the baseline) and later determination of change resulting from options. These changes may result in impacts for a number of environmental receptors and it is essential that close links are maintained with the environmental assessment process from the outset. This also helps reduce duplication of work, both data collection and analysis.

3.3.2 Main guidance: Identify problem and key issues	
How much data to take from other sources	It is unlikely that you will need all the data available from these sources. Consider the key data you need to describe probabilities, consequences, timing and mechanisms. You can collect more data later should you need to.
Check data quality and relevance	Extracting data that you need from high level plans and previous projects could save time and effort. However, you will need to verify that: • data are still relevant. For example, the results of economic analysis (such as quantification and monetisation of damages) may have been undertaken using old and now obsolete data sources (for example, pre-dating the Multi-Coloured Manual). In such cases, you would normally need to update the approaches to use the information so you may only be able to use some of the initial data and assumptions. • data are robust, from reliable sources and referenced (where applicable). • data are comprehensive and any decisions have been made based on a good data set (where economic, environmental and social issues have all been taken into account during decision-making). • consider the level of detail used and if this matches the level of detail required for your project.
Read more	
	Examples on data quality and relevance The quality of information may have been adequate for SMP/CFMP or strategy but may be to high level for detailed project appraisal. i) The erosion rates defined in an SMP may have been assessed at a large scale. "this coast is eroding". At a detailed level the erosion rates may vary putting certain properties at risk but not others. ii) The extent of flooding may not have identified local variations in topography. It is useful to describe: • where the data have come from; • how the data have been derived;

3.3.2 Main guidance: Identify problem and key issues	
	• from your analysis of the data, why the data are considered to be of good (or bad) quality; and/or • why they are appropriate (or inappropriate) for your project. This information can be used to provide a transparent record of the data collection phase of the appraisal. The information can also be used in the sensitivity analysis when you will test the impacts of key uncertainties on the preferred solution.
Flag up data quality issues Read more	Include descriptions of the source, reliability and uncertainties associated with data taken from other sources during the appraisal. Highlight any particular data quality issues. This information can be used during sensitivity analysis and helps maintain a transparent record of the appraisal process. Being clear on the unknowns and uncertainties will help to manage expectations and allow stakeholders and the public to understand the complexity of the decisions to be made.
Consider whether more data are needed Read more	Data collection and analysis can be expensive and time consuming. It needs to be justified and tailored to the project, the appraisal period and the appropriate boundaries. Where possible, any additional data collection should be co-ordinated with any other projects within the study area. Even where data are based on broad-brush analysis, this may be sufficient for your type of project. Consider whether it is really necessary to undertake more detailed assessment. Figure 3.3 summarises the thought process for deciding if to collect more data or not.

3.3.2 Main guidance: Identify problem and key issues

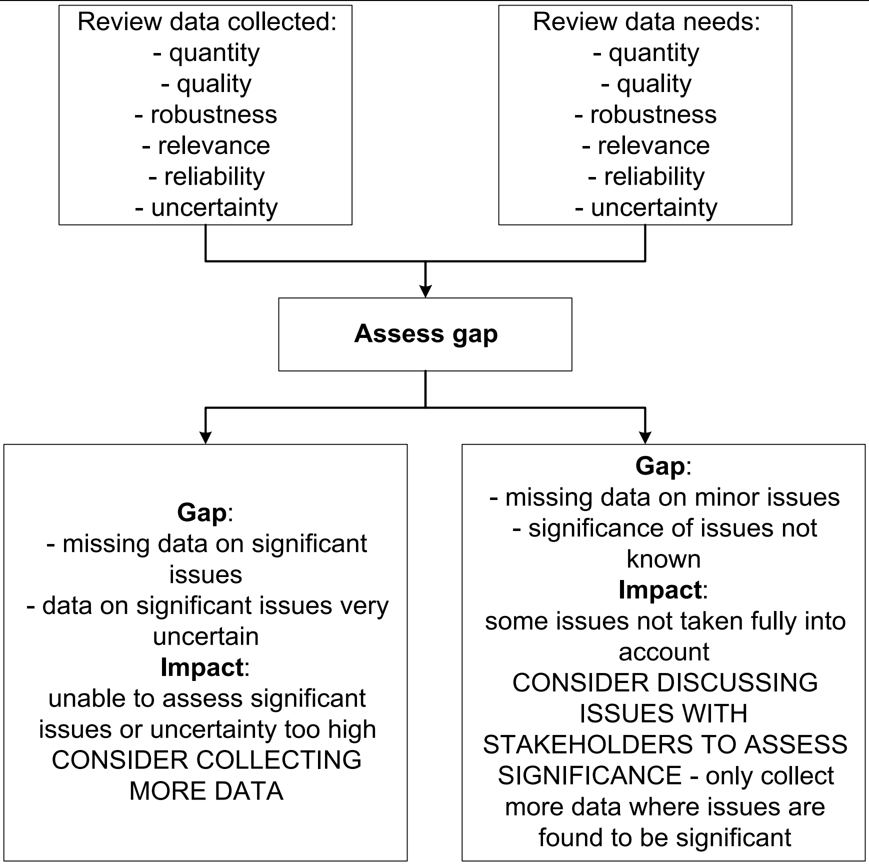


Figure 3.3 Deciding whether to collect more data

Use uncertainty to help you decide whether to collect more data

The best way to decide if additional data collection would be useful is to consider how much uncertainty there is and how this uncertainty affects the appraisal. Even if there is a lot of uncertainty associated with a dataset, but this is not that important in terms of the overall appraisal (for example, where the data are not associated with a significant issue), then broad-brush data may be sufficient. You will have an opportunity to identify where uncertainty is having a significant impact as you proceed through the appraisal, so it may be prudent to use what you have readily available in the first instance, refining it later where necessary (further guidance is provided as appropriate in later chapters). Being clear on and being able to explain the uncertainty will help you to discuss it with stakeholders and to decide whether or not to collect more data. Testing the uncertainties with stakeholders will also help to clarify the significance in being able to make and explain your decisions.

Read more

3.3.2 Main guidance: Identify problem and key issues

Use uncertainty to help you decide whether to collect more data

Appraisal is about making choices.
It is not necessarily about reducing uncertainty.

- **are the data from scientific studies or based on anecdotal evidence?** At what level is one better than the other?
- **what timescale have the data been collected over (for example, over several years or specific seasons)?** Does this cover the full range of variation?
- **is it easy to understand how the data have been used in the study?** What has it been used for?
- **are the data presented clearly making it easy to extract what you need?** What do you need?
- **are data combined such that you cannot easily determine what the data refer to (or where)?** Is it fully relevant?
- **is there information on uncertainty associated with the data?** How critical is this to your use of the information in making choices?

You need to ask yourself these, and similar questions, when assessing if additional data are likely to be useful or not.

Sensitivity testing is an on-going process

Consider waiting before collecting more data

The choice on whether to collect more data or use what is readily available does not need to be made at this point. Appraisals can be iterative so you can collect additional data beyond that which is available from other sources and include it in the appraisal later as necessary (see Figure 3.4). This will help reduce the amount of time that is spent collecting and analysing information that is not significant to the decision.

Read more

3.3.2 Main guidance: Identify problem and key issues

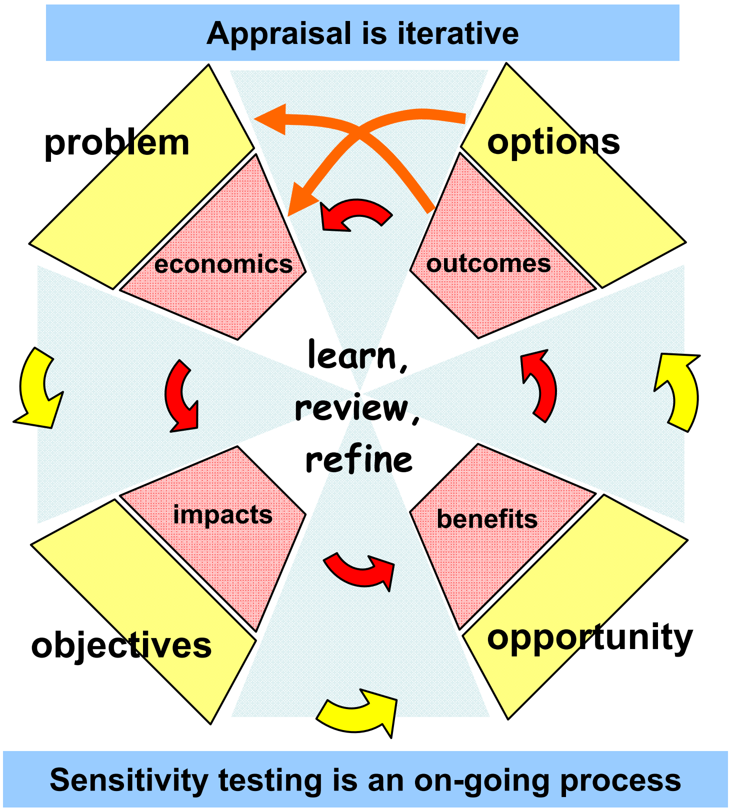


Figure 3.4 The need for new data as part of the process of learning

Identify constraints and opportunities

One approach to identify constraints and opportunities is a workshop involving key stakeholders and asset managers. This can include discussions on problem definition in general and identification of constraints and opportunities should be stressed. Your assessment of engagement risk and SEP will help you to decide if this is the best approach for your project. It is useful to do this when setting the project objectives, see Chapter 4: Set objectives.

Read more

Identify constraints

Constraints are those factors that affect which options could be implemented. They can also be used to help identify the key criteria that will make the difference between the options that are being appraised. It is important when identifying constraints to make sure that they are real issues and not ones that could unnecessarily limit your choice of options later on. Real issues include legal constraints, such as the need to update the non-compliant electrical elements of pumping stations or to protect designated environmental sites.

3.3.2 Main guidance: Identify problem and key issues

Example constraints include:

- legal obligations, for example, to protect designated environmental sites (including SACs, SPAs, SSSIs) or health and safety;
- presence of listed buildings or scheduled monuments
- commercial activity, such as docks;
- alignment of roads and railways;
- tourism and access needs;
- needs of the community in terms of protecting the nature and aesthetic setting of their homes;
- development along the river or coast that prevents or reduces access; and
- morphological or sediment issues.

This list is not exhaustive.

Read more

Identify opportunities

Consider where there are opportunities to deliver wider benefits that address issues highlighted in plans or programmes, during engagement or through involvement of project partners. Partnership working could help to draw in additional resources and, potentially, contributions.

Examples of potential opportunities include:

- habitat improvements, for example, creation of BAP habitat;
- improvements to the setting of historic properties
- opportunities for development of riverside walks and amenity areas;
- provision of a footbridge across the river that would provide a short-cut to the town centre or other amenities;
- rebuilding a road bridge to reduce flow constriction in the river and, at the same time, building a bigger bridge that is better able to cope with traffic flows; and
- opening a culvert where it is no longer required, and restoring the watercourse.

This list is not exhaustive.

Read more

Move to establish appraisal period OR
Check you have completed the expected outputs

3.3.3 Explanation and further guidance: identify problem and key issues	
The need for a clear statement of the problem Return to main guidance	The description of the problem focuses on what the risks are (probability and consequence) and when these risks are expected to occur. It needs to explain how the existing level of risk is predicted to change and why. A comprehensive description of the problem and a clear reason explaining why the project is needed will give you a good feel for the area. This will help you when you identify the preferred solution as you will be able to verify the option suggested by the economic appraisal against your own logic. A good understanding of the area and the problem will also mean that you are better placed to verify that data have been interpreted correctly and that any trends or changes that have been predicted are reasonable.
Risk Return to main guidance	Risk analysis involves investigating the possible ways in which an option could behave in future and attaching probabilities to all of those future scenarios. So, for example, a risk-based assessment of a fluvial flood defence project will involve predicting its performance in a number of hydrological events with different probabilities of occurrence. This risk analysis will calculate the average risk associated with each option, often expressed in economic terms (quantitative or qualitative). The benefit of a flood or coastal defence project derives from the extent to which it reduces risk to the developed and natural environment. Each option will have some cost associated with it, which is also uncertain. The decision maker is therefore in a position of balancing risks and costs. The expected value of any option can be thought of as the average predicted benefit in terms of risk reduction less the average predicted cost. Risk assessment is critical to inform and support decision-making. Furthermore, it is very important to follow risk assessment through into risk management, as even if based on perfect risk analysis (which of course is not achievable in practice), risk-based decision-making will only pay off in the long run if risk mitigation, monitoring and response strategies are in place.

3.3.3 Explanation and further guidance: identify problem and key issues	
Take account of future change in risk Return to main guidance	Future changes in risk due to, for example, sea level rise, deterioration of defences, or development could make the problem worse or change the problem. It is important to make sure you have identified any positive impacts that might occur as risk changes into the future (such as environmental benefits). If you do not take future risks into account, you may not identify the full impacts over the whole appraisal period. This could mean that the 'best' solution, including opportunities for adaptation is missed from the appraisal. **Example consequences** Failure of defences along the River Zed will lead to flooding of the 200 properties including the retirement home and local hospital. This would mean that the properties would become uninhabitable. Sea level rise means that the probability of overtopping of coastal defences will increase. This will benefit a grazing marsh in the short-term by reducing the amount of scrub that is encroaching into the area. Over time, the defences may fail. This is likely to result in the grazing marsh reverting to mudflats and saltmarsh. While this will lead to important intertidal habitat gains, it will also result in important freshwater habitat/grazing marsh losses.
Do not prejudge the solution Return to main guidance	It is essential that the description of the problem does not set the solution. This is more likely to occur when setting objectives than in the description of the problem. Be careful when describing probabilities of risks to make sure you do not include any reference to an 'acceptable level'. At this stage, just state the probability and consequences.
Example of a poorly defined problem	**An example of a poorly defined problem that could prejudge the solution could be**: There are 200 properties at risk of flooding from the River Zed with an annual probability of flooding that is **less than the locally acceptable probability of 0.01**. Inclusion of this last phrase (in bold) prejudges the solution as any options that did not reduce the probability to 0.01 could not be preferred. An appraisal showing that 0.01 is the most economically efficient solution has not been undertaken. Therefore, the problem prejudges the solution. A better definition would be in explaining the negative

3.3.3 Explanation and further guidance: identify problem and key issues	
Return to main guidance	consequences, identifying the different aspects of the problem.
Work with project partners Return to main guidance	Working with project partners will help you to: • understand the problem, interactions and consequences in a way you may not have considered; • identify issues that you might not otherwise have included; • find and use data sources that you might not otherwise have identified; and • identify potential to bring in contributions from other sources where you are able to deliver wider objectives.
Using data from other sources Return to main guidance	Do not be afraid to use broad-brush data from other sources in the first instance. It is important to remember that data used in other studies (especially those that are not focused on flood and coastal erosion risk management) may not include all the impacts that are important for your project.
Using data from higher level studies Return to main guidance	Information from higher level studies may be broad-brush, but this can still help you to identify which impacts are most significant. You can use this information during data collection to make sure your efforts are focused on those areas that are more likely to affect the choice of preferred option. For example, you could spend a lot of time assessing the damages of road disruption only to find at the end that the impacts are small (say £100s of pounds), which would be negligible in terms of choice of the preferred option if damages to properties are £100,000s or £millions.
Data from local people Return to main guidance	Local people can be a source of help, knowledge and expertise. Do not underestimate the understanding that those living in the at-risk area have of the risk, processes and consequences. You can collect and use information from stakeholders to help you understand local needs and attitudes. Differentiate between factual information and hearsay. Information based on hearsay which is considered important always needs further investigation to ascertain validity.
Collection of new data Return to main guidance	If you find one or more impacts are key to the appraisal (where uncertainty over a particular impact means it is not possible to describe the problem), you can collect additional data at that point to help you define the problem.

3.3.3 Explanation and further guidance: identify problem and key issues	
Be prepared to accept some uncertainty Return to main guidance	Beware though as you will never be able to collect enough information to enable you to make a *certain* decision. There will always be some uncertainty. It is not necessary to reduce all uncertainty but make a note of the uncertainty for testing later in sensitivity analysis (or as a pointer on where to collect more information if you find this is a key factor later on in the appraisal).
Deciding when to collect more data Return to main guidance	You should ask questions on whether, and the extent to which, additional information: • will help you to better understand the problem or the processes? • will help you to describe the impacts? • will reduce the level of uncertainty? • will be relevant to the project and the level at which the project is being undertaken (strategy or scheme)?
Check the quality and robustness of data	It is important when using any data (whether taken from another project or not) to assess the reliability of the data. The most reliable data are usually those that have been collected or generated using best practice or standard methods. They are often accompanied by an indication of the uncertainty associated with them and a description of how they have been collected or developed. Beware of using data that are reported as 'certain' or which are not accompanied by a description of how they have been collected or derived. You must check how robust and reliable the data are, and that any assumptions that have been made are verified or explained. This can be done by looking at how the data has been referenced and how it has been collected. For example: • are the data from scientific studies or based on anecdotal evidence? • what timescale(s) have the data been collected over (over several years or specific seasons)? • is it easy to understand how the data have been used in the study? • are the data presented clearly making it easy to extract what you need? • are data combined such that you cannot easily determine what the data refer to (or where)? • is there information on uncertainty associated with the data?

3.3.3 Explanation and further guidance: identify problem and key issues

You need to ask yourself these, and similar questions, when assessing if the data are likely to be useful or not. It is useful to describe:

- where the data have come from;
- how the data have been derived;
- from your analysis of the data, why the data are considered to be of good (or bad) quality; and
- why they are appropriate (or inappropriate) for your project.

This information can be used to provide a transparent record of the data collection phase of the appraisal. The information can also be used in the sensitivity analysis when you will test the impacts of key uncertainties on the preferred solution.

Return to main guidance

Anecdotal data

It is important that the problem is described based on a logical assessment of the risks and consequences. Take care when using anecdotal information that the risks are not influenced by perceptions of what the risks might be. If you have anecdotal information that differs from a technical assessment of the risks, you should double check the risk assessment and any associated predictions of impacts (for example, from modelling) to help verify whether the technical assessment needs to be revised.

Return to main guidance

Examples of anecdotal data

Factual information typically includes:

- the flood level at the peak is as drawn or indicated on the local pub wall (be aware though that the flood level indicator could have been moved during redecoration!);
- the flooding followed a week of very heavy rainfall;
- a large tree blocked the culvert below Road X;
- the flood water was about an inch from the top of the defence, but did not overtop.

Hearsay can include:

- I'm sure someone forgot to open the penstock, that's why the flooding occurred;
- we wouldn't have been flooded if the river had been dredged;
- I'm sure the new motorway or development caused
- this flooding.

3.3.3 Explanation and further guidance: identify problem and key issues	
Social and environmental data Return to main guidance	All of the principles defined above similarly relate to the collection, review and use of social and environmental data. Useful descriptions of data requirements can be found in guidance referenced in the supporting document on environmental assessment.
Set the quality criteria for the project Return to main guidance	The description of the problem is used to help you begin to describe what would happen under the do-nothing option. It will also help you to explain why the project is needed.
Identify constraints Return to main guidance	Care is needed when defining constraints that they are real. Issues such as the need to rebuild a floodbank because it carries a footpath may not be real. The footpath could be realigned or relocated such that it would not necessarily have to be on the existing defence line. Strategies and policies may also highlight key constraints and opportunities that you could use to inform your appraisal. Key issues highlighted in SMPs, CFMPs or the strategy can also be used when developing and short-listing options and provide reasons that you can refer to if you are screening out options. This approach will also help ensure that there are strong links between the SMP, CFMP or strategy, other relevant studies and the project you are appraising.
Identify opportunities Return to main guidance	Engage with local people, organisations and potential project partners to identify if they have needs and aspirations within the locality that will be affected. If they are planning other activities there may be opportunities to develop partnerships. If this is the case then it may be possible to deliver more objectives (see Chapter 4: Set objectives), save project costs through approaches to joint working and phasing or deliver their objectives through the project with the provision of financial resources from third parties with interests.
	Move to establish appraisal period OR Check you have completed the expected outputs

3.4 Establish appraisal period

3.4.1 Expert summary: Establish appraisal period	
Appraisal Period Read more	The appraisal period is usually taken as 100 years unless the life of the asset(s) (taking maintenance into account), or the potential to predict future events is such that a shorter or longer time frame is more appropriate. The reasons for using a shorter or longer time period must be recorded. **Move to set the boundaries** OR Check you have completed the expected outputs

3.4.2 Main guidance: Establish appraisal period	
100 year appraisal period - unless different period can be justified Read more	The appraisal period is usually taken as 100 years (for both strategies and schemes) to allow appropriate comparison of options. Justification should be included where a different appraisal period has been used. It is essential though that the same timeframe is used when assessing the costs, benefits and damages of all options. The timeframe needs to be considered in relation to the decisions being made. The decision must take account of the implications of that decision at different timescales. For example, does it close down future options for management or does it influence other decisions which may affect management over a longer period of time?

Examples of justifiable reasons for using a different appraisal period

- timeframes that have been extended or shortened because of the physical life of the assets in question (taking into account maintenance), to tie in with future strategic works. Read more
- long-term geological changes to the coast require a longer-term perspective to be taken into consideration even if it cannot be precisely assessed. Read more
- where the rate of change in either natural or man-made systems is high (due to erosion for example) and it is not be practical to make predictions over a timescale of 100 years, and a rather shorter time horizon is more appropriate. It may be possible to test the impact of uncertain predictions through sensitivity analysis. Read more
- community need or community opposition in the light of uncertainty in data.

3.4.2 Main guidance: Establish appraisal period	
Impact of shorter or longer appraisal periods Read more	Using a shorter timeframe (such as 50 years) would mean that costs or benefits that occur after 50 years are not taken into account and this could affect which option is identified as preferred. For example, short time horizons can bias the economic appraisal against options that cost a lot now but which are less expensive to maintain, which provide significant benefits, and/or may be more sustainable over a longer timeframe.
Using shorter appraisal periods	Where shorter appraisal periods are used, the analysis may have to take account of residual values of assets. This means that you would have to calculate how much the assets could be worth at the end of the appraisal period and subtract this from the costs. The residual value is the value of the asset minus any depreciation in value that has occurred over its life to date.
Read more	You may also want to note down any longer term impacts that are not taken fully into account to ensure these are considered during decision-making.
Appraise on an equal basis Read more	All options have to be appraised over the same time period such that they can be compared on an equal basis. If one option includes assets with shorter lives, then the asset will need to be replaced at an appropriate point in the future (for example, an asset with a 60 year life would be replaced in year 59 while an asset with a 20 year life would replaced in years 19, 39, 59 and 79).
	Move to set the boundaries OR Check you have completed all the expected outputs

3.4.3 Explanations and further guidance: Establish appraisal period	
100 year appraisal period	It is usually appropriate to consider project appraisals up to 100 years because: • the Treasury Green Book suggests the use of an appraisal period that reflects the useful lifetime of the assets included in the options being appraised. For options typically considered within flood and coastal erosion risk management, a timescale of 100 years is considered appropriate; • policies that can be shown to be sustainable over this period may be more likely to be sustainable in the longer term. A 100 year appraisal period requires flexibility to be considered during the appraisal and for

3.4.3 Explanations and further guidance: Establish appraisal period

- options to be robust or adaptable to uncertainties; and
- it is difficult to predict social, environmental and economic impacts over 100 years. You should consider the additional uncertainty that would be added by making predictions over longer time periods. In most cases, it is not feasible to make reasonable physical or social predictions over a significantly longer time interval (some coastal processes can be an exception to this).

Return to main guidance

Physical life of the asset

The physical life (with maintenance) of the longest-lived asset under consideration in the appraisal is also important and can affect the appraisal period. There is a general presumption that projects involving major earthworks, concrete or masonry structures should assume that the life of these assets would be 100 years. Conversely, projects that primarily include assets with significantly shorter lives (such as mechanical plant) may be appraised over shorter appraisal periods.

Return to main guidance

Predicting future events

It can be difficult to predict future events over a 100 year timescale, though. Recording any uncertainties and assumptions made in your future predictions will help when you come to sensitivity analysis as you will already have an idea where some of the key uncertainties may lie. It will also help in identifying what monitoring is required over time to check the assumptions made.

Return to main guidance

Impact of shorter or longer appraisal periods

Shorter appraisal periods can mean it is more difficult to justify solutions that provide environmental benefits, or that adapt to future changes because the total value of any benefits is much less (summed over, say 50 years, rather than 100 years).

Longer appraisal periods allow more of the environmental and adaptation benefits to be included. However, discounting result in benefits (and costs) that occur further into the future having less influence on the choice of preferred solution. Therefore a balance is needed between taking full account of future changes and the influence of these changes on decision-making. The risk with longer time periods is the additional uncertainty that is introduced by predicting further than 100 years.

Return to main guidance

Using shorter appraisal periods

It is important to take residual value into account when a flood or coast protection asset (such as defences, pumping stations, sluices or barriers) is not at the end of its useful life. Otherwise, there is a risk that the costs of the option would

3.4.3 Explanations and further guidance: Establish appraisal period	
Return to main guidance	be over-estimated (when compared with other options whose assets may be at the end of their life). This can unfairly influence decision-making. The accurate assessment of residual value requires additional tasks and can be problematic so you need to consider whether this provides a better outcome than extending the appraisal period. Discounting means that it will not always be worthwhile spending a lot of time calculating residual values (see also: 7.5: Discounting).
Appraise on an equal basis Return to main guidance	Assessing options over different appraisal periods makes it very difficult to compare options. If the costs of one option are over 50 years and another are over 80 years, while the benefits are estimated over 100 years, it will not be possible to compare the options fairly. You should make sure that both the costs and benefits of all options are estimated over the same appraisal period.
	Move to set the boundaries OR Check you have completed all the expected outputs

3.5 Set the boundaries

3.5.1 Expert summary: Set the boundaries	
Set the boundaries Read more	Set the project boundaries taking into consideration the scale of the problem (strategic or local), processes, mechanisms that result in the risks (sources), impacts and consequences for the at-risk area (receptors), including the area likely to be affected by any intervention to the system. If any 'boundary conditions' are applied then these should be described and they may require review as the appraisal progresses.
Link the boundaries to higher plans and the environmental assessment Read more	Link the boundaries to the SMP, CFMP and strategy (where applicable or available) as well as other high levels plans and the environmental assessment. It is usual for the boundaries in the environmental assessment to extend wider than the appraisal boundaries, and to differ according to the receptor being considered.
Be aware of community needs Read more	You should discuss boundaries with stakeholders. Be aware of community needs and community identity which may extend wider than the appraisal boundary in terms of assessing potential opportunities and constraints.
Consider the need for flood cells Read more	Consider the use of flood cells or lengths of coastline that protect specific assets, taking into account the potential for individual as well as strategic solutions. Make sure that the damages are attributed to individual flood cells or lengths of coastline in such a way that double counting does not occur.
	Check you have completed the expected outputs

3.5.2 Main guidance: Set the boundaries	
Defining spatial extent	The boundaries need to be set so they capture the extent of the problem. This includes major processes, impacts and consequences such as: • location and size of areas at risk; • types of land use and assets at risk (including properties, critical national infrastructure, community infrastructure, and environmental assets); and • economic and environmental factors (including physical, hydrological, geological, geomorphological, topographical, and social information) that provides the national, regional and local context.

3.5.2 Main guidance: Set the boundaries

To set the boundaries you need to have a broad understanding of what floods or is at risk of coastal erosion, the extent of physical processes, what floods or erodes first and what the subsequent mechanisms are. Understanding this may provide clear boundaries based on the extent of flooding or coastal erosion and whether there are interrelationships or not. In the coastal erosion setting, it may be necessary to extend boundaries beyond the erosion area to include the sources of sediment. Information collected and used to set the boundaries will help you to define the problem in terms of the extent of the area affected. Reference to other river basin planning processes could be useful when setting boundaries where there is opportunity for coincidence.

Read more

Link to high level plans and policies

As with identifying the problem and key issues, high level plans may provide information to aid the selection of boundaries when these may be extensive. Large-scale plans may provide information that will help you determine the boundaries. Some plans (in particular, SMPs or CFMPs) may define units that you can use in strategies. Strategies may define the units for a scheme appraisal.

Read more

Understanding the system – understanding the boundaries

A small independent catchment with steeps sides and a flat valley bottom contains three small towns along the river. The river flows south to the sea where there is wide flat hinterland.

Although the settlements that are subject to flooding are small and independent, the boundary had to be set at a catchment level due to the impacts of works in one area on the increase in attenuation (containment of the river) or back up of water (storage area) affecting up and downstream areas. This was investigated in a strategy, which provided an overview of the behaviour and the approach for each of the solutions in the areas.

3.5.2 Main guidance: Set the boundaries

Setting the boundaries

For many projects, the boundaries may be reasonably obvious based on topography and catchment, existing defence systems (for example, from the AMP) or other structures (such as bridges). In others, it may be difficult to know where to draw the boundary lines. In such cases, it may be preferable to begin defining the boundaries by identifying how natural processes work (including along the coast, fluvial processes, or the drainage system). Consider also the floodable areas and erosion lines to work out how far the direct impacts may extend. Take account of community boundaries, which may be inconsistent with physical boundaries.

Example for setting the boundaries

A flood cell boundary may stop halfway through a parish due to a change in topography and even if the other half of the parish was at risk we would consider them separately. This is illogical to the community as they are one parish and should be considered as a whole in terms of our work with them to find a solution to manage the risk.

3.5.2 Main guidance: Set the boundaries

Discuss boundaries with stake-holders

It is important to discuss how and why boundaries have been set with stakeholders, as set out in the Stakeholder Engagement Plan (SEP). Stakeholders may suggest different boundaries, especially when sub-dividing the project area, linked to their understanding and knowledge of how the area operates (economically and socially). The identification of opportunity objectives (see Chapter 4: Set the objectives) may assist in defining the scope and extent of the area needing to be considered.

Read more

Example of boundary discussions with stakeholders

If separate flood embankments are proposed for several different villages then the protection of each village should be justified separately. Where it is possible to protect all of the villages with a single scheme such as a tidal barrage or flood storage reservoir it is still necessary to consider the option of protecting each one individually. In this case the aggregate costs and benefits of the best worthwhile individual protection schemes should be compared with those of the single scheme.

Sub-dividing the project area into flood cells or lengths of coastline

In some cases, the appraisal will depend on whether the solution is a single project or a series of independent projects, where the defence assets protect individual and independent areas. In such cases, it may be necessary to sub-divide the project area into a number of 'cells'. These can reflect independent flood areas or lengths of coastline protecting specific assets. It is preferable to sub-divide the area into cells that are completely independent but often this is not possible due to the nature of the area at risk.
Read more

You should try to use features that result in each area being a separate cell from its neighbours, using, for example, high ground or structures such as road or rail embankments, or bridges that constrain the movement of water from one area to another. Care needs to be taken when considering community boundaries. Appraising large areas is preferable to dividing areas on an artificial basis as this can make it difficult to determine which impacts are caused and when, and how to divide benefits up across the areas.

Read more

3.5.2 Main guidance: Set the boundaries

Use features of the area to identify cells

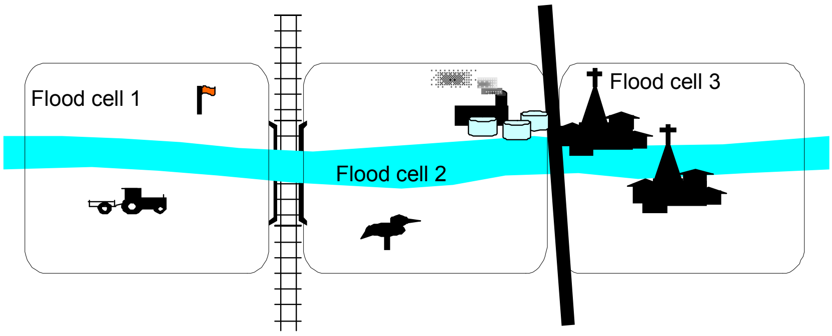


Figure 3.5 Interacting flood cells

If a project has been divided into flood cells then it is usual to assume that they are independent in the appraisal. Any linkages between them should be noted as this will have to be taken into account when comparing and selecting options. Beware of political and social implications associated with justifying different standards in adjacent flood cells or on opposite banks of a river in a city or town. Although political influences should not (in theory) affect your appraisal, there may be distributional and fairness issues associated with varying solutions to different parts of a community.

Read more

Example of interacting flood cells

Flood cell 1 in Figure 3.5 is hydraulically independent of flood cells 2 and 3 due to the bridge and railway embankments. Flood cells 2 and 3 have been divided along the line of the road, although they are not independent. Flooding up- or downstream of the road (from breaching of the embankments along the river) could affect the town and industrial estate. The decision was made to separate the area into two flood cells to reflect the different land uses. There may also be potential to use a washland on the south side of the river in flood cell 2, which would not be possible in flood cell 3 due to built-up areas alongside the river.

From a different perspective, there may be interconnection between flood cells in terms of land use. The industrial area may be an important employer of those resident in cell 3. The golf course in cell 1 may provide an important amenity value to the area. The agricultural output of the area as a whole may be significant at a regional scale.

All aspects have to be brought together at different scales of analysis in determining the boundaries of the appraisal.

3.5.2 Main guidance: Set the boundaries

In all cases, the reason for sub-dividing flood cells 2 and 3 should be noted and used when developing and appraising options and when comparing and selecting the preferred solution.

Influences from outside the project area

An option may have an influence outside that of the immediate area of the project, but, in addition, the consequences of the different options may depend upon what happens outside the project boundaries. For example, urbanisation of the catchment upstream of a project could have an effect upon the flood risk in the project area (although this should be controlled under PPS25/TAN15 with new developments expected to be neutral in terms of increased run-off). Alternatively, it may not be practicable to extend a coastal study boundary to include an important distant source of sediment. All appraisals of the consequences of the different options will therefore be conditional upon the assumptions made about these external or boundary conditions. The assumptions made should be realistic and not simply convenient.

It may be necessary to use different boundaries for different purposes. For example, the area of economic benefit may not coincide with boundaries associated with coastal processes or environmental impact. Also, options could take place outside the project boundaries, for example, non-structural upstream solutions such as land management. The significance of this needs to be taken into account in the appraisal. How the various implications are dealt with in the appraisal, how the boundaries may then be set needs to be recorded. If during the course of the appraisal issues arise that reinforce the external impact, the boundaries might need to be adjusted.

Read more

Combining areas because of planning issues

It may also be necessary to combine areas because of planning issues, for example, where a project in one location would have to be mitigated in a second location. In such cases, it can be easier and more efficient to address both problems at the same time (even where the funding is from different sources).

3.5.2 Main guidance: Set the boundaries	
Example factors to consider when setting the boundaries	**Example factors to consider when setting boundaries** • A project for a **chain of defences** to a low-lying area will need to consider all elements that contribute to the defence chain. For an inland drainage area it may be necessary to assume that the defences, or defences to adjacent areas, will be maintained unless there is an identified long-term plan for their abandonment or realignment. In some cases (for example. Levels, Fens), the impacts of do-nothing can extend over a very wide area (ideally requiring a strategic solution) but if a strategic solution is not defined it may be necessary to set virtual boundaries such as using roads. A full description and explanation of why this has been done and the consequences for other areas will be required. Read more • A **flood risk** management **project** for the **middle reaches of a river** may not necessarily need to consider the whole catchment, provided that upstream and downstream boundaries are defined with known inputs and outputs that remain unchanged by the project. Any potential increase in water levels downstream can mean it is necessary to consider impacts over a larger, more strategic area, extending far downstream due to the need to manage the risks downstream. Consideration will also need to be given to uncertainty, which may require a precautionary approach. Read more
	• Where there are strong geomorphological links between sections of the coast, such as where harbour structures either constrain sediment drift or retain the stability of a section of the coast, a **coastal management strategy** should consider the functioning of the whole sediment system taking account of impacts on source and sink areas. In particular, the boundaries should be set to capture the area of influence or extent of significant impact on management of the area or on the management of other areas. The appraisal should also include all features that materially affect the management of the strategy area. Read more • A **coast protection scheme** along part of a frontage that is protected by defences should identify the extent of the effects of the defences and determine if their presence is significant to the effectiveness of any management approach, especially if there could be positive or negative impacts on adjacent areas of coast or different effects on rural or urban areas. The SMP

3.5.2 Main guidance: Set the boundaries	
Read more	• management unit should provide the appropriate boundaries although the extent of the effects at scheme level also needs to be taken into account. Read more
Be flexible with the boundaries when exploring potential solutions Read more	You should explore different solutions that may involve combining benefit areas in some cases. Be prepared to be flexible with the boundaries, especially when developing options. You should not be constrained by boundaries set at the outset of the project if options arise that require a change to the boundaries. It is important that your appraisal does not become too focused on solving individual problems or even providing one solution for all. Look instead for solutions that would deliver the greatest economic, environmental and social benefits (see Chapter 6: identify, develop and short-list options).
	Check you have completed all the expected outputs

3.5.3 Explanations and further guidance: Set the boundaries	
Defining spatial extent Return to main guidance	The boundaries are set to capture the significant processes, impacts or consequences because this ensures that the full extent of the problem is considered during the appraisal. Sometimes, though, including **all** the impacts (positive and negative) could lead to boundaries that are very wide such that the appraisal could become unwieldy. It is necessary, therefore, to balance the different issues that affect the boundaries (see Figure 3.6). Where some of the processes, impacts or consequences extend outside the boundaries set for the project, you will need to consider whether any one process, impact or consequence is felt wholly within the project area or partly within the project area. If partly, you will need to decide which proportion of the process, impact or consequence should be included and which proportion should be excluded. This can add to the complexity of the appraisal but is a useful approach where the boundaries of the process, impact or consequences are otherwise too large to be workable. You should use the environmental assessment to help you determine what is inside or outside the project boundary. The boundary of environmental impacts for receptors may be different to the project boundaries. For example, there may be legal requirements which require consideration of impacts outside the project boundaries.

3.5.3 Explanations and further guidance: Set the boundaries

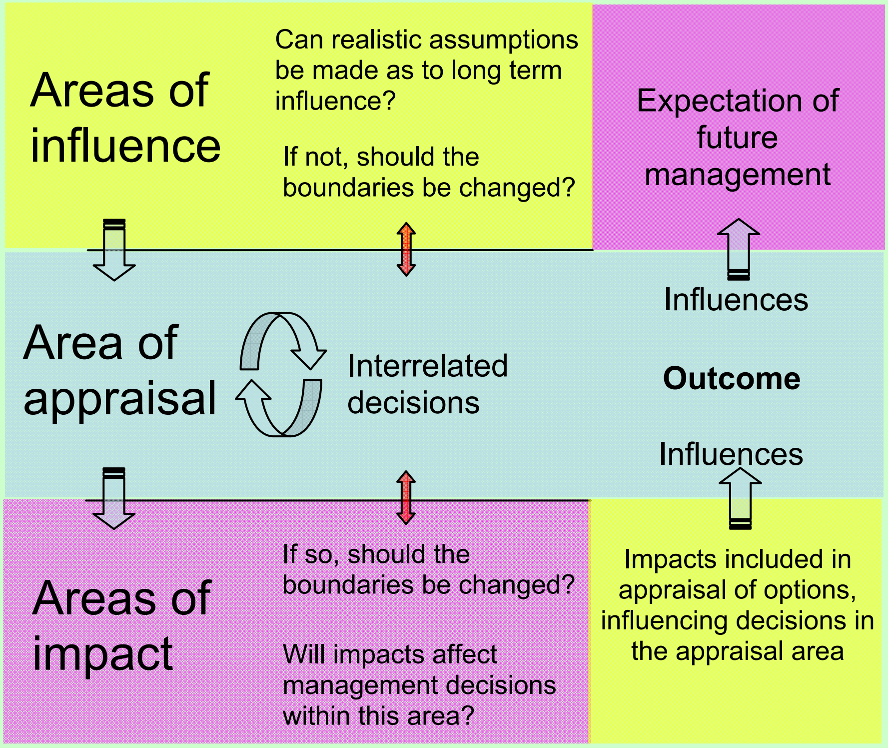


Figure 3.6 Influence and Impact affecting setting of boundaries

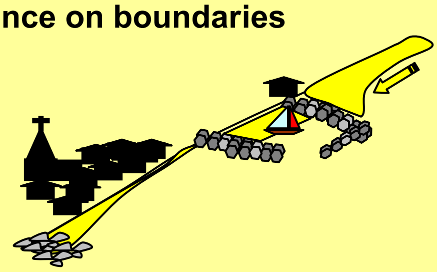
Links to large-scale plans for strategies

SMPs and CFMPs should include policy management units that will describe (more or less) discrete areas. Using these boundaries to define the strategy boundaries means it will be easier to use information and data contained in the SMP or CFMP. An added advantage is that direct links will be made to the SMP, CFMP or strategy. One possible drawback is that the management units identified at a higher level may not be totally appropriate for at the strategy level. You may need to make some adjustments to the boundaries where more detailed consideration shows that an area should be sub-divided into flood cells or separate lengths of coastline.

Return to main guidance

Higher Level Plans influence on boundaries

The SMP indentified the significance of the harbour in influencing sediment drift to the town but also the potential for the harbour to resist erosion.



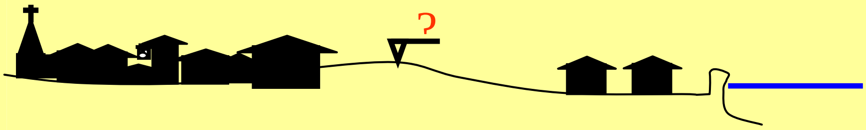
Although the area comprised several policy units, the SMP highlights the need for the area to be considered as one management area for the strategic appraisal.

3.5.3 Explanations and further guidance: Set the boundaries	
Links to strategy plans for schemes Return to main guidance	Strategy plans should also include smaller units within them that you can use when defining the boundaries of a scheme. As with SMPs and CFMPs, this can simplify the links and allow you to use data directly from the strategy, but beware that slight adjustments may have to be made when you are looking at the area in greater detail. You will also need to take account of interactions between policy areas (this should be identified in SMPs and CFMPs).
What to look for to help you sub-divide the project area Return to main guidance	In fluvial floodplains, you should look for natural or man-made bottlenecks that could constrict flows if you need to sub-divide the floodplain (using, for example, bridges, road or rail embankments, high level carriers, canals and counter or cross walls). Confluences of tributaries are also good points at which to sub-divide catchments (where smaller areas are needed) as the upstream area will have different flows from downstream of the confluence.
Discuss boundaries with stakeholders Return to main guidance	It can be useful to divide areas by receptors (for example, where individual villages or parishes are included in separate units) although they may need to be combined at a later stage if they are in a common benefit area. You should always confirm the boundaries with stakeholders to make sure that these are logical and understandable.
Sub-dividing the project area by land use Return to main guidance	In coastal areas, sediment cells may be based on long stretches of coast. Smaller areas may need to consider the influence of promontories (natural or man-made) on sediment transport. This influence may have already been identified in the shoreline management plan or defined as water bodies in the river basin management plan. It is rarely acceptable, however, to sub-divide the coast on the basis of land use areas (for example, villages, agricultural land or caravan parks); there may be strong physical, social and economic interactions between such areas. Each component of the coastal (or estuary) system has to be considered to establish how they interact and how they contribute value to management of the area (supply of sediment, contributing to the social, environmental or economic structure). This interaction can be at a large scale through to the local scale.

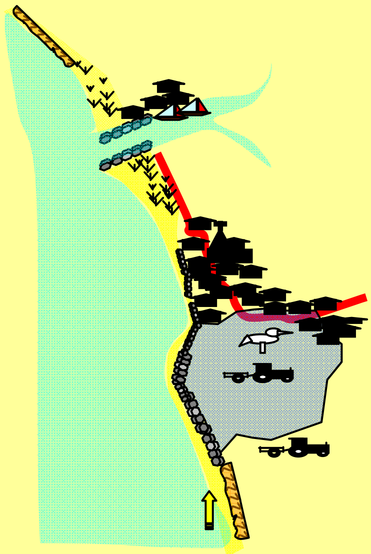
3.5.3 Explanations and further guidance: Set the boundaries

Strategy influencing scheme boundaries

Town G has developed in two areas of lower lying land separated by a ridge. The main town lies behind the ridge, with few properties to the front. In assessing potential solutions, the level of the ridge, in relation to water levels and flood risk, is critical to decision-making. A strategy would define the extent of detailed appraisal. Is the front line defence only defending the front line properties or should it take account of the wider issues associated with the main town?



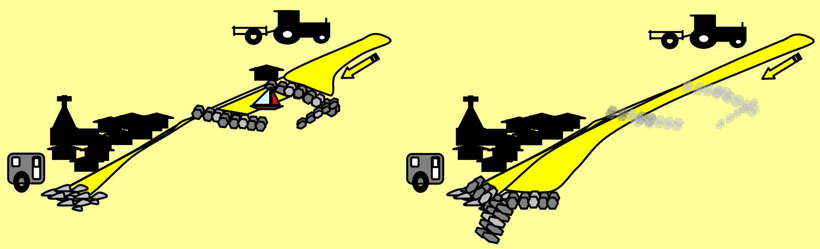
Town H has been hit by a major winter storm. The reveted flood defence to the south of the town was damaged, with risk of breach. Within the emerging strategy the medium term policy with respect to this defence is for removal of the structure and setting back the defence in this area to protect property and the road behind. The aim of setting back the defence is to re-establish a more naturally functioning coastline. The intent is still to manage flood risk to the area behind. It is assessed that the forward line of the defence will not really impinge on coastal processes for some 20 to 30 years; this is being monitored. The strategy has defined the timeframe within which to appraise actions required to safeguard property over the short term and therefore, also, the physical extent of the appraisal to that of addressing the only integrity of the revetment. Works to achieve this may be developed under a Framework for Action, spanning the gap before the strategy policy was implemented.



3.5.3 Explanations and further guidance: Set the boundaries

Dividing the coast with purpose

In Village F, the supply of sediment to the village comes from the erosion of cliffs to the north, but is held up by the old harbour structures. The caravan park to the south is suffering from erosion. The caravan park is an integral part of the tourism value to the village. The harbour does provide beach launching facilities to a small number of local fishermen, who provide fresh fish to the village restaurants.



Scheme options may include defending the caravan park as a means of retaining the beach in front of the town (not specifically for the benefit of the caravan park). The new defence structure might also provide suitable area for relocation of the beach launching facilities. The old harbour might be removed to restore sediment drift but accepting loss of individual properties and increased erosion to agricultural land. All these issues need to be considered within a scheme appraisal. The controlling features need to be understood, in terms of the physical, social, environmental and economic issues.

Pumped drainage systems
Return to main guidance

Projects associated with pumped drainage systems will need to consider the areas drained by individual pumping stations as well as the whole area affected. Drainage systems can be more complex if they cross more than one fluvial catchment.

3.5.3 Explanations and further guidance: Set the boundaries

Separate components of a Pumped Drainage System

An extensive area of low-lying land is served by a main pumping station. This is supported by a number of additional smaller pumping stations that raise the water up to the main river. The main pumping station forms part of a network that interacts and complements each other. The wider network was being assessed by a strategy. The main pumping station would not be assessed in relation merely to the area it serves but with respect to its role within the whole catchment area. It might be argued that there was a need to take a do minimum approach in support for the wider catchment. This would be revised once the strategy was complete. The value of maintaining individual smaller stations would need to be considered independently. Each component of the system has to be justified against its function in managing risk, not necessarily against the benefits derived from the whole system. It might be that one of the smaller pump stations could not be justified, the negative Net Present Value, for this area should not be carried forward within the assessment of the system as a whole.

Rural and urban areas

Return to main guidance

It may be necessary to sub-divide the project area according to whether they are mainly rural or urban. This is a useful approach as the solutions to address the risks in urban and rural areas may vary. You should always consider whether you can work with, rather than against, natural processes.

What to do with areas that are not independent

In deciding how to divide your project area into benefit areas, consider whether the areas are totally independent of one another. If not, you can either:

- combine areas until they are independent. This makes the appraisal easier as long as the boundaries do not become so large that it is difficult to manage; or
- keep them sub-divided but record where and how the areas are inter-dependent. You will then need to use this information when comparing and selecting the preferred solution. This is because you will need to consider if different solutions and different levels of risk could have knock-on effects to the other area(s).

Return to main guidance

3.5.3 Explanations and further guidance: Set the boundaries

Example of areas that are not independent

An urban area may flood if the defences in the town breach or are overtopped. The urban area may also flood if defences in an upstream, rural area breach or are overtopped. In such cases, you should assess whether it is the same area of the town that would be affected.

If it is two discrete parts of the town that floods, you have two benefit areas reflecting the different assets that are protected by the different defence locations.

If it is the same area of the town that floods, or if the areas are hydraulically linked, you should consider whether it is possible to provide a strategic solution or to separate the rural and urban areas as part of the solution to the flood risk.

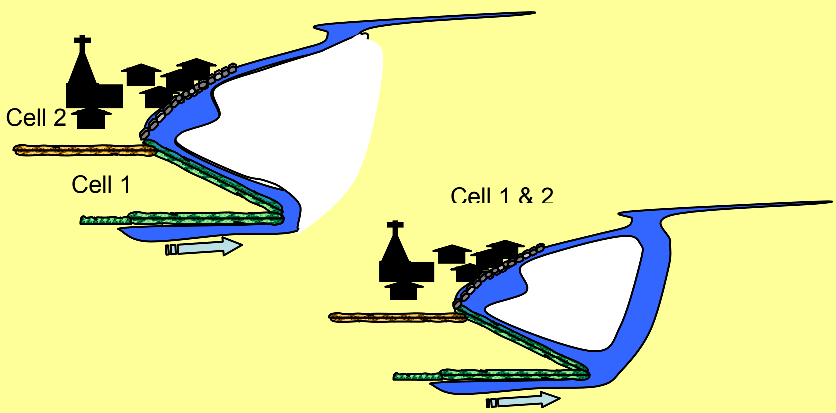
Consider strategic solutions

Return to main guidance

While you may have a number of separate areas where risk management measures can be undertaken independently, you should also consider whether a larger-scale strategic solution may be appropriate. This is important as it provides you with greater flexibility to manage the risk. As a result, you can look for solutions beyond those that may have been traditionally considered (see Chapter 6: identify, develop and short-list options).

Example of areas that are not independent continued

The town in the above example may benefit from a washland upstream, or a flood relief channel that bypasses the town, which could reduce flows through it thus reducing the risk of breaching and overtopping for both the rural and urban areas.



3.5.3 Explanations and further guidance: Set the boundaries	
Be flexible with the boundaries when exploring potential solutions [Return to main guidance]	It is important that the appraisal is flexible. This allows you to develop options as you progress and as you learn more about the project area. In this way, you should be able to move towards options that would deliver more benefits, would meet more of the objectives and potentially provide more sustainable, adaptable solutions. Being flexible with the boundaries also means you can take a proportionate approach in the knowledge that you can revise the boundaries during the appraisal should you need to.
	Check you have completed all the expected outputs

3.6 Checkpoint and outputs: Understand and define the project

Checkpoints

Assess whether it is worthwhile continuing with the appraisal in its current form by answering the following questions:

1. Is there a risk that needs to be managed?

Your description of the problem should explain why the project is required, which risks it is managing and how these risks are predicted to change over time (see: 3.3 Identify problem and key issues).

You may decide that the risk does not need to be managed at this time where:

- current risk is low (probability is low and (or) consequences are small);
- uncertainty over current risk is high; and (or)
- future risks are uncertain.

In such cases, it may be preferable to undertake a period of monitoring to measure how risk is changing. You could undertake appraisal at a later date when knowledge of the risks, and how they may change, is better.

Where current risk is high (probability is high and (or) consequences are high), you should continue with the appraisal. You can then begin to explore how the risks can be managed.

2. Are there conflicts between the description of the problem at the strategy level compared with the SMP or CFMP or at the scheme level compared with the strategy?

If so, you should refer back to the appraisal in the SMP or CFMP noting reasons for the difference. You will need to feed back your findings (at the end of the appraisal) to the SMP or CFMP (see: Chapter 10: Monitoring, evaluation and feedback). These differences should not stop the appraisal.

Outputs

Typically by this stage, you should have produced the following outputs. These will be helpful to inform the remaining steps in the appraisal:

- a description of the problem (see: 3.3 Identify problem and key issues);
- a statement setting out why the project is required (see:

3.6 Checkpoint and outputs: Understand and define the project

set the quality criteria for the project);
- identified sources of data that can be used to inform the appraisal, including data gaps;
- confirmation of the appraisal period for the project, with justification if this differs from 100 years (see: 3.4 Establish appraisal period);
- maps showing the boundaries of the project, including if, how, where and why the area has been sub-divided (see: 3.5 Set the boundaries);
- outputs relevant to the environmental assessment process being undertaken; and
- quality criteria that will be used to assess whether the final outputs from the appraisal, SEP, SEA or EIA and for partnership working have achieved their goals and why those goals are important (see: set the quality criteria for the project).

You should also have produced an outline SEP that details your planned approach to managing engagement risk (why, what, when and how you will be engaging stakeholders). You should have already undertaken some engagement when identifying and defining the project (for example, to discuss the problem or agree boundaries).

All outputs for understand and define the project complete: the extent of the problem and the implications for the scope of the appraisal are understood

Move to Chapter 4: Set the objectives

4. Set the objectives

4.1 Key Principles: Set the objectives
The identification of objectives gives a clear direction for the selection of a range of options to be taken forward for assessment. Objectives are set by reference to government policy, the duties, standards and targets of operating authorities, and from stakeholder engagement. The project team needs to develop and agree the project objectives as this is what the subsequent option development will be trying to achieve. It is also the benchmark against which the post appraisal and post implementation evaluations will be carried out. The task of identifying and managing objectives should not be underestimated and is key to a successful project output that clearly achieves the stated policy, duties, standards and targets and maximises opportunities for multi-functional benefits.

Figure 4.1 shows where you are in the appraisal process (orange coloured box). Follow the hyperlinks to move back to previous chapters of the guidance if you need to revisit previous tasks. Clicking on a hyperlink to another chapter takes you directly to the start of that chapter (to the key principles). Clicking on a hyperlink to a section within Chapter 4 takes you to the main guidance.

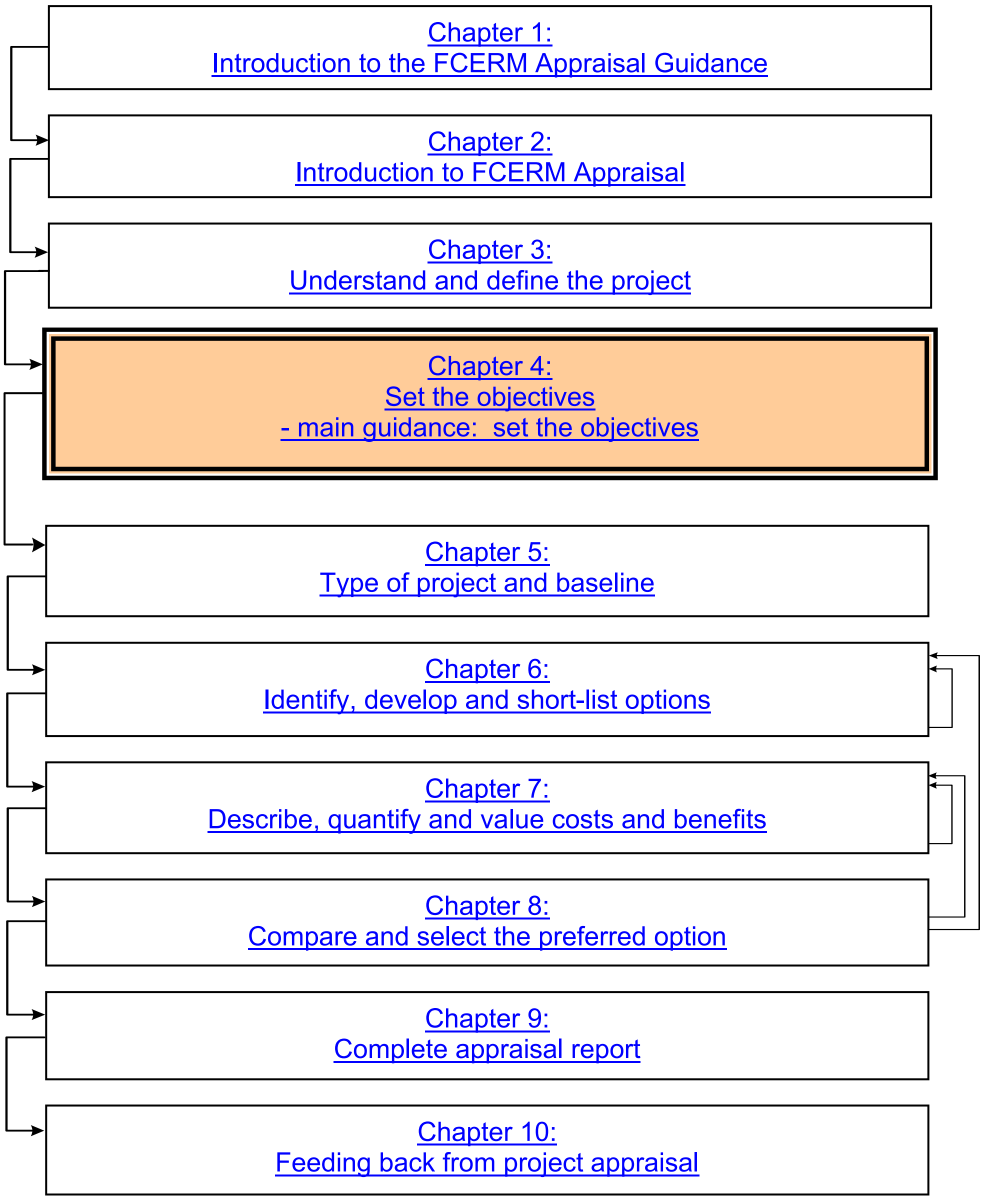


Figure 4.1 Navigation flowchart

4.2 Inputs to set the objectives

Outputs from Chapter 3

The scope and, therefore, the detail and effort required by the appraisal process have to be defined from the initial definition of the problem (Chapter 3: Understand and define the project). You should have confirmed, through the checkpoints in Chapter 3 that the appraisal needs to continue.

Working with others

The Stakeholder Engagement Plan should be finalised during this stage as the outcomes from preliminary engagement with stakeholders are taken into account through the objective setting. The mechanism for gaining initial views should have been defined in the draft Stakeholder Engagement Plan undertaken during identification of the problem of the project, see Chapter 3: Understand and define the project). It will be important to manage engagement and expectations during this stage as some stakeholders may want aspirations for local environmental change unrelated to flood or coastal erosion risk management to be included as project objectives. The process of initial engagement for objective setting should be well planned with a clear explanation at the outset of the purpose of objective setting in relation to the overall project objective.

Environmental assessment

During the project definition stage, key environmental constraints and opportunities will have been identified in the context of the policy and legislation framework. The objectives for the project should take account of this background, representing legislative requirements and opportunities for environmental enhancement identified in existing plans or through the engagement process. The SEA scoping stage will 'scope out' environmental issues (justifying why they have been removed) allowing remaining environmental issues to form the basis of strategic objective setting.

4.3 Set the objectives

4.3.1 Expert summary: Set the objectives	
State objectives Read more	The objectives need to be stated clearly and linked to the problem. Some of these objectives may already be stated in high level plans such as CFMPs and SMPs and strategies if prepared. Objectives may need to be added to reflect the project specific requirements and should be consistent with Defra's policy statement and the operating authority's policies, duties, standards and targets, as well as other plans and policies.
Make sure the objectives are not restrictive Read more	The objectives must relate to the problem but must not presuppose a solution or exclude potential opportunities for multiple benefits that may be linked with the project. Make sure the objectives can be used to help you identify the preferred solution during decision-making.
Links to environmental assessment and stakeholder engagement Read more	The outcomes of environmental assessment and stakeholder engagement must feed into the definition of objectives to enable justification of any environmental and social enhancements that could be implemented. Make sure that the objectives can stand up to scrutiny and can be understood by anyone interested in the project in terms of the problem and what you are trying to achieve for the solution.
Use a hierarchy approach Read more	A hierarchy approach should be used to identify those objectives that are key to the delivery of the project as opposed to those that could provide opportunities and enhancements. The objectives should also be linked to the funding source, with national objectives linked to national funding. This will be particularly important where there are conflicting objectives.
Agreeing objectives Read more	The objectives should be set and agreed by the project team with input from stakeholders.
Set the quality criteria for the project Read more	Any objectives that relate to the appraisal process should be included as quality criteria. The quality criteria will be used at the end of the appraisal to assess whether the appraisal has achieved what is required (see Chapter 10: Monitoring, evaluation and feedback).
	Check you have completed all the expected outputs

4.3.2 Main guidance: Set the objectives	
Identify objectives Read more	Setting objectives is key to ensuring that there is a clear direction for the project. It is important that the objectives are consistent with: • Defra's policy aims from Making Space for Water; • the policies, duties, standards and targets of the operating authorities; and • the interests of promoters and stakeholders (including any project partners).
Sources of objectives Read more	It is necessary to scope objectives from a variety of sources. If the area is covered by a CFMP or SMP the recommended management policy will provide a starting point for setting objectives as will any objectives from a strategy (if one has been prepared). Also, these plans will have liaised with stakeholders to arrive at wider objectives. Defra's aim from Making Space for Water (restated in the policy statement, Defra, 2009) can be a starting point when discussing the objectives. Objectives can also be found in other plans and policies, such as: • river basin management plans (RBMPs); • local development frameworks (LDFs); • strategic flood risk assessments (SFRAs); • drainage plans and surface water management plans (SWMPs); • biodiversity action plans (BAP) and habitat action plans (HAPs); • regional habitat creation programmes (RHCPs); • water level management plans (WLMPs); • management or restoration plans for SACs, SPAs and SSSIs; • plans from owners and operators of critical national infrastructure (such as water and wastewater companies, electricity providers, transport infrastructure operators (National Rail, Highways Agency), primary care trusts); • community or local authority flood plans; and • sustainable community strategies and economic development strategies.
Legal requirements	There may also be legal requirements that will form objectives and (in some cases) will determine which actions need to be undertaken. Such requirements should be recorded as constraints on options. This is important as it can avoid spending time appraising options that may be found at a later date to be non-starters.

4.3.2 Main guidance: Set the objectives

Links to environmental assessment	Environmental objectives driven by legal requirements may already be clearly defined. Other environmental objectives may be identified during the initial information gathering phase, be driven by regional or local targets, or priorities or could result from conditions associated with any partnership funding or involvement. You should discuss delivery of funding or targets with those involved as early on in the process as possible. Engagement with statutory bodies should be undertaken to help set targeted objectives where necessary.
Read more	
Engaging with stakeholders	Objectives should be set through engagement with stakeholders. Identifying objectives in this way should help to identify potential project partners and who may be able to provide contributions. Engagement may raise a significant number of objectives and care will be needed to ensure that expectations are managed as not all the objectives raised may be relevant or delivered simply through flood risk management. The process of engagement should be clearly defined in the draft Stakeholder Engagement Plan which will be finalised further to the objective setting process.
Read more	
Example objectives	**Example objectives** Objectives may be set at different levels: • reduce the threat to people and their property; and • deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles. These may then be unpacked to reflect specific or local objectives. These should be clear and should reflect the function of a feature: • to reduce risk of flooding to a specific residential area or town; • to maintain the transport system between A and B; • to maintain or enhance the condition or integrity of an SSSI site within the context of a dynamic coastal system; and • to maintain the interests and access to the sea of a sailing club.

4.3.2 Main guidance: Set the objectives

These may need to be qualified so that the intent of the objective is understandable and may be demonstrated.

- To maintain the transport system between A and B.
  - to safeguard the regional economy; and
  - to ensure viability of village B.
- To maintain or enhance the condition or integrity of an SSSI site within the context of a dynamic coastal system.
  - to maintain water levels throughout the site; and
  - to maintain sediment supply to allow dynamic function of the dune system.

Make sure the objectives are not restrictive

The objectives must relate to the problem that is being addressed but must be set in such a way that they do not prejudge the solution. However, they must not be restrictive or exclude potential opportunities for multiple benefits that could be provided as part of the project. It is essential that the objectives do not presuppose a solution.

Make sure the objectives can be used to help you identify the preferred solution during decision-making (see Chapter 8: Compare and select the preferred option).

Examples of objectives prejudging solutions

- "To reduce risk of flooding to a specific residential area or town." Is acceptable.

An objective to reduce the risk to people and property to a probability of less than 0.01 is not, as it could only be met by solutions that reduce the risk to less than 0.01. This objective would prejudge the solution and is not appropriate.

- "To maintain the transport system between A and B." Is acceptable.

An objective to protect the road between A and B might exclude the possibility of re-routing the road.

Read more

Hierarchy of objectives

Not all objectives will carry the same weight in the appraisal and a hierarchical approach will help in identifying those that relate to policies and duties (and therefore carry more weight) and those that identify opportunities not directly linked to the main purpose of the project but could provide multiple benefits. The distinction between objectives could be based on the funding source where national funding would be expected to deliver national objectives. Regional

4.3.2 Main guidance: Set the objectives

or local funding could be used to deliver other objectives. It must be recognised, though, that some objectives may conflict or would prevent delivery of other objectives. Where such differences occur, you may need to identify those objectives that are considered more 'important' (based on engagement) or are more deliverable from a FCERM perspective.

Read more

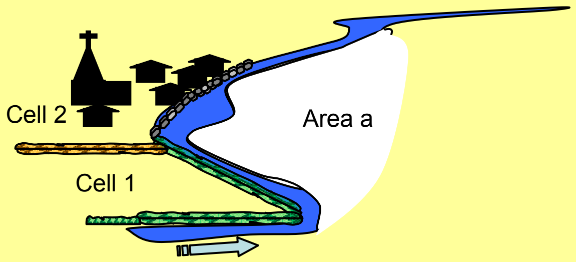
Examples of opportunity objectives

Opportunity objectives have to be carefully expressed so as not to prejudge solutions. However, they can advance an idea of how risk management may relate to other broader objectives. They may typically be expressed as the need for collaborative consideration.

- To consider how coastal defence may enhance the development of a promenade.
- To consider how alleviation of a flow constraint at a bridge may also alleviate traffic congestion.
- To consider how flood risk management may enhance the integrity of nature conservation site.

Such opportunities are likely to require investigation into the potential for contributions from others. This may also meet requirements of the Water Framework Directive if natural processes are restored. The intent is to try and broaden awareness of opportunity for good management. The simple objectives for Town M might be:

- To reduce risk of flooding to the town (cell 2)
- To maintain agricultural use in the area (cell 1).



By identifying wider potential benefits:

- To consider how flood risk management may enhance the integrity of nature conservation site (Area a).

The identification of opportunity objectives may assist in defining the scope and extent of the area needing to be considered (see 3.5. Setting Boundaries). It may also help when identifying the full scope of options.

4.3.2 Main guidance: Set the objectives	
Agreeing objectives	The setting and agreement of clear objectives at the outset provides a useful reference point for stakeholder engagement and managing stakeholder expectations for the remainder of the project. It also provides an opportunity to explore the potential for contributions through working with project partners throughout the appraisal.
Quality criteria	Most objectives will relate to the decision to be made but there could also be process objectives relating to how the work would be done. For example in an open and inclusive manner. Engagement objectives should reflect the needs of those to be engaged and why they would want to be engaged in the project. These will then need to synthesised to form clear objectives which can be signed up to by the project team. These objectives should be considered as quality criteria and added to the quality criteria identified when defining the project (see Chapter 3: Understand and define the project). Check you have completed all the expected outputs

4.3.3 Explanation and further guidance: Set the objectives	
Objective setting Return to main guidance	It is important to consider first the objectives associated with core policies, duties and drivers associated with flood and coastal erosion risk management as that will be the source of funding for any works that are required. Contributions from external sources can be obtained from public and private sources who may be beneficiaries of the flood or coastal risk management scheme. Such parties should be considered as key stakeholders and potential project partners during the project's engagement process. More information on contributions is provided in the Environment Agency's Contributions Policy.
Do not prejudge the solution	It is important that appraisals are undertaken in a manner that does not prejudge the preferred solution. This is because any preconceived ideas on the solution may affect how the appraisal is undertaken, including driving you to collect more and more detail to 'justify' that solution. Setting objectives that presuppose a solution, especially objectives that set risk levels or suggest some form of structural intervention, can undermine an appraisal such that it restricts the identification of broader, non-obvious solutions. It also undermines any stakeholder engagement as it gives the impression of having pre-decided the answer so any engagement is just a tick box process.

4.3.3 Explanation and further guidance: Set the objectives	
Return to main guidance	As you will also need to verify that the preferred solution meets the project objectives once the appraisal is complete, an appraisal with objectives that prejudge the solution can appear biased. If stakeholder expectations have been raised but there is no justification for options that meet their expectations, it can be more difficult to implement the preferred solution.
Links to higher level plans and policies Return to main guidance	SMPs and CFMPs, strategies and other higher level plans and policies should set objectives that can be used here. It is important that the objectives are consistent as this provides a more robust basis for appraisal. The higher level plans and policies may also have carried out considerable engagement including formal consultation that you can draw on, helping to reduce the costs associated with the appraisal for this project.
The role of engagement Return to main guidance	Stakeholder engagement is an important part of identifying objectives. Care must be taken that the objectives of flood and coastal erosion risk management are linked to those set by Defra and do not become a 'wish' list that cannot be met. Identifying other, wider, objectives through working with project partners will help you during identification and development of options (see Chapter 6: identify, develop and short-list options) This may require management of perceptions and expectations and should be guided by the Stakeholder Engagement Plan.
Hierarchy of objectives Return to main guidance	Having a hierarchy of objectives will help you choose between options when you are comparing and selecting the preferred option (see: Chapter 8: Compare and select the preferred option). This will help ensure that the preferred option delivers those objectives with the greatest weight. It is important, though, that you consider how and if all the objectives could be delivered. This will require working with project partners during the appraisal and, where possible, obtaining contributions to help fund the wider objectives. Where there are conflicting objectives, it will not be possible to deliver them all and you will need to use the hierarchy, engagement and funding sources to help identify which objectives can (and cannot) be delivered. You should also consider the overall benefit to the project and the distribution of benefits (who benefits and who loses) when considering which objectives can (and cannot) be delivered. The distribution of benefits is discussed in more detail in Chapter 7: describe, quantify and value costs and benefits).
	Check you have completed all the expected outputs

4.4 Checkpoints and outputs: Set the objectives	
Checkpoints	Assess whether it is worthwhile continuing with the appraisal in its current form by answering the following question: **1. Is there significant opposition from stakeholders?** If so, then you should revisit the problem definition and objectives in the light of the concerns to ensure nothing significant has been missed, and amend the objectives if necessary. Key within this is the need to ensure the process is transparent and the outcomes are communicated appropriately.
Outputs	Typically by this stage, you should have stated the objectives for the project and developed a hierarchy structure to clarify those associated with policies, duties, standards, targets and drivers of the operating authorities and those that are not core to the project but could provide possible opportunities and constraints to be considered when developing options. You should also have reviewed the SEP, reflecting the objectives that have been set. **All outputs complete: the objectives have been identified and agreed by the project team and with stakeholders** **Move to Chapter 5: Type of project and baseline**

5. Type of project and baseline

5.1 Key Principles: Type of project and baseline

Consideration has to be given to the type of project and its context to ensure that appraisals are as efficient and effective as possible. Proportionality of appraisal, in terms of the activities required and the level of detail they go to at each stage in the process, is a key concern.

The baseline is used to set out current and future risks against which other options are compared. It is therefore **essential** that an appropriate baseline is identified and that the description of the baseline includes all of the issues considered significant in the description of the problem. The description of the baseline has to be tailored, in extent and scope, to the risk management problem being examined.

The focus of this chapter is on identifying the appropriate project type and then on defining the assumptions that are made when describing the baseline. Approaches to describing, quantifying and valuing the impacts of the baseline (and all options) are set out in Chapter 7: describe, quantify and value costs and benefits.

You will need to periodically review the choice of project type as new information becomes available and be prepared to change, if necessary, to ensure your appraisal will result in a recommendation that is a best fit with appraisal policy.

Figure 5.1 shows where you are in the appraisal process (orange coloured box). Follow the hyperlinks to move back to previous chapters of the guidance if you need to. Clicking on a hyperlink to another chapter takes you directly to the start of that chapter (to the key principles). Clicking on a hyperlink to a section within Chapter 5 takes you to the main guidance.

5. Type of project and baseline

5.1 Key principles

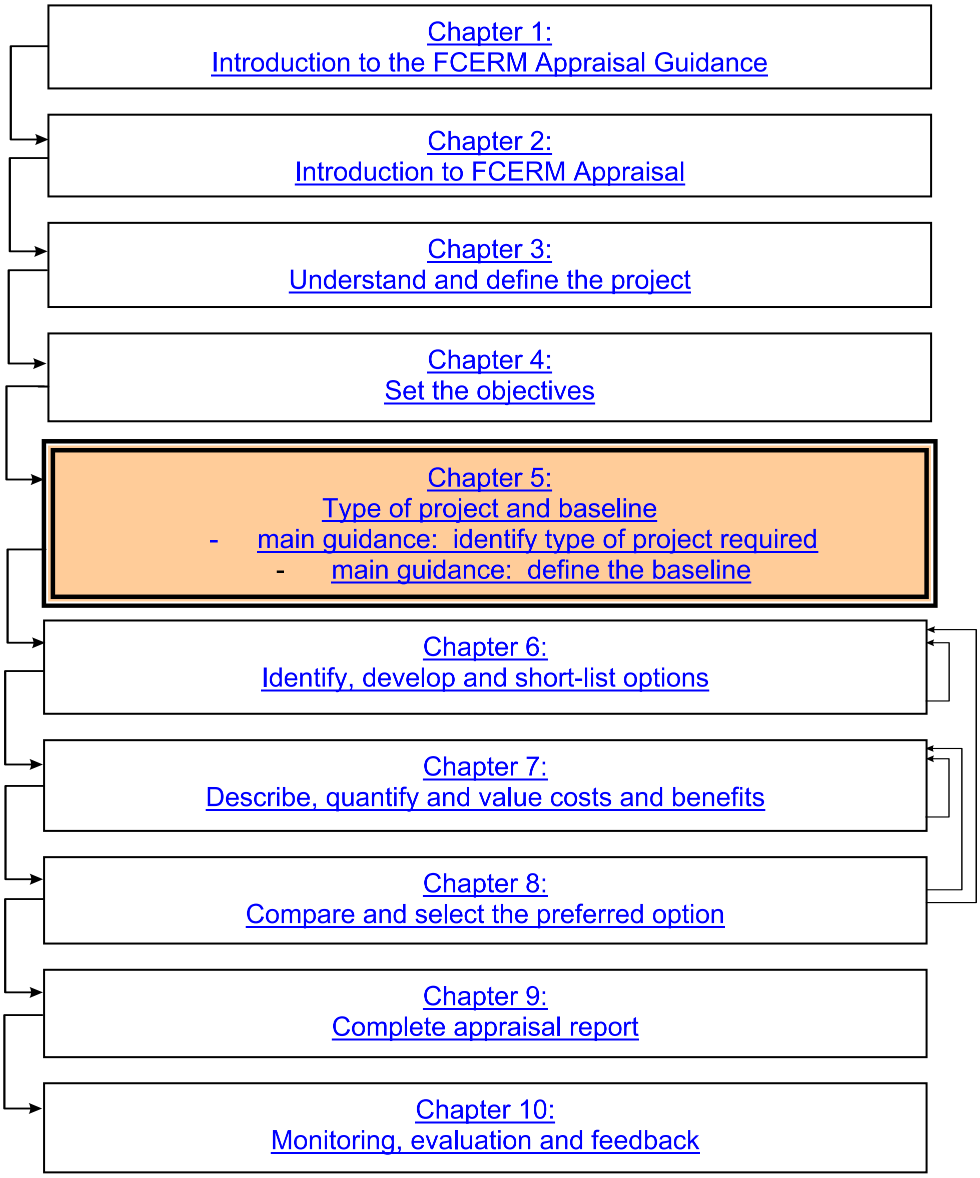


Figure 5.1 Navigation flowchart

5.2 Inputs to type of project and baseline

The different types of project are defined in Chapter 2 (2.4: Different types of project). The appraisal type appropriate to your project, its scope and, therefore, the detail and effort required are defined from the initial definition of the problem (Chapter 3: Understand and define the project) and the objectives (Chapter 4: Set the objectives). The objectives identified in Chapter 4 tell you whether there are legal objectives to be met. You should also have confirmed, through the checkpoints in Chapters 3 and 4 that the appraisal needs to continue.

The Stakeholder Engagement Plan (SEP) should have identified objectives for the project. Information gathered during initial consultation could help support development of the baseline, including anecdotal records from local communities and information from key stakeholders about previous plans and projects.

Environmental assessment will determine the key opportunities and constraints which inform the type of project and project baseline. The legislative and policy framework may also be of relevance in identifying different project types.

NB: The baseline for FCERM appraisal is not the same as and should not be confused with baseline information gathered for the purpose of an environmental impact assessment (EIA) though some of the information gathered at this stage in project appraisal will be relevant to the EIA process.

5.3 Identify type of project required

5.3.1 Expert summary: identify type of project required

Identify the type of project required
Read more

The following flowchart will help you decide which project type is most appropriate for the problem you are addressing and, as a result, whether this is likely to require CEA or CBA The project team is responsible for the correct choice.

Are there legal requirements that have to be met?
Read more

Q1. Is the main purpose of the project to fulfil a legal obligation?

Yes → **CEA should be used** for minimum required to meet legal requirement (identify and describe the benefits of achieving the legal requirement). Use CBA for actions that go beyond the minimum requirements

No ↓

Does your project meet *all* the requirements for a Sustain SOS?
Read more

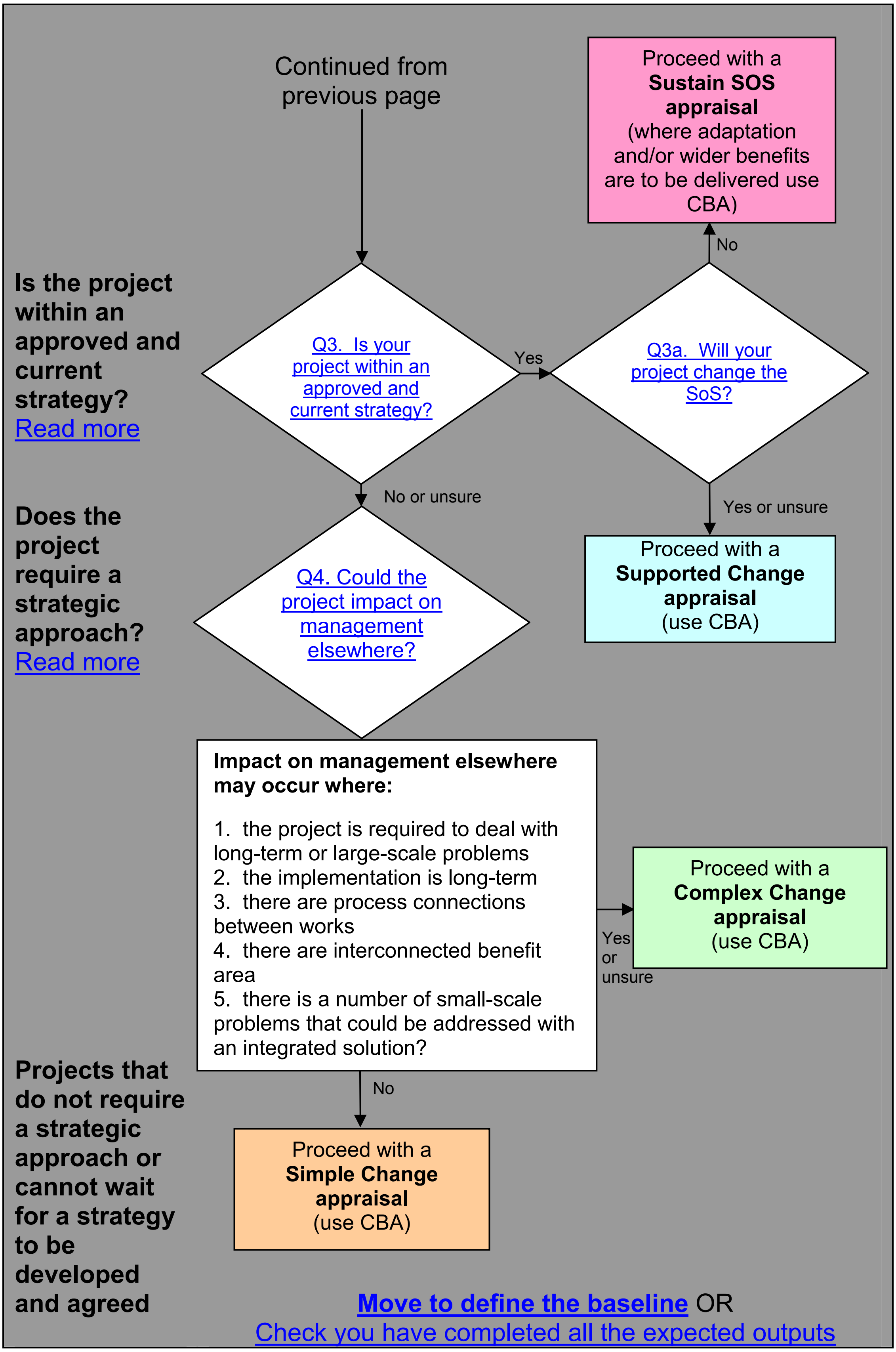
Q2. Does your project meet **all** the conditions set out below?

- the asset(s) requiring work is within an asset system with an agreed and current AMP
- the benefit-cost ratio of sustaining the asset system is in the AMP
- the sustain action is viable and consistent with the agreed CFMP or SMP
- the average residual life of other assets in the system is >20 years
- the indicative costs (Gateway 0 - 5) for the proposed project is <25% of the estimated cost in the AMP to sustain the system for 10 years
- the indicative costs (Gateway 0 - 5) for the proposed project do not exceed the following limits:
  - No limit - projects (and AMP) within a valid and approved Strategy;
  - £2m – projects within a PAR/ Simple Change appraisal with approval received within the last 5 years;
  - £0.5m – projects whose approval is older than 5 years.

Yes → Proceed with a **Sustain SOS appraisal** (where adaptation and/or wider benefits could be delivered use CBA)

No or unsure ↓

Continued overleaf…


Continued from previous page
Is the project within an approved and current strategy?
Read more
Q3. Is your project within an approved and current strategy?
Yes
Q3a. Will your project change the SoS?
No
Proceed with a **Sustain SOS appraisal** (where adaptation and/or wider benefits are to be delivered use CBA)
Yes or unsure
Proceed with a **Supported Change appraisal** (use CBA)
No or unsure
Does the project require a strategic approach?
Read more
Q4. Could the project impact on management elsewhere?
Impact on management elsewhere may occur where:
1. the project is required to deal with long-term or large-scale problems
2. the implementation is long-term
3. there are process connections between works
4. there are interconnected benefit area
5. there is a number of small-scale problems that could be addressed with an integrated solution?
Yes or unsure
Proceed with a **Complex Change appraisal** (use CBA)
No
Proceed with a **Simple Change appraisal** (use CBA)
Projects that do not require a strategic approach or cannot wait for a strategy to be developed and agreed
Move to define the baseline OR
Check you have completed all the expected outputs

5.3.2 Main guidance: identify type of project required	
The types of project	To allow appraisals to be undertaken at an appropriate level of detail, five types of project have been identified. Each requires different starting points and steps through the appraisal (see Chapter 2.4: Different types of project). In all cases, the focus of the projects is on managing risk and finding the best way to do this, reducing the amount of unnecessary time and resources spent on appraisal.
Read more on CBA	Three of these types of appraisal use cost-benefit analysis (CBA) (the hyperlinks will send you to the description of the different project types in Chapter 2.4): • complex change project (strategy); • supported change project (implementation of schemes within a strategy); and • simple change project (standalone project, where no strategy is required or there is no time to wait for a strategy).
Read more on CEA	Two of the types of appraisal use cost-effectiveness analysis (CEA): • Sustain Standard of Service (Sustain SOS); and • projects whose main purpose is to fulfil legal requirements.
Identifying the appropriate type of project for your project	A series of questions are set out below to help you identify which type of project you should follow. These are illustrated with examples to help you. These questions follow the same steps as shown in the flowchart in the expert summary, here with extra text to help you identify the most appropriate responses to each question.
Are there legal requirements that have to be met?	**QUESTION 1**: *Is the main purpose of the project to fulfil a legal obligation?* The objectives for the project (strategy or scheme), as set out in Chapter 4 (set the objectives) should provide the answer to this question. It is not possible to provide a 'not sure' answer here; you should have identified the need to fulfil the legal obligation as the primary reason for undertaking the project when identifying the problem (see: 3.3: Identify problem and key issues). Legal requirements that are the main purpose of projects include: – legislation with 'general' application, such as the Habitats and Birds Directives. This type of legislation typically uses cost-effectiveness analysis; and – specific legislation, including local legal agreements,

5.3.2 Main guidance: identify type of project required

such as navigation acts for specific rivers, or unacceptable health and safety risks. You should consider whether the costs of meeting this type of legislation would exceed the benefits before deciding to follow the CEA route as it may be more cost-effective to buy out the legal agreement, rescind the legislation or overcome the need for the legal requirement by alternative means. For example, removing or replacing a bridge that is no longer needed rather than having to make it safe or upgrade it under Health & Safety or Highways legislation. You should always take advice from the appropriate organisations (such as statutory consultees) where there appears to be a legal requirement when assessing if the legal requirement does not **have** to be met.

Legal requirements that place duties or obligations on the project tend to introduce constraints that will affect the types of options that delivered. They include:

- duties that stem from legislation such as Health & Safety or Town and Country Planning; and
- obligations that arise from contractual agreements, such as contracts between an Operating Authority and a water company to provide adequate water levels for abstraction by pumps.

It is important to distinguish between where the project is required solely to meet the legal requirement and legal constraints that might affect which options can be delivered. You should only follow the CEA route where the reason for undertaking the project is to fulfil a legal requirement that is inappropriate to buy out or rescind. Any legal constraints that would affect the options that can be delivered will be considered when identifying options (see: Chapter 6: identify, develop and short-list options).

Where the main purpose of the project is NOT to fulfil legal obligations, move to question 2.

If the answer is ***Yes the main purpose of the project is to fulfil legal obligations***, then CEA is likely to offer the most cost-effective appraisal route. Go to 'appraisal tasks required by appraisal type'. This sets out which particular activities you will need to undertake a CEA to estimate the most cost-effective way of delivering the legal requirement.

Under the Defra policy, information is needed on the costs and benefits of meeting the legal requirement. This is

5.3.2 Main guidance: identify type of project required	
	usually undertaken at a high level for strategies. For schemes that are not covered by a strategy, a description of the benefits and who receives these benefits is sufficient. Further detail on identifying, describing and valuing the costs and benefits of legal requirements is set out in Chapter 7 (describe, quantify and value costs and benefits).
Including wider objectives and delivering more than the minimum legal requirements	If ***Yes, but you are looking to deliver more than the minimum legal requirements***, you can use CEA to assess the least-cost method of delivering the legal requirements and CBA to assess the economic viability of the additional work. Go to 'appraisal tasks required by appraisal type'. This identifies which tasks have to be undertaken, as a minimum, and those extra tasks that may be required to show that delivering more than the minimum legal requirements is worthwhile.
	Example: Improvement beyond legal requirement There is a small storage area that has a legal requirement for repairs. In addition to the repairs there are a number of additional improvements that could be made including addition of a reinforced spill way and seeding of the embankment area to provide habitat corridors. These additions are not required by legislation. Therefore, the additions need to be assessed with a CBA, on the basis of the incremental additional benefits and additional costs.
Does your project meet *all* the requirements for a Sustain SOS?	**QUESTION 2**: *is the project likely to use cost-effectiveness analysis through the Sustain SOS route?* To follow the Sustain SOS route (and undertake a cost-effectiveness analysis), your project needs to meet **all** the following conditions. If you are unsure whether your project meets any of the following conditions or are sure that it does not, you should move to question 3:
Read more on AMPs	• the asset(s) requiring work is within an asset system with an agreed Asset Management Plan (AMP) **and**; • the costs and benefits of the do-nothing option and the existing defence system have been estimated within the asset management plan and show that there is a good economic case to sustain the existing defence system (the results of the previous CBA should be included as an annex to the project appraisal report) **and**; • the sustain action is viable and consistent with the agreed CFMP or SMP **and**; • the average residual life of other assets in the system is

5.3.2 Main guidance: identify type of project required

>20 years and;

- the indicative costs (Gateway 0 - 5) for the proposed project is less than 25% of the 10 year system sustain cost estimates shown in the AMP **and**;
- the indicative costs (Gateway 0 - 5) for the proposed project do not exceed the following limits:
  - No limit - where the project (and AMP) can be shown to be within a valid Environment Agency/Defra approved Strategy **or**;
  - £2m - where the project can be shown to fall within a PAR/Simple Change project appraisal with Environment Agency FSoD approval received within the last five years **or**;
  - £0.5m – where the project is not within a valid Environment Agency/Defra approved Strategy, the project cannot be shown to fall within a PAR/Simple Change project appraisal or its approval is older than five years.

***Where one or more of the above conditions is NOT met, or you are unsure, move to question 3*.**

If all the conditions set out above are met and the answer is ***Yes***, then CEA can be used. Go to 'appraisal tasks required by appraisal type'. This sets out which particular activities you will need to undertake to complete the CEA. You should periodically review your choice of appraisal route to ensure it remains appropriate.

It is essential that the CEA appraisal route is not used as a short term way to more quickly address failing components of asset systems. In addition to failing to comply with appraisal Policy such a choice could deny local communities the opportunity of receiving increases in the standard of risk management.

Delivering wider objectives and adaptation

If ***Yes, but you are looking to deliver more than the just replacing like-for-like***, you can use CEA to assess the least-cost method of delivering the like-for-like replacement. You can use CBA to assess the costs and benefits of adaptive approaches or solutions that would enable wider objectives to be delivered. This would involve assessing the costs and benefits of actions that go beyond the like-for-like replacement typically associated with a Sustain SOS project. Your baseline would be the situation with the like-for-like replacement. Any additional benefits delivered beyond the like-for-like replacement can then be compared with the costs to assess whether they are worthwhile

5.3.2 Main guidance: identify type of project required	
	(benefits outweigh the costs). Go to 'appraisal tasks required by appraisal type'. This identifies which tasks have to be undertaken, as a minimum for Sustain SOS, and those extra tasks that may be required to show that adapting to future risks and delivering wider benefits (through partnership working) is worthwhile.

Examples for Sustain Standard of Service

i) The old timber groynes in front of town H were falling into disrepair, mainly as a result wear and tear on planks and some king piles. There was a risk that the groynes would become ineffective and, with loss of the beach, the sea wall might fail over a winter storm. This might be considered to be a sustain standard of service project (Sustain SOS), where sections of the groyne field undergo substantial refurbishment. A strategy is in place demonstrating the benefit of retaining the existing system for a period of 20 years. The strategy has anticipated that the cost of maintaining the existing defences over that period would be of the order of £320k. Replacing a critical section of groynes would cost £60k (< 25%). A Cost Effectiveness Appraisal (CEA) might consider use of rock or timber and this decision may be influenced by the longer term strategy for the area.

ii) Flood risk to a community is currently effectively managed by a combination of tidal outfall, earth embankments, pile walls, pumping station and a network of main drain/rivers. The flood risk management assets are generally in good condition with residual lives of at least 25 years. However, the automated weedscreen cleaner to the pumping station has become unreliable, due to normal wear and tear, parts are increasingly hard to source and running costs are increasing significantly. The weedscreen will be replaced with one of the same general specification which will sustain the existing SoS of the cleaner, the pumping station and wider system.

iii) the area down stream of Town I is defended by 9km linear defence composed of 8.5km of earth embankments and concrete wall with residual lives in excess of 25 years and a 0.5km length of steel pile crest wall that is heavily corroded. The steel pile wall has reached its minimum acceptable condition grade and is predicted to fail in the short-term (within 5 years) if it is not replaced. The CFMP supports maintenance of the defence but there is no strategy in place. Replacing the crest wall would cost

5.3.2 Main guidance: identify type of project required

£400k. A CEA might consider use of materials and whether, in relation to the standard of service of the rest of the system, the crest wall is critical to the overall performance.

iii) There is concern over the integrity of other sections of the above defence system down stream of Town I. In several areas the earth embankment has suffered toe erosion. It is anticipated that work to the embankment may be required within 10 years. In this case it would be inappropriate to undertake a sustain SOS appraisal separately for the crest wall without consideration of the system as a whole. A strategic examination of the whole system is required. This would require using CBA.

Is the project within an approved strategy?

QUESTION 3: *is the project within an approved and current strategy?*

If ***no*** (or you are ***not sure***), go to ***Question 4***.

If you answer 'yes' to this question, you need to answer **Question 3a**: does the project change the standard of service (SoS) set out in the strategy?

If the SoS will change due to the project (or you are not sure), you should undertake a supported change (using CBA). Go to 'appraisal tasks required by appraisal type'. This sets out which particular activities you will need to undertake to complete this type of CBA. If the SoS is not expected to change, you can undertake a Sustain SOS (using CEA). To follow the CEA route, it is essential that the strategy has undertaken a CBA in line with the approaches set out in Chapters 3 to 8 of this guidance.

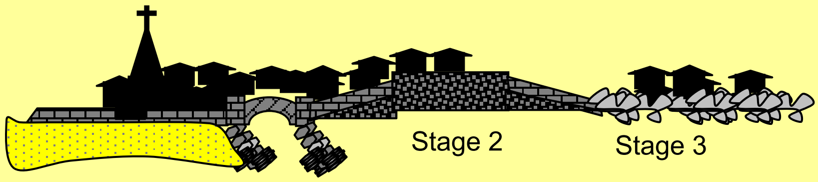
Examples of Supported Change Projects

i) A strategy investigates options for the fluvial defences along a large tidal river. The river is mature and widens through the town. Adjacent to the river, areas are distinct as they are affected by small sections of the river and separated by parks, roads and railway embankments. The overall strategy recommends the continued use of linear defences. The supported change projects in different areas investigate the detailed layout, type and routing of defences in each of the areas, supported by the decisions made in the strategy.

ii) A coastal town N is defended by a typical variety of coast protection works. A strategy has been undertaken

5.3.2 Main guidance: identify type of project required

and approved. This strategy established that defence of the frontage would not have significant impact elsewhere along the shoreline and that defence of the town and the coastal road running along the shoreline was worthwhile and appropriate. Due to the condition of defences it was sensible to stage works over a period of 15 years. It was found by the strategy that each stage of works could be undertaken independently and that there was little interaction between frontages. Each stage was estimated to cost in the order of £1M.



Stage 1 was completed immediately following the strategy in year 1. Stage 2 is now being planned in year 5. Monitoring has demonstrated that the conclusions of the strategy seem valid and Stage 1 has performed as might be expected. The costs for Stage 2 are estimated to be within the strategy estimate. Stage 2 would be undertaken as a Supported Change Project. The outcome of the appraisal and CBA were compatible with the strategy

iii) It is now year 12. Continued monitoring has highlighted significantly greater erosion along the frontage than predicted by the strategy and revised estimates of climate change and sea level rise are available. The estimates for Stage 3 and maintaining Stage 1 are in excess of those predicted by the strategy. The strategy needs to be revisited and management of the whole frontage needs to be reviewed. This would no longer fall within a Supported Change Project.

Does the project require a strategic approach?

QUESTION 4: *does your project require a full strategic approach?*

Every appraisal using CBA requires the assessment of costs, benefits, and physical and environmental impacts over the affected area for the whole life of the scheme. This will often be most easily achieved within a strategic framework. This should not be taken to imply a blanket requirement for the production of strategy plans.

5.3.2 Main guidance: identify type of project required

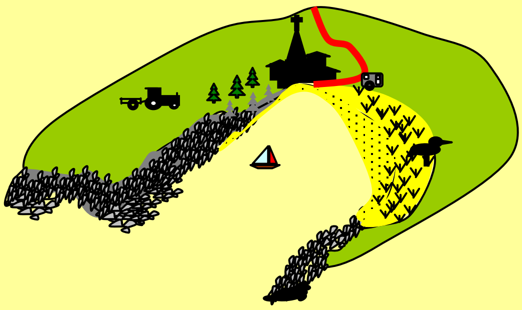
[Read more on the benefits of a plan-based approach](#)

You should take a strategic approach where a large-scale or decision is being made, or where a decision made for one area may impact on management elsewhere. You should follow the approach for a complex change project (using CBA). If there are no impacts on management elsewhere, or the project is small-scale you should follow the approach for a simple change project (also using CBA). See also the flowchart in the expert summary and the following examples when deciding whether to follow a complex change or simple change project.

Deciding whether a strategic approach is required

It is not the case that a strategy is required where there are many issues associated with management of an area. The most appropriate approach may instead involve integrated planning and careful setting of objectives.

For example, Town O is situated within a small bay where there is coastal erosion and flood risk. The town is to one side of an enclosed bay with



dunes along much of the rest of the bay. The risk is to the town and the potential impact this may have on interests within the bay.

The town is defended but the defences are in poor condition. A scheme might be developed without the need for a strategy. All potential interactions would however need to be considered.

Examples where a strategic approach is appropriate

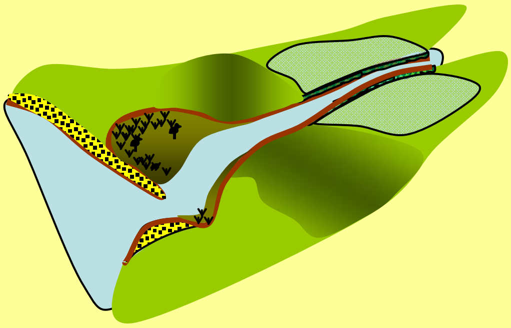
Examples where a strategic approach is typically required

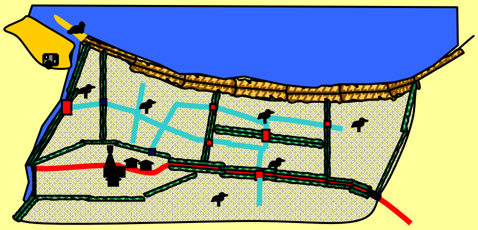
i) There are extensive fishing grounds and environmental protected marine habitat for rare shells. The preferred option of dredging the river channel and nourishment of the adjacent beach at the entrance could potentially affect the habitats.

5.3.2 Main guidance: identify type of project required

Examples where a strategic approach is appropriate

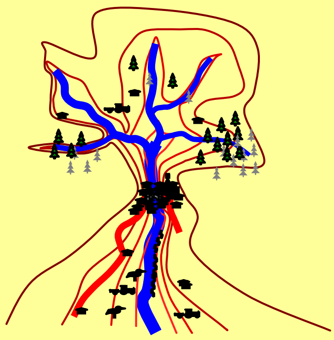
ii) Defences well upstream in Estuary W protect large areas of flood plain. Potential realignment of these areas could significantly increase the tidal volume of the estuary, influencing behaviour of the lower estuary and at the mouth. While the defended flood plain is remote from the lower and separated from the lower estuary by high areas of land, the potential impact of their management could extend over a large area. This might affect areas designated for nature conservation.





iii) The adoption of a long-term plan for renewal or replacement of pumping stations in a large area may allow a significant package of work to be tendered as a single contract

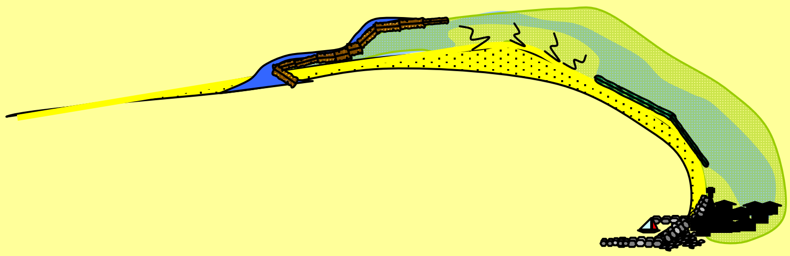
iv) Where there are process connections between management or policy units, strategic level options have to include management of flow through the entire catchment area, balancing the impacts of controlling flow from the upper catchment, to widening the channel through the town and the impact on flood risk this might have on the flood risk downstream area.



v) A coastal town P, with its harbour, is located on a headland to a bay. The bay is backed by a sand dune shoreline cut by a small river. There is a low hill between the town and where the river cuts the bay. The dunes form the primary flood defence to low lying land which runs through from the river to the back of the town. There are defences to one side of the river and there are defences in one area to the back of the dunes. The

5.3.2 Main guidance: identify type of project required

defences along the river are in poor condition and possibly need replacing. However, flooding from the river may impact on the town, the set back defence behind the dune also protects the town and the future management of the harbour and defences directly in front of the town influence the position of the whole bay and hence their integrity as a defence. There is a need for strategic consideration of the whole frontage.



vi) A river frontage is defended by a series of short defences that are all in reasonable condition but with climate change the standard of service is possibly too low. There is potential for creating a flood storage reservoir or long diversion channel that benefits many discrete areas and flood cells. These benefit areas may not be continuous but are "interconnected " by the possible solution.

vii) A section of coast is suffering from erosion of its protective beaches. The problem became apparent following the defence of one long section of cliff. This defence is now failing and consideration is being given as to its future management. Re-establishing the sediment supply from the cliff may provide a source of recharge for down-drift beaches, mudflats or salt marshes.

Appraisal tasks required by appraisal type

Once you have identified the project type, you can then identify which steps of the appraisal are likely to be required. Table 5.1 shows (i) which steps must be undertaken in the appraisal (ii) which steps may be required and (iii) where information can be used from the sponsor document.

It is important to note that Table 5.1 only provides a guide to which steps may (or may not) be required. The actual requirements will have to be tailored to each project, based on your judgement as to whether the specific circumstances of the project in question may require an alternative approach. In most cases, the suggestion in the table is likely to reflect the minimum requirement. In particular, consideration of adaptation and/or wider objectives in CEAs might also require CBA to be undertaken.

5.3.2 Main guidance: identify type of project required

Table 5.1 Tasks required by appraisal type

Appraisal task	**Appraisal type**				
	Project whose main purpose s to fulfil a legal requirement CEA	**Sustain SOS CEA**	**Supported change CBA**	**Complex change CBA**	**Simple change CBA**
Identify problem	Already undertaken by following guidance in Chapter 3 (understand and define the project)				
Establish appraisal period					
Set the boundaries					
Set objectives	Already undertaken by following guidance in Chapter 4 (set the objectives)				
Identify appraisal type	Identified above				
Define the baseline	■	■ ⍓	■ ⍓	■	■
Initial list of options	●/□	●/□	■ ⍓	■	■
Screening and short-listing	●/□	●/□	■ ⍓	■	■
Describe, quantify and value costs	●/□	●/□ ⍓	■ ⍓	■	■
Describe, quantify and value impacts	●/□	●/□ ⍓	■ ⍓	■	■
Apply discounting	●/□	●/□ ⍓	■ ⍓	■	■
Compare options	■	■	■ ⍓	■	■
Decision criteria and decision process (select preferred solution)	■	■	■	■	■
Management of residual risk	■	■	■	■	■
Complete appraisal report	■	■ ⍓	■	■	■
Feed back from project appraisal	■	■	■	■	■

KEY:

■ This step **must** be undertaken in the appraisal

□ This step is **unlikely to be required except** where you go beyond the minimum required to meet the legal requirement or the like-for-like replacement of an existing defence system

● This step is **likely to be required** for most appraisals, but you may be able to use approaches from the sponsor documents (for example, the SMP/CFMP, strategy or AMP) such that only limited additional work may be required for the appraisal

⍓ The **sponsor document should provide information** for these steps such that little or no additional work is required in the appraisal (read more)

Read more on when you need to go beyond the sponsor document

5.3.2 Main guidance: identify type of project required	
Check whether other tasks might be needed for your project	You should also verify as you proceed with the appraisal whether any information collected could require a different approach. This may mean that some of the steps previously not needed may become necessary. **Move to define the baseline** OR Check you have completed all the expected outputs

5.3.3 Explanatory guidance: identify type of project required	
Why CEA?	Cost-effectiveness analysis (CEA) is an approach that compares the costs of alternative ways of producing the same or similar outputs. It assumes that the benefits are equal. A CEA should take account of negative impacts (damages) that may occur as a result of how the legal requirements are fulfilled. The damages are usually added to the costs as options that cause damages may be less cost-effective than those that do not. CEA is used where the main purpose of the project is to fulfil a legal requirement because there is a defined need for the project. The benefits (and the distribution of benefits) of meeting the legal requirements need to be identified, described and, where appropriate, valued. How and why this is required is set out in Chapter 7 (describe, quantify and value costs and benefits). CEA is used for Sustain SOS projects because it is assumed that sustain SOS is being used to maximise use of an existing asset (or series of assets). It is assumed that this has been shown to be worthwhile elsewhere (for example, through a CBA in the asset management plan). If the conditions set out under Question 2 (above) are met then this should indicate that the scale of the CEA project should not be significant to the wider decision to sustain the system in the medium term. Otherwise, there is a risk that assets would be maintained even where there may be greater benefits from withdrawing maintenance or by replacing the asset and managing the risk in a different way. It is essential that the existing, overarching CBA used to justify following the CEA route has considered both the costs and benefits of do-nothing option and (as a minimum) the sustain option, following the approaches set out in Chapters 3 to 8 of this guidance. Otherwise, there is a risk that the 'best' solution to the problem will not be delivered. You should include relevant information from the AMP as an annex to your appraisal report and use this to justify your decision to use CEA (Sustain SOS).

5.3.3 Explanatory guidance: identify type of project required	
Return to main guidance	It is essential that the CEA appraisal route is not used as a short term way to more quickly address failing components of asset systems. In addition to failing to comply with appraisal Policy such a choice could deny local communities the opportunity of receiving increases in the standard of risk management.
Why CBA? Return to main guidance	Cost-benefit analysis (CBA) involves assessing both the costs and benefits of a project so it is possible to assess whether the project is worthwhile (benefits outweigh the costs). CBA is used where the case for the project has not been made elsewhere.
Asset management plans Return to main guidance	Asset management plans are used to manage an organisation's infrastructure and other assets to deliver an agreed standard of service. They typically take a system approach and cover more than one asset, especially where assets are co-dependent and need to work together to deliver the agreed standard of service. The plan should provide information on the costs and benefits of withdrawing maintenance and continuing to maintain the assets. Where this information is available, it can be used to support a Sustain SOS appraisal.
The benefits of a risk-based, plan-led approach	A risk-based, plan-led approach allows a long-term view to be taken. The advantage of this approach is that it is intended to avoid disruption to natural processes and to deliver sustainable approaches to flood and coastal erosion risk management in the long-term. Such matters can often only be considered by taking a long-term coherent view of a large area of coastline or river catchment. A risk-led, plan-based approach: • encourages planning and prioritisation of flood and erosion risk management over a wide area; • encourages balanced solutions taking account of all the key issues, including inter-relationships between issues and solutions to those issues; • encourages co-operation and partnership working between operating authorities and stakeholders; • promotes long-term sustainability through strategic thinking and planning; and • is risk-based, providing the opportunity to undertake assessments of risk and sensitivity at the widest levels, for example assessment of the sensitivity to climate change or changes in planning or investment policy.

5.3.3 Explanatory guidance: identify type of project required

When compared with assessing each problem through standalone schemes, risk-based, plan-led approaches can reduce:

- duplication of work;
- inconsistencies;
- double counting between adjacent schemes; and
- therefore, lead to better and more appropriate decision-making.

The benefits of a strategic approach are that they allow the overall contribution of actions to be identified and taken into account, even where the action initially (or when viewed narrowly) seems to have limited benefits. In this way, strategies provide solutions that are much greater than the sum of the local benefits provided by a series of individual actions.

Return to main guidance

When do you need to go beyond the information from the sponsor document?

The decision on when additional information is required above that provided in the SMPs, CFMPs, or strategy plans will depend on the following:

- ***the detail of the information***: it may be necessary to collect additional data where the level of detail provided by the sponsor document is insufficient to allow you to differentiate between options;
- ***the scope of the information***: more specific data may be required, for example where the information from the CFMP, SMP or strategy is regional or general and the project requires more focused information; and
- ***the extent to which engagement has been undertaken***: it may be necessary to widen engagement to allow more or different stakeholders to be engaged.

Chapters 6 and 7 provide more detail on the need for proportionality in appraisal. You should follow the guidance in Chapters 6 and 7 when deciding whether you need to collect more data to supplement that provided in the sponsor documents.

Return to main guidance

Move to define the baseline OR
Check you have completed all the expected outputs

5.4 Define the baseline

5.4.1 Expert summary: define the baseline	
Define the baseline Read more	You will have identified which type of project is required in 5.3 Identify the type of project. This identifies which baseline should be used: For **CBAs**, use **do-nothing** (walk-away, no further intervention undertaken at all). For **CEAs**, use **do-minimum** (minimum required to meet the legal requirement or to sustain the standard of service, SOS). For sustain SOS projects, the do-nothing baseline will have been used in the strategy or asset management plan used to justify use of CEA.
Do-nothing baseline	Consider a realistic do-nothing option, describe the risks (flood and coastal erosion) and how these risks change over time (for example, due to climate change (see supporting document on climate change for details of the approach to taking climate change into account during the appraisal). The definition and description of the baseline may need to be discussed with stakeholders, in line with the requirements of the Stakeholder Engagement Plan (SEP) and the environmental assessment. For supported change projects, you should use information from the strategy to help define the baseline. For complex change or simple change projects, you should use information provided in the SMP or CFMP, as well as other plans and policies (see also high-level and strategic plans, data on physical processes, data on previous floods and historical erosion rates, data on management activities and data from local people and stakeholders. You will have collected much of this information during identification of the problem (Chapter 3). The do-nothing baseline should set out a story on what is expected to happen in the future in terms of: • deterioration, failure/loss and time to failure of structures such as defences, coast protection works and pumping stations; • how the frequency of erosion and flooding events will change and whether or not there are existing structures or management activities; and • the impacts (positive and negative) that occur as a result. All assumptions and the information on which the assumptions are based must be recorded.

5.4.1 Expert summary: define the baseline	
Read more	Approaches to describing the impacts, who/what is affected and when (guidance on how to do this are provided in Chapter 7: describe, quantify and value the costs and benefits).
Do-minimum	Do-minimum is defined as the minimum amount of action or intervention necessary to deliver the legal requirement or sustain the standard of service of the asset. The minimum requirement needs to be described (using the objectives set out in Chapter 4). Use information from the sponsor document (such as the strategy or Asset Management Plan, AMP) to help describe the do-minimum option for Sustain SOS projects. For a legal requirement, you may be able to obtain some general information from the strategy, where available.
Read more	You will also need to identify and describe the benefits of do-minimum. For Sustain SOS appraisals, you should use the CBA undertaken in the asset management plan or strategy. For projects to fulfil a legal requirement, you will need to identify and describe the benefits (and the distribution of the benefits), which may also be in a strategy supporting the scheme.
Consider whether to go beyond do-minimum Read more	It is important to remember that the do-minimum option will not deliver adaptation options or wider objectives. This could result in reduced SOS over time (for example, due to climate change) or missed opportunities (benefits that are not realised). You should consider whether you need to look at benefits that go beyond the do-minimum, such as to deliver wider objectives or go beyond the minimum legal requirement. You may then need to assess a do-nothing baseline so you can assess whether the additional benefits are worth the additional costs.
	Check you have completed all the expected outputs

5.4.2 Main guidance: define the baseline	
Which baseline?	For those projects that are to deliver legal requirements or Sustain SOS projects, use **do-minimum**. Do-minimum is used as it the least-cost way of meeting the legal requirements or determining the sustain SOS cost. As well as the costs of delivering the project, you will also need to consider any negative impacts that it could cause (see Chapter 7: describe, quantify and value the costs and benefits). The benefits of maintaining a system or asset should be available from the strategy or asset management plan. You will need to provide an indication of the benefits of meeting legal requirements (in line with Defra's Policy Statement)

5.4.2 Main guidance: define the baseline	
	(see: 7.4.2: assessing the benefits of legal requirements). For supported change, complex change and simple change projects, use **do-nothing**. Do-nothing is used as it assumes that no action is undertaken, thus the baseline has zero costs (costs here being defined as the capital or revenue costs of actions or interventions. Any negative impacts are defined as damages with positive impacts defined as benefits).
Read more	
Engaging stakeholders	Engagement with stakeholders may need to be undertaken on the baseline or at an appropriate stage, as detailed in the Stakeholder Engagement Plan (SEP). It is important that stakeholders understand and accept (if not agree) with the baseline and what it considers before detailed work begins on developing solutions to the problem. This approach can help reduce engagement risks. Stakeholders also have a lot of knowledge that can be used to: • better define the impacts and consequences of the baseline; • validate data collected during development of the baseline; • identify opportunities; and • provide understanding of what happens locally. In addition, engaging stakeholders during definition of the baseline can help increase their understanding and support for the project. Early engagement can also be beneficial when identifying, describing and communicating the impacts of the do-nothing baseline, especially where there may be environmental or combined environmental and flood risk management benefits. For more information, see the supporting document on engagement. Go to: guidance on defining a do-nothing baseline guidance on do-minimum
The 'do nothing' baseline	The do-nothing baseline is critical to the analysis and needs careful consideration. A do-nothing option should be developed for supported change, complex change and simple change projects, however inconceivable it may seem, as it forms the baseline against which all other options are appraised. Use of a common baseline across all these types of project allows national comparisons to be made. When describing the baseline, you can draw on information from the no active intervention option in the SMP or CFMP,

5.4.2 Main guidance: define the baseline

or from the do-nothing baseline in the strategy. For supported change projects, you should use information from the strategy to help define the baseline. For complex change or simple change projects, you should use information provided in the SMP or CFMP, as well as other plans and policies (see also high-level and strategic plans, data on physical processes, data on previous floods and historical erosion rates, data on management activities and data from local people and stakeholders. You will have collected much of this information during identification of the problem (Chapter 3).

Read more

Do-nothing means do nothing

Do-nothing assumes that there is no future intervention of any kind, including no emergency response or warning system. Where there are assets at present or where maintenance activities or other interventions are carried out, the option will be to withdraw all activities, allowing nature to take its course. Continuing with maintenance or repair of existing structures is one of the 'do something' options to be considered. The examples below illustrate where the proposed do-nothing baseline involves some actions and are therefore, do-something options.

Read more

Examples of do-nothing options that are actually do-something

i) Coast protection works are predicted to fail in year 5. When they fail there will be a large drop onto a stony area, with the beach having been eroded. The proposed do-nothing option involves providing steps down onto the stony beach to maintain access.

The addition of steps would have significant costs so is not do-nothing. If provision of access is important, this should be part of a do-something option (this may involve partnership working with the local council to encourage contributions for access arrangements during delivery of a proposed solution. There may also be efficiency benefits from providing access in line with the requirements of local people, through engagement with them over the number and location of access points).

ii) A pumping station will continue to be operated without any maintenance until the pumps fail, after that time the pumping station will be closed.

Continued operation of the pumping station would involve actions being taken and costs so is not do-nothing. The do-nothing baseline should assume no further operation of

5.4.2 Main guidance: define the baseline	
	the pumping station. The original proposition could form a short term 'do something' option.
Link back to the problem you are trying to address	The problem that the project is addressing (developed in Chapter 3: identify problem and key issues) will help to define the do-nothing baseline.
	Example – use the problem to help develop the do-nothing baseline The problem is that defences protecting a seaside town from erosion will fail in the short-term (estimated 5 years) due to erosion of the beach. This will lead to erosion of the land behind the defences including loss of the promenade and associated tourism assets and, over time, to the loss of properties and a main A road (including associated water, electricity and sewerage services). The do-nothing baseline uses predicted erosion rates of 0.5 to 0.7 m/year to translate the problem into impacts. In this case, the time when beach access points from the promenade are lost, the promenade itself, shops, cafés, amusement arcades, the road and the services it holds plus the properties themselves can all then be predicted. Thinking through what would actually happen identifies that the problem affects not just the promenade but the integrity of the town; its regeneration opportunities, its viability as a regional tourism centre; as well as the direct risk to life and properties lost to erosion, transport system and services. This broadens the definition of objectives (see 4.3.2: Set the objectives).
Assumptions under do-nothing	When defining the do-nothing baseline, it is necessary to make assumptions that will enable you to 'tell the story' of how the area will change over time. You should always record your assumptions along with the data and information on which they are based and any uncertainties that these assumptions introduce. You can test the impact of these uncertainties during sensitivity analysis. When engaging with stakeholders you must explain clearly the assumptions you have made and uncertainties you are working with, and why. By doing this others will be able to see how you are making decisions about the project and work to be done. You will need to make assumptions on:

5.4.2 Main guidance: define the baseline

- how defences/assets will deteriorate over time and how this will affect their performance. Consider for example how the standard of protection (SoP), or onset of flooding or erosion where no interventions currently exist will change over time, taking account of climate change;

- whether defences/assets will eventually fail or be lost. For example, whether there is increasing likelihood that pumps will fail when they are not maintained, that culverts will block and collapse, whether embankments will breach and/or collapse, whether coast protection works will fail allowing erosion of the land behind or if beaches would be lost.

- once you have identified what might happen, consider the time to failure/loss. This could be based for example on condition grade of defences, exposure to waves, impact of lack of maintenance/operation, impact of not clearing culverts once blocked, or rate of natural processes.

Read more

Tricky assumptions

Read more

Requiring do-nothing to mean that no further action is taken can require some tricky assumptions. Suggested methods for dealing with these assumptions are provided below. It is essential that you explain all the assumptions you make.

Examples of dealing with tricky assumptions: thinking beyond the obvious

i) overtopping of defences and whether this causes breaching. Some defence types (such as embankments or shingle ridges) may be more likely to fail following overtopping (where the water flowing over the defence removes the material leading to structural instability and collapse). This should be considered in terms of impact or consequence. Different scenarios may have to be considered looking at the probability of each scenario.

Scenario a) assumes that there is no breach:
- the consequence of a 10% probability event failure might be damages amounting to £1M. The risk (probability x consequence) is of damages of £100k.
- the consequence of a 1% probability event failure might be damages amounting to £2M. The risk (probability x consequence) is of damages of £20k.

Scenario b) assumes that there would be a breach: during a 10% probability event there might be a 1% probability of a breach, the overall probability of a beach is therefore 0.1%, with a higher consequence of £20M

5.4.2 Main guidance: define the baseline	
	– damages. The risk is of damages of £20k. – during a 1% probability event there might be a 50% probability of a breach, the overall probability of a beach is 0.5%, with the consequence of £30M damages. The risk is of damages of £150k. The scenarios are mutually exclusive (they cannot both happen but either could!). • In the case of the 10% probability event, strictly, there is a 99% chance of Scenario (a) consequences and a 1% chance of Scenario (b) consequences, with total value damages of £990k + £200k = £1.1M for that event x the probability of the event (10%) = £110k. • In the case of the 1% probability event, strictly, there is a 50% chance of Scenario (a) consequences and a 50% chance of Scenario (b) consequences, with a total value damages of £1M + £15M = £16M for that event x the probability of the event (1%) = £160k. Understanding how possible outcomes may give rise to different consequences may be critical in understanding the problem and the real risks. There may be other consequences, such as risk to life and the ability to respond to events, which may influence the way in which the problem and objectives might be expressed. Clearly in the above example a breach in the defence may lead to a range of different impacts. The problem may therefore be less one of standard of service but one of reducing the consequences of a breach. The assessment of probability may be relatively uncertain but the effort may be better spent on the severity of the consequence in understanding the baseline. **ii) Failsafe position of structures**. If an asset is at the end of its operational life then for safety reasons it might be shut down (for example, a pumping station switched off or a sluice gate ‘parked’ in the closed position). This might be at no cost but may result in significant impact within the defence system. **iii) Failing closed or open (such as barriers, sluices)**. It is often not known whether an asset that is not at the end of its operational life will fail open or closed. It is often pragmatic to assume they would be left open, giving a worst case scenario. In situations where the effect of the fail position is significant, you can test the impact on the appraisal outcome during sensitivity testing. Alternatively, you can assign probabilities to each condition

5.4.2 Main guidance: define the baseline

(open/closed) and assess the impacts under each scenario. You can combine scenarios using the probabilities assigned or assess the scenarios separately during the appraisal.

iv) Removal of a defence asset for re-use elsewhere. There may be some types of assets that have a residual life (such as rock armour) and the cost of removal will be a cost to the receiving project. Therefore, do-nothing in your project would not include damages associated with loss of that asset (avoiding the need to calculate the residual value of the defence asset).

v) Blockage of bridges and culverts. It should be assumed that blockages are not cleared. This may increase the likelihood that a bridge or culvert would collapse or may result in river flows taking new, overland routes. You will need to identify realistic alternative flow routes (based on actual events wherever possible).

vi) Site security and health and safety issues. In some circumstances do-nothing may have health and safety issues (for example, corroded steel groynes on an amenity beach). Inclusion of damages in terms of injuries or deaths, not specifically related to flood and erosion risk management, but related to deteriorating defence assets may unduly distort the do-nothing damages, with the need then to examine the incremental benefits of real do something options in comparison with an option for providing safety warnings. However, the sustainability of just providing safety warnings should be examined critically. The loss of an important bathing beach due to exclusion of the public and the real risk that safety warnings may not be adequate in the long term have to be considered. The sustainable position should always start from the position that the risk may be avoided, not mitigated. The damages under do-nothing may have to be the cost of removal of the hazard.

vii) Abandonment of defences that are not at the end of their operational life. Where do-nothing involves abandoning defence assets that still have some residual value in reducing risk, this needs to be considered. Where do-nothing is identified as the preferred option, it will be necessary to calculate the residual value of the assets in terms of the reduced level of risk they continue to provide. A sea wall, although deteriorating may still offer some protection against erosion. This needs to be assessed such that damages may occur later than if the wall were

5.4.2 Main guidance: define the baseline

	not there. An embankment, which is no longer maintained, may still be effective as a defence over the first 5 years. This will reduce the risk of flooding. The overriding rule is to think through the real consequences and to think through the probability of these consequences happening.
Take account of future changes in risk	Do-nothing also reflects the evolution of the baseline over the appraisal period in the absence of any actions of interventions. Therefore, it is important that account is taken of future changes in risk where there is adequate certainty that the change will occur and its nature and magnitude can be reasonably forecast. For example, under do nothing a flood embankment may continue to offer flood mitigation to the end of its residual life which is currently estimated at 10 years. After this time, it is reasonable to assume that no effective intervention exists. Other changes such as population growth are less certain and would more properly be addressed through a sensitivity analysis on option outcomes.
Effect of climate change	The effect of climate change in increasing risk over time may form part of the baseline or a form of sensitivity analysis on option outcomes (see climate change supporting document).
The impacts under do-nothing	There may be significant impacts under do-nothing (for example, due to flooding or erosion of properties, critical national infrastructure, local infrastructure, environmental sites or heritage buildings). The aim is to identify the economic, environmental and social damages that would occur if no further flood and/or coastal erosion risk management actions are taken. This then provides the basis for estimating the benefits (estimated as damages avoided) of the do-something options. The impacts of the do-nothing baseline should be recorded in an Appraisal Summary Table (see also 7.4: Describe, quantify and value benefits). Consider how the do-nothing baseline will result in impacts and when the impacts will occur. Ask, for example: • how often will assets such as properties, infrastructure, roads, habitats and listed buildings flood? • could the assets, including properties, infrastructure, roads and listed buildings, still be used or would they have to be written-off? (see below) • could habitats benefit by being flooded more frequently?

5.4.2 Main guidance: define the baseline

- would increasing frequency of flooding or changing the system regime (discharge/sediment/tidal) result in a change to habitats?
- when will assets such as properties, infrastructure, roads, habitats and listed buildings, be lost to erosion?
- will the impacts extend beyond those that are directly affected? Think about what the loss of assets including properties, infrastructure, roads, habitats and listed buildings means, not just for the flooded area but outside the flooded area as well. For example, loss of a sewage treatment works could affect the whole town. Loss of a major road link, railway line or hospital could affect many towns.
- Are the impacts significant at the national level (such as critical national infrastructure), regional level or local (community) level?
- Does increased flooding in one location, as a result of doing nothing, have potential flood risk management benefits elsewhere in the system?

Read more

Potential for positive impacts

It is important to note that do-nothing may have positive impacts (benefits), particularly when some environmental impacts are considered. For example, recurrent flooding of land alongside a river may generate significant floodplain habitat benefits, or failure of defences along the coast may allow saltmarsh to colonise creating new intertidal habitats. The floodplains could also act as flood storage areas, with flood risk management benefits to downstream communities. At the same time, there may be damages to the land owner, who may, for example, have to write-off the land for crop or livestock production.

Read more

Examples of benefits of the do-nothing option

i) An area of flood plain was defended by an extensive pumping system and embankments. This protected an area of agricultural land which was partially used for grazing as it was too wet for permanent crops. The do-nothing option proposed opening the pumping station to allow water to flow freely. This allowed the area to revert to valuable wet woodland habitat. This area was then promoted to attract visitors, bringing the opportunity for generating income to the area.

ii) A sea wall had been constructed to protect a promenade and car park. The position of the sea wall resulted in increased erosion, loss of the beach and increased overtopping. Maintenance of the car park surface was difficult because of the overtopping, and the use of the

5.4.2 Main guidance: define the baseline

promenade was restricted. The area was in decline. Do nothing included removal of the sea wall as a safety hazard, together with removal of the car park. These costs were included within the appraisal as a necessary damage associated with the do nothing option and collaborative funding was obtained to enhance the amenity value of the area. The removal of the sea wall would allow natural restoration of a beach, increasing the amenity value of the area and providing a longer term more effective natural defence to properties behind.

Links to environmental appraisal

The categories and description of impacts included in the Appraisal Summary Table (AST) should be linked to and based on the environmental assessment, so will differ from project to project. Specific guidance on assessing the impacts under different categories within the AST is given in the AST supporting document.

More detail on assessing impacts can be found in 7.4: Describe, quantify and value benefits.

Do-nothing as an option

Doing nothing is always an option for supported change, complex change and simple change projects. While it might appear to be impossible for political or other reasons to simply withdraw from the area, this should mean that the advantages of preserving what is there are overwhelming. It should then be straightforward to demonstrate that continuing present practice (at least) is better than the 'do-nothing' option.

The do-nothing baseline is often considered an option that could be implemented if the costs of providing a do-something option (including do-minimum) are predicted to outweigh the benefits or if a higher level policy, such as the SMP or CFMP, suggests so. It is important, therefore, that you assess the impacts that could realistically occur under the do-nothing option. Consider what could happen if there is no further intervention of any kind – no maintenance, no capital work, no emergency response. Consider how the risks increase over time – they are likely to become substantially higher than the existing situation because no intervention *at all* will take place.

Identify what will happen and when

Be realistic about what would happen over the 'lifetime' of the project (the appraisal period). Consider knock-on effects and how this would affect the area. This will be essential when explaining the consequences and changes to stakeholders.

Read more

5.4.2 Main guidance: define the baseline

Justify your description of the damages

Make sure all of your assumptions are clearly set out. Include a description of the risks and how the risks change under the do-nothing option and how this results in impacts in the Appraisal Summary Table. Be careful not to paint a catastrophic scenario where this cannot be supported by logical arguments. Being realistic and clear will be essential for working with stakeholders to manage expectations, avoid blight and creating fear and to enable a valid economic assessment.

Read more

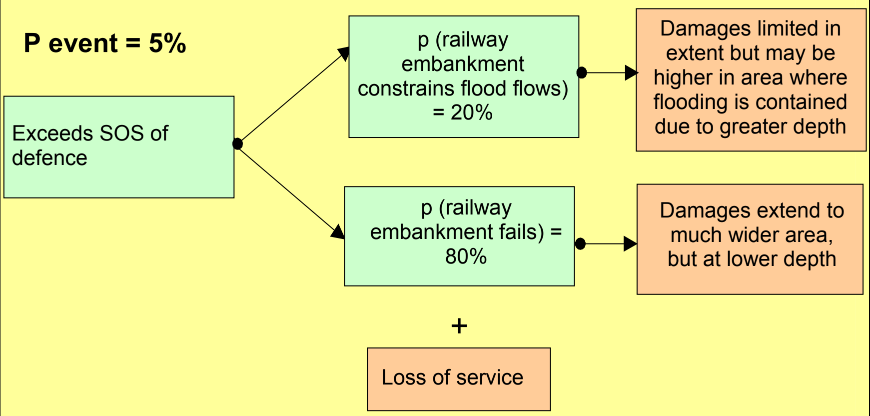
Assessing impacts where there are combinations of effects

Examples of multiple impacts or different consequences: understanding possible scenarios in defining the baseline

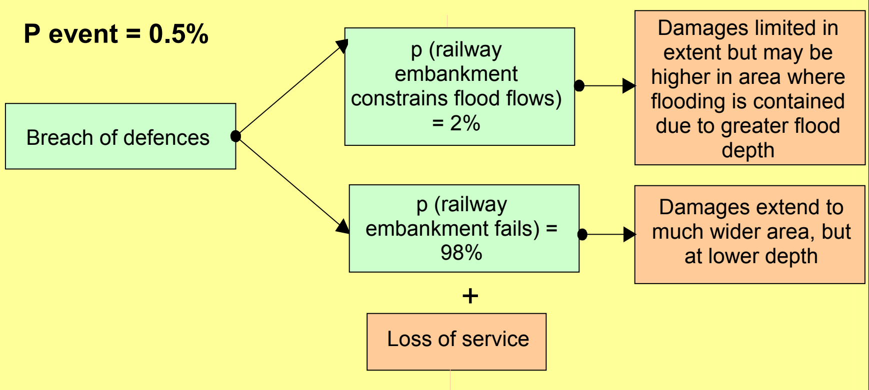
Set back informal defences. Where there are road or railway embankments (or other similar structures that can form informal defence or protection works) that provide some flood or coastal erosion benefit (by constraining flood flows or reducing erosion rates), you should take account of the role of these constraints when defining benefit areas. It is necessary to consider possible different scenarios:

- Will the embankment act as a competent defence?
- Would it be repaired should it be damaged so the service it provides can continue?
- Would it be abandoned?
- What would the consequences be of any of these actions?
- Will the consequence be different for different event probabilities?

Any costs associated with repairing the embankments will need to be included within the option costs.



5.4.2 Main guidance: define the baseline



Where there are multiple sources of flood risk (such as surfacewater, groundwater tributaries to a main river, flooding from the sea) it may be necessary to use joint probabilities to assess the relative inputs of each source to the damages (as well as the cumulative effects). Be careful not to double count damages where the different sources of risk affect the same assets. This approach should allow you to divide up the damages associated with each source to provide an approximate estimate of the benefits of addressing the problem caused by each source individually.

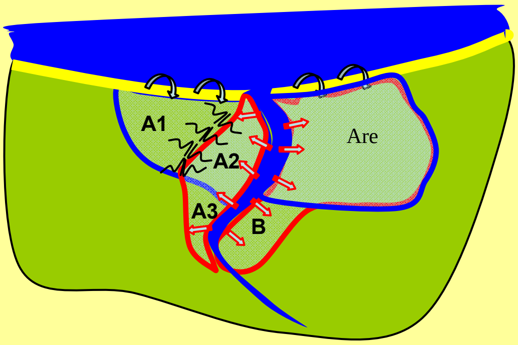
A simple approach is to assume that the sources of flooding are independent of each other. This is a simplification since it is more likely that you will get river flooding following high rainfall, when you are also more likely to have flooding from surfacewater. Descriptions of historical events may be valuable. “We were watching the water level rising in street, when we noticed flooding coming from the kitchen drain to the rear of the house.”

The combination of sources in terms of probability may be complex. They can be clarified by network diagrams and decision trees. It is essential for a good appraisal that they sequence and consequences are understood; every event is a story with a beginning, a middle and an end: a source, pathway and receptor.

Example. A town that is at risk of flooding from the sea and/or a river. Here, the Standard of Protection of defences is 1% from the sea and 5% from the river. Some areas of the town reside within shallow basins, the main basin being along the river valley (flood cells A2, A3, B1 and B2) but with a secondary basin to the west of the town towards the sea (A1).

5.4.2 Main guidance: define the baseline

The ridge between A1 and A2 offers some defence from river flooding but because flooding to A1 is due mainly to wave overtopping and because of the level of the promenade, on a 0.5% coastal event A2 would be subject to flooding as water builds up in cell A1.



The initial analysis is purely assessing the pathways. Probability can then be assessed as follows:

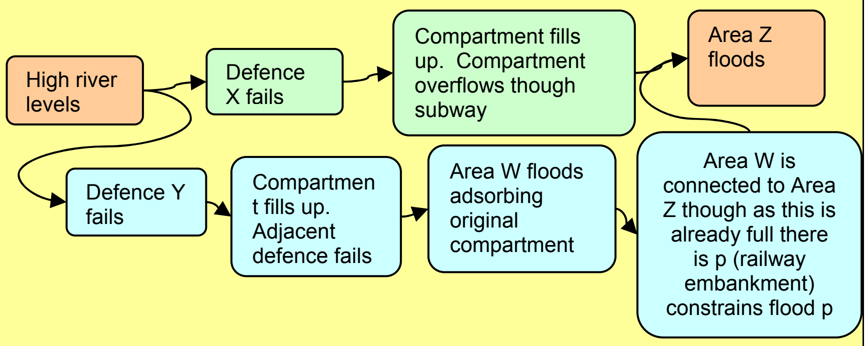
Area	Source 1	p %	Source 2	p %	Source 3	p %
A1	Sea	1	No other source	-		
A2	Sea via A1	0.5	Sea via river	1	River	5
A3	River	5	Sea	>1?	Sea via A1	>0.5?
B1	Sea	1	Sea via river	1	River	5
B2	River	5	Sea via river	>1%	Sea via B1	>1?

Different probability events may give rise to different levels of damage and may expose different areas to new pathways of flooding. Clearly both direct flooding and wave overtopping from the sea are not independent. But defence of the river frontage may not resolve flooding to A1 and B1. If river flooding is independent the damages in areas affected both from river and sea would be determined as cumulative values in determining average annual damage.

Where there are multiple defences of different condition grades and/or with varying residual lives, it will be necessary to make an assessment of the most likely pattern of breaching (see example on multiple sources of flood risk). This can then be used to define a timeline for the do nothing scenario (bearing in mind that it is one of many possible scenarios). The timeline will allow a storyline to be described of when impacts occur and how they change over time. A detailed storyline of the impacts and when they occur should help you determine when to include certain damages and when to extend them further. An initial assessment of this is essential in defining the project boundaries.

5.4.2 Main guidance: define the baseline	
	Such approaches can make assessment of damages to individual features (such as properties) much easier to assess as the onset of damages can be allocated to a specific time (similar to approaches used for erosion of properties linked to erosion contours). Linear features (including roads, railways, footpaths) are more difficult. Consideration needs to be given to individual aspects of the linear features. For example, a stretch of road linking two villages may be affected in year 10 cutting off direct links between the villages and requiring a 10 mile detour. Although the length of road affected may increase, it may not be until year 25 that an additional roundabout is affected that restricts links to a third village. Complex road networks may need to be simplified, for example, by only including roads of the same of higher category (if an A road is affected, only looking for diversions along other A roads). Railways may be simpler since there are generally fewer alternative routes available for diversions. The focus must however be on the overall impact. **Where there are multiple defence structures, each of which would result in different impacts**, it may be necessary to use decision trees. For example, a town centre includes five culverts Each of the culverts can be assigned a probability that it will block, with an assessment of the likely flooding that would occur should each block independently. Consideration can then be given to the probability that if one culvert blocks, what would be the affect on the next culvert. It may be best to start from the culvert with the highest probability of blocking and work back to the culvert with the lowest probability, taking account of any reduced risk to other culverts because water is flowing overland due to the previous blockage (or increased risk because there is a greater chance that objects will be picked up and could flow into the next culvert). This will allow you to develop a better understanding of the overlaps between culverts such that you can then distribute benefits (again approximately) to each.

5.4.2 Main guidance: define the baseline



The same approach would be applied to bridges, weirs, and sluices.

Do minimum

Do-minimum is used where the primary purpose of the project is to satisfy a legal requirement or where a Sustain SOS project is being undertaken. In such cases, do-minimum is defined as the minimum action or intervention needed to ensure that the legal requirements or the performance of the asset as set out in the AMP is met. In such cases, a cost-effectiveness analysis (CEA) is used. The do-minimum option is defined as the level of benefits that is to be provided by all the possible options.

Do-minimum is appropriate where there is a minimum legal requirement that has to be met. For example, projects in areas designated as SPA or SAC (Habitats Directive sites) often use do-minimum as this meets the legal requirement of avoiding damage (adverse effects on site integrity) that would be caused by the do-nothing option. Similarly, where action is required under Health & Safety legislation, it would again be appropriate to use do-minimum.

The do-minimum requires differences between options to be identified (for example, linked to differences in the ways that they would provide the legal requirement or sustain the standard of service. The description of do-minimum should focus on the benefit that is to be provided by the options (this will need to link back to the objectives set in Chapter 4).

Read more on

Go beyond the minimum requirements

In some cases, you may want to look at options that go beyond the minimum level of benefits (do more than meeting the minimum legal requirements, meet more of the objectives or look for more adaptable solutions). You will also need to estimate the additional costs as you will need to show that any additional activities are worthwhile during decision-making (where the benefits need to exceed the costs).

Check you have completed all the expected outputs

5.4.3 Explanations and further guidance: define the baseline	
Which baseline? Return to main guidance	**A do-minimum option** is used for **legal requirements** and **Sustain SOS** projects where the case showing that do-minimum is economically worthwhile (benefits exceed the costs) or that do-nothing would be illegal has already been made. For legal requirements, the economic case may be made in Impact Assessments undertaken when the legislation was proposed. For Sustain SOS projects, the economic case will have been made in the asset management plan or strategy. You will need to make sure that this case is robust and that you can justify why CEA is the most appropriate route in the project appraisal report (including relevant sections of the CBA in an annex).
Why do we use do-nothing? Return to main guidance	Where a case has not already been made, you need to show that the project is worthwhile. This requires the costs and benefits to be compared. In this case, use cost-benefit analysis (CBA). **Do-nothing** is used as the baseline because there flood and coastal management works are permissive in England and Wales. This means that there is no right to protection from flooding or erosion. As a result, it has to be shown that undertaking works to reduce the risks from flooding and/or erosion are beneficial to society as a whole. This is done by showing that the benefits (which occur mostly to people living and working in the at risk area) outweigh the costs (which are paid by taxpayers from all around the country). Assessing the costs and benefits can also help you identify who benefits. This information can be used to identify potential contributors to the project. You should have considered potential project partners during identification of the problem and when setting objectives.
Do-nothing means do-nothing Return to main guidance	Do-nothing means just that. You need to assume that no more work is undertaken **at all** in the project area. No maintenance work, no capital work and no emergency responses to failures or near failures. This is important as it is the average benefit-cost ratio of implementing one of the other options that will determine whether it attracts funding (or not). The benefits of the option are measured as damages avoided against the do-nothing baseline. Thus, the damages of doing nothing need to be appraised as realistically as possible.
Describing the impacts of do-nothing	You will need to consider information on areas at risk of flooding or erosion rates when assessing how far the impacts of do-nothing could extend. This may require modelling but, in some cases, flood maps and estimated

5.4.3 Explanations and further guidance: define the baseline

erosion lines could be sufficient. Description of the impacts of do-nothing is always uncertain (particularly in areas that have defences, barriers, sluices or pumping stations). You need to make sure that you have a clear description of the risks and how these risks are predicted to change; a timeline of events (for example, failure of defences, collapse of culverts or blockage of bridges) and the impacts that occur as a result.

Describe what will happen once the defences fail. Use data such as flood maps, and erosion rates to define the at-risk area. Look for assets that could result in knock-on effects for people outside the at-risk area (including sewage treatment works, water treatment works, hospitals, fire stations, police stations and major access routes). Look for alternative assets outside the at-risk area and where there may be redundancy in the system such that a service can continue to be provided through a different route (for example, it may be possible to maintain electricity supplied to properties by re-routing supplies through alternative sub-stations if a small number are out of action due to flooding). If there are no alternatives consider what life would be like without the services that would be lost. If there are alternative assets consider how far away they are and whether they would be able to cope with additional demand. This approach will help show that you have undertaken a considered assessment of do-nothing. See also 7.4: Describe, quantify and value the benefits.

If the impacts resulting from lost or interrupted services are likely to be key to the do-nothing option, it may be necessary to contact the service providers and see what they believe the impacts would be to the specific installation and potentially the recipients of the service. Consider though whether it is sufficient just to identify the potential impacts at this stage; you can collect more detailed information later should the choice of preferred option be dependent on a detailed understanding of those impacts.

Return to main guidance

Be realistic

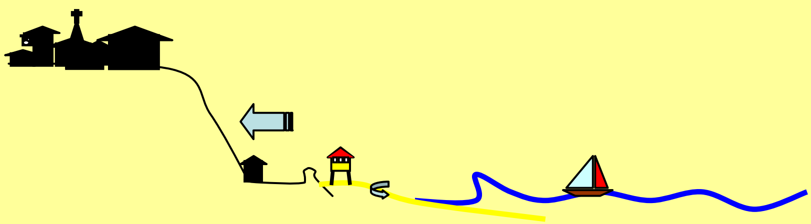
It is important that do-nothing options are realistic. Assets affected should not only be counted and recorded (for example, using GIS), but proper consideration should also be given as to what loss of those assets would really mean, in particular relating to services that are provided. The categories in the AST can be used as a guide to make sure that a wide range of possible impacts has been considered when describing the impacts of the do-nothing option.

If you significantly under-estimate the damages of do-

5.4.3 Explanations and further guidance: define the baseline	
[Return to main guidance](#)	nothing, you may find it is difficult to justify any options. If you significantly over-estimate the damages of do-nothing, your appraisal will lose credibility as a decision-making tool and will be questioned and criticised when it is reviewed. Make sure that you can support your assumptions with clear, reasoned explanations. Look at other appraisals and see how they have described the do-nothing option. Be careful though not to fall into the trap of assuming that the do-nothing baseline is merely an extension of the current situation. Make sure you consider and describe what could really happen as the risks change over time.

Example of a realistic do-nothing option

Erosion is predicted to result in loss of all the recreational facilities associated with a coastal resort, Town A. It may not be sufficient to just take account of the write-off value of the recreational facilities alone. It is important to consider what the impacts would be on the economy and community of the resort and when they would occur.



This has to be thought through.
The initial loss may just be to the beach, which may result in loss of amenity and tourism. Other questions may include:

- How would this impact locally?
- Is it a local impact or does it impact nationally?
- Does this result in loss of use of facilities, are the facilities made redundant and, therefore, lose part of their asset value?

Subsequent loss may be of the actual promenade.

- With physical loss of assets, but part of their value may already have been taken into account.
- Is there further loss of amenity/tourism?

Continued erosion may result in the loss of the town or part of the town.

- What physical assets are lost?

5.4.3 Explanations and further guidance: define the baseline

- What does this mean to the region and the nation? Have these broader scale losses already in part been taken in to account in assessing the loss of tourism and amenity?
- If there is no town, should amenity loss still be considered as an annual loss?

You may decide that some of the impacts are not a loss to the nation and use would be transferred as a benefit to a neighbouring town. You may not be able to realistically value some losses. Even so you should make sure you have considered them and described them in sufficient detail when developing the do-nothing scenario. This may influence the manner in which objectives are defined.

Think through the story.

Use the Appraisal Summary Table Return to main guidance	Use information from scoping of the project during the environmental assessment and a consideration of the types of economic impacts that could occur to help you describe the do-nothing option. See 7.4: Describe, quantify and value benefits for more information on the types of impacts to consider and the Appraisal Summary Table supporting document for more information on how to complete the AST. This includes a worked example.
Why is it necessary to show the benefits of legal requirements? Return to main guidance	Information on the benefits of legal requirements will help Defra and the Environment Agency to understand who is gaining or losing from the programme of work, and demonstrate that the programme provides good value for money. It is important that the benefits (and the distribution of benefits) is identified and described (as a minimum). Further information, for example, valuing the benefits in monetary terms will not always be necessary. In all cases, the effort used to identify, describe and (where appropriate) value the benefits should be proportionate.
Explain all your assumptions	Use the do-nothing option as an opportunity to explore how impacts would occur over time when no further work is undertaken. Explain all your assumptions and the basis on which you have made them. This will help you make the right decisions and to explain your decisions to others including stakeholders.

5.4.3 Explanations and further guidance: define the baseline

Explain all your assumptions

Statement: A defence is predicted to fail in year 5

Reason: explain because:

- the defences are already in poor condition
- part of the defence has already failed
- timber groynes have a typical life expectancy of 30 to 40 years and they were constructed 35 years ago.
- erosion is reducing beach levels.
- water levels are set to increase as a result of do-nothing elsewhere

Evidence:

- based on a site visit and experience elsewhere.
- the condition of defence and its rate of deterioration has been monitored.
- there are cracks in the roadway above.
- corrosion of the steel sheet pile has been measured.
- modelling predicts a change in conditions.
- a person who walks their dog along the beach has a set of photographs.

The quality and confidence or uncertainty associated with evidence does not necessarily relate to the sophistication of the method used in obtaining the data.

Return to main guidance

Check you have completed all the expected outputs

5.5 Checkpoints and outputs: type of project and baseline

Checkpoints

Assess whether it is worthwhile continuing with the appraisal in its current form by answering the following question:

1. Has the correct appraisal type been identified?

You need to verify that you have identified the correct type of project. For the Sustain SOS route, you should verify that the CBA undertaken (for example, in the asset management plan) follows the general principles of this guidance and includes costs and benefits of both the do-nothing option and the sustain SOS option. You will need to justify and explain your choice of Sustain SOS route (including to stakeholders), so you will need to have confidence in the approach used and results. If in doubt, you should seek expert advice to minimise the risk that you are using CEA when you should be using CBA (and that you may miss opportunities to deliver more or wider benefits) or that you are using CBA when you should be using CEA (resulting in higher appraisal costs and taking more time to deliver).

2. Have the benefits of legal requirements been shown?

For some types of legislation (such as local legal agreement that relate to the ownership of defences or the operation of structure, or that require a specific standard of protection or height of defence to be provided), it is necessary to identify whether the costs of complying with the legislation exceed the costs. If so, you will need to consider (through consultation with appropriate organisations) whether the legislation can be overcome, rescinded or bought-out before continuing with the appraisal.

3. Have the right stakeholders been engaged at the right level?

The Stakeholder Engagement Plan (SEP) should identify the right level of engagement at the outset of the project. This should cover an understanding of the project and its objectives; definition of the appraisal type and baseline and build trust in and understanding of the work completed to this stage. The SEP should be updated at this stage to record all engagement actions including outputs to date.

5.5 Checkpoints and outputs: type of project and baseline	
Outputs	Typically by this stage, you should have identified the appropriate appraisal type and defined the baseline. • **Identification of the appraisal type**: this is essential as it determines which appraisal tasks need to be undertaken and which can use information from elsewhere (in particular the sponsor document) (see: identify type of project required). • **Definition of the baseline**: this will be either do-nothing or a do-minimum option (depending on the type of project you are undertaking). You should have described the do-nothing or do-minimum option. You should also have identified that the benefits of do-minimum outweigh the costs (see: define the baseline). **All outputs complete: the project type has been identified and the baseline has been defined** **Move to Chapter 6: Identify, develop and short-list options**

6. Identify, develop and short-list options

6.1 Key Principles: Identify, develop and short-list options

Development of the options involves identifying as wide a range of options as possible and following a systematic process of understanding, removing, enhancing, amending and combining to remove duplications, making improvements to option definition, clarifying unknowns and uncertainties, addressing constraints and concerns, and incorporating identified opportunities. The approach is an iterative process, following three main stages:

1. **identifying and developing a wide range of options**: a divergent process needing a very open mind and a good breadth of disciplines;
2. **screening out non-starters**: a focussed convergent process where objectiveness, practicality and feasibility with respect to the objectives come in; and
3. **developing a short-list**: development and assessment of the remaining options to be able to describe their content (and associated broad cost) and impact (both positive and negative) and evolve a short-list for detailed appraisal.

The development of options is a key activity and if carried out correctly can save time and resources and help you identify optimal solutions.

The role of stakeholder in developing options is to ensure all local knowledge, needs, constraints and aspirations are considered. Potential contributors and funding sources may also need to be explored. Stakeholders can be involved in selecting possible options, testing them, refining them and finally supporting the proposed solution. Engagement with stakeholders should be expected rather than unusual in this stage of the appraisal.

Figure 6.1 shows where you are in the appraisal process (orange coloured box). Follow the hyperlinks to move back to previous chapters of the guidance if you need to iterate. Clicking on a hyperlink to another chapter takes you directly to the start of that chapter (to the key principles). Clicking on a hyperlink to a section within Chapter 6 takes you to the main guidance.

6. Identify, develop and short-list options

6.1 Key principles

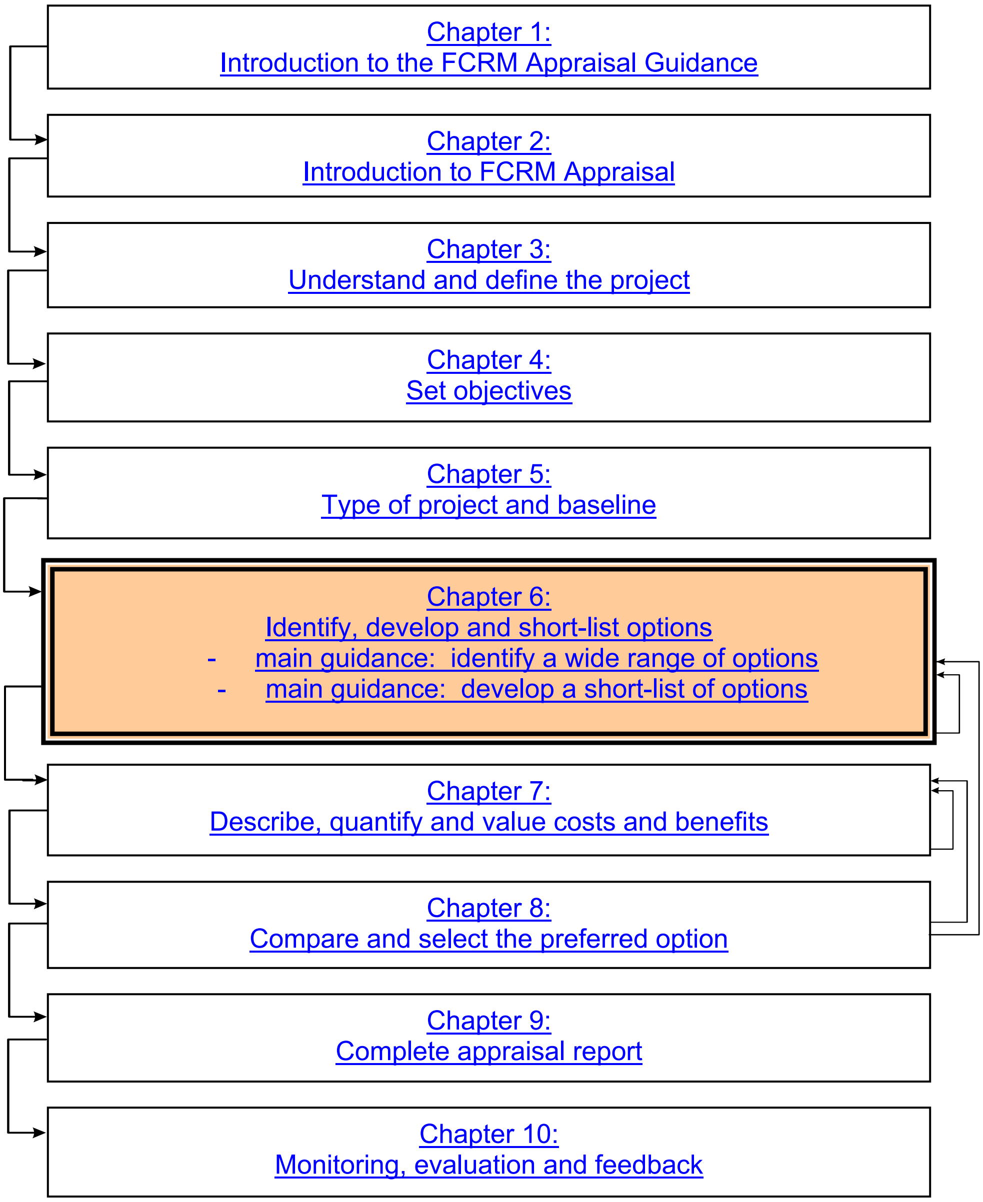


Figure 6.1 Navigation flowchart

6.2 Inputs to identify, develop and short-list options

To inform the identification, development and short-listing of options, you should draw on the outputs from Chapters 3 to 5:

- options need to be identified that can provide solutions to the problem and key issues identified and described in Chapter 3 (understand and define the project), that can meet objectives defined in Chapter 4 (set the objectives) and which would maximise any positive impacts and minimise negative impacts when compared with the baseline from Chapter 5 (type of appraisal and baseline);
- constraints described in Chapter 3 (understand and define the project) will need to be considered when identifying potential options;
- opportunities and objectives described in Chapter 3 understand and define the project) and Chapter 4 (set the objectives) should be used to look for options that can provide additional benefits, wherever possible, in association with project partners.

The Stakeholder Engagement Plan (SEP) will have identified the level of engagement required for the project. Engagement will have been carried out to help identify and describe the problem, key issues and baseline and to help set the objectives.

What will have happened in the environmental assessment that should be used here?

The consideration of options is an important component of the environmental assessment process. Those responsible for the assessment should be fully integrated into this part of the process as they will have an important contribution to make in:

- screening out environmentally unacceptable options.
- identifying conflicts with environmental legislation.
- proposing less environmentally damaging options.
- modifying options to improve their environmental performance.
- identifying opportunities for synergies with external initiatives.

6.3 Identify a wide range of options

6.3.1 Expert summary: Identify a wide range of options	
Identify a wide range of options Read more	At the early stages of appraisal a wide range and broad portfolio of options should be identified. These options should be appropriate to the scale and type of project being undertaken: strategy or scheme. It is important to think widely to capture as many potential options as possible as this can save time. Consideration of alternatives will also be important in the context of legal requirements such as the Water Framework Directive and the Habitats Regulations. In the event that the selected option runs counter to the objectives of these Directives, it will be important to demonstrate that reasonable alternatives have been considered and can be justifiably rejected.
Engagement Read more	The level of engagement during the options appraisal stage should be defined within the stakeholder engagement plan dependent on particular issues. Further information from key stakeholders may be useful in developing options, particularly to meet drivers which were used to inform the objective setting process. Statutory consultation required for SEA, should have been completed during the definition of baseline and objective setting process. The outcomes from this process are likely to have influenced the objective setting process.
Types of options to consider Read more	Consider the following when identifying and developing the wide range of options: • options that change the source of risk; • options that modify the pathway or change probability (including options that could increase the probability where this could deliver environmental benefits); • options that manage or modify receptors to reduce the consequences (including options that deliver social benefits); • temporary as well as permanent options; • options that work with natural processes wherever possible; • options that are adaptable to future changes in risk; • options that require actions to be taken to deliver the predicted benefits (for example, closing a barriers, erecting a temporary defence or moving contents on receiving a flood warning); • innovative options tailored to the specific needs of the project; • options that can deliver opportunities and wider benefits, through partnership working where possible.

6.3.1 Expert summary: Identify a wide range of options	
Considering win-win options	Some flood and coastal erosion risk management options will work with natural processes and deliver a range of benefits, such as reduced costs, habitat creation, more resilient defences, carbon sequestration and fish nurseries. FCERM solutions may be able to contribute to delivering on the objectives of other legislation, plans or programmes (such as programmes to improve community health or economic prospects). Particular regard should be given to measures contained within the appropriate River Basin Management Plan, national and local biodiversity action plans and the extent and condition of other designated habitats.
Screen out non-starters Read more	Remove any impractical or 'non starter' options from the initial list. Provide and record justifications for their removal. Ensure that options which could be combined to deliver an overall solution are not discounted too early. You should consider legal and technical issues. Recording of the decisions made is crucial to explain how the project has progressed to others and to secure support for the final decision. Make sure that you have a do-nothing (when you are undertaking a CBA) and do-minimum option in the options taken forward. In addition, the best available environmental option and those with strong sustainable social benefits should remain in the appraisal process unless they are manifestly unviable.
Combine option identification with screening of non-starters Read more	The identification of a wide range of options and screening out of non-starters can often be combined as the bulk of this work could sensibly be done in a well facilitated workshop based on the definition of the problem and baseline, project objectives and the key constraints and opportunities from Chapters 3, 4 and 5.
	Move to develop a short-list of options OR Check you have completed all the expected outputs

6.3.2 Main guidance: Identify a wide range of options	
Identify a wide range of options	At this stage, you need to identify options that could address the problem (partly or completely). You will develop the options through the appraisal; some options will be screened out, others will be refined, combined and optimised. All reasonable and significant options to address the problem and meet the objectives should be investigated to an appropriate level of detail. You do not want to spend too much time developing the options here. It is sufficient to

6.3.2 Main guidance: Identify a wide range of options	
Read more	identify them and describe how they would address the problem, meet the objectives and could deliver opportunities. The aim is to develop a broad portfolio of options that include different approaches to managing risk, and work with natural processes, wherever possible. You should then be able to build in other requirements such as the Water Framework Directive and Habitats Regulations.
Link to higher level plans	The process of identifying options should take account of (but not be constrained) by potential solutions identified in higher level plans (such as SMPs and CFMPs or RBMPs).
Engagement	Stakeholders should be engaged to provide input when the wide range of options is being identified. Particular consideration should be paid to which of the stakeholders could become project partners and help deliver the preferred option through financial and in kind contributions.
Read more	The consultation requirements set out in the EIA/SEA regulations should also be considered to ensure that the statutory consultees are included in the process and that internal policy and good practice is followed.
Types of options to consider	The range of options should initially be as wide as possible and may include (this list is not exhaustive): • options that change the source of risk; • options that modify the pathway or change probability; • options that manage or modify receptors to reduce the consequences; • temporary as well as permanent options; • options that work with natural processes wherever possible; • options that are adaptable to future changes in risk; • options that require actions to be taken to deliver the predicted benefits (for example, closing a barrier, erecting a temporary defence or moving contents on receiving a flood warning); • innovative options tailored to the specific needs of the project; • options that can deliver opportunities and wider benefits, through partnership working where possible.
Tailor the options to project level	Options developed for a project should be at the appropriate level to the nature of the decisions to be made (strategy versus scheme) and be informed by the objectives set for the project. The range of options should also recognise preceding work. For example, for supported change projects,

6.3.2 Main guidance: Identify a wide range of options	
	the options should be constrained to those that deliver the preferred strategy as well as do-nothing and do-minimum (both of which should already be available from the strategy).
Strategic options	Complex change appraisals require the development of strategic approaches to addressing the problem. Strategic options often consider the level of change in risk, it is important to remember that this is being measured from the do-nothing baseline (see 5.4: define the baseline). You should also consider any existing levels of protection (and how these might change over time, for example, due to sea level rise). It is important that the strategy includes options that can provide different levels of risk reduction (particularly for flooding projects; it can be more difficult on eroding coasts as protection works often stop erosion). A good range of levels of risk reduction provides a better basis for finding the best solution. Considering a narrow range of levels of risk reduction can constrain the appraisal. Strategic options could include adaptation options (such as relocation of assets) or options remote from the problem (such as hard points).

Examples of what could be considered when identifying strategic options

It is the need to address the problem that should drive the identification of options. It should not be a scatter-gun approach. There should be structure to this thought process. The way in which the risk is being managed under each potential option should be considered. This imposes a framework on the thought process.

There are only two underlying options.

- **not to manage the risk** – do nothing. This would be covered in considering potential outcomes of do nothing, (5.4: define the baseline). If it is concluded that this is the preferred option then the implications for this would need to be considered further.
- **to manage the risk** – do something.

In looking at other potential approaches strategically it is helpful to consider options for managing:

- the **source**, altering the behaviour/frequency of the flood event or reducing or modifying the energy impacting on the coast:
  - flood storage (dams, attenuation)

6.3.2 Main guidance: Identify a wide range of options	
	- removal of constraining structures - changes in land use - reshaping the coast and its behaviour (Offshore breakwaters, reefs, headlands) • the **pathway**, altering the way in which the source interacts with the area: - diversion channel - channel works - re-establishing or introducing sediment feed (removing structures, recharge) - linear defence/Channel containment (embankments and walls) • the **receptors**: - resilience or flood proofing - adaptation - warning and monitoring In each of these options there should be consideration of options for: - making use of the existing defence system - hold present defence line - managed Realignment - advance defence line And whether this should be reactionary, responsive or proactive: - repairs and maintenance - temporary or demountable defences - monitor and beach recharge Finally, consideration should be given to options that: - reduce flood risk management activities, allowing a reduction in standard of service - manage flood risk at current level with similar or alternative options - sustain current flood risk with additional work - improve the standard of service The framework above might vary in line with the specific problems being considered and the list of examples is neither prescriptive nor exclusive. There may also be a combination of approaches in any area and this may arise from an iterative approach, considering benefits, constraints and impacts of particular approaches.

6.3.2 Main guidance: Identify a wide range of options	
Scheme options	Identification of scheme options will depend on the type of appraisal being undertaken (see 5.3: identify type of project required) as this will determine whether the scheme is delivering a strategic option (supported change projects), replacement, repair or refurbishment options (sustain SoS project) or delivering a standalone scheme (simple change project). For supported change projects, you should identify approaches to deliver the preferred option identified in the strategy. The flexibility you will have in terms of the range of options to consider will depend on the detail given in the strategy. For sustain SoS projects, the scheme options will be limited to those that can provide the required replacement, repair or refurbishment. You should though consider whether it is possible to adapt to future changes in risk and provide some of the wider objectives identified in Chapter 4 (set the objectives). You should aim to identify option that would address the problem and meet the objectives of simple change projects. This may mean you have greater flexibility in terms of the options that could be implemented. Simple change projects may also require specific solutions tailored to the problem. **Examples of what could be considered when identifying scheme options** As at the strategic level, it is the need to address the problem that should drive the identification of options. It should not be a scatter-gun approach. Even in thinking about a possible long list, there should be structure to this thought process. This may be driven by the outcome of a strategy, CFMP or SMP. Thinking about the function and impact of any element of defence may allow options to be grouped, making it simpler to develop a short list and to consider combinations. In any particular circumstance works might be grouped by the possible need (or function) to: • raise the level of a defence: - embankments; - crest walls; - sea walls; and - rock revetments. • or options to reduce water levels, wave heights or improve conveyance

6.3.2 Main guidance: Identify a wide range of options

- use of control structures (weirs, sluices, locks);
- barriers/barrages;
- breakwaters, offshore structures, reefs, jetties;
- diversion channels;
- dredging, removal of material;
- pumping stations.

• reduce scour or erosion:
- beach nourishment;
- groynes;
- breakwaters, offshore structures, reefs;
- vegetation; and
- use of control structures (weirs, sluices).

• or options to resist scour or erosion:
- sea walls;
- revetments;
- scour protection; and
- mattresses/sand bags/geo-tubes/gabions/soil reinforcing.

• hard linear barriers or responsive natural means of dissipating energy; and

• local flood defence or linear flood defence.

The framework above would vary in line with the specific problems being considered and the list of examples is neither prescriptive nor exclusive. There may also be a combination of approaches in any area and this may arise from an iterative approach, considering benefits, constraints and impacts of particular approaches.

Options that change the source

Source management for flood risk management projects could include source run-off management such as SUDS, afforestation or sustainable land and farm management practices.

Source management on the coast could include options that reduce wave energy or reduce wave run-up, such as beach re-nourishment, groynes and off-shore breakwaters.

Read more

Options that modify the pathway

Options that modify the pathway and/or change probability of flood or erosion risk are typically structural options. The change in risk could occur as a result of the impacts of climate change (including sea level rise), or the options themselves (such as withdrawal of defences in certain areas or options that would increase the probability of flooding in one location to reduce it elsewhere). Structural solutions do

6.3.2 Main guidance: Identify a wide range of options

not necessarily have to be on site but can be remote such as flood storage reservoirs or washlands. They can also be local such as flood proofing (ring banks or flood resistance measures) for individual properties or groups of properties.

Pathway management options could cover new, raising or strengthening of walls and embankments for flood or coastal erosion protection and outfall non return valves, pumping stations, barriers and barrages.

Options that reduce probability can also include maintenance activities such as dredging channels and refurbishment of structures such a sluices.

For coast protection schemes, the influence of options in terms of their effect on the probability of failure (or time to failure) should be considered. In both cases, different approaches to reducing risk and the optimum time to undertake the project should be determined.

Read more

Options that manage or modify receptors

Options that manage or modify receptors and reduce the consequences of flooding or erosion are typically (but not always) non-structural solutions. They typically fall into two categories:

- measures which can be assessed, defined, and implemented in advance of flooding or erosion. They include:
  - flood forecasting;
  - relocation;
  - change or redistribution of land use to fit the risk;
  - floodplain management such as river re-meandering, floodplain reconnection, catchment land use or land use management changes;
  - use of natural features such as salt marsh and floodplain storage to reduce energy and/or flood levels;
  - education;
  - strategic or local land-use development planning; or
  - flood resilience measures to individual buildings.
- planned emergency response measures which are applied to help mitigate the effects of flooding or erosion. They include:
  - flood warning and flood awareness;
  - emergency response planning
  - flood incident management;
  - evacuation; or
  - emergency assistance and relief.

Read more

6.3.2 Main guidance: Identify a wide range of options

Temporary options

Demountable and temporary defences can be used in some circumstances but the additional probability of operational failure (to erect or close the defence in time) must be taken into account in the subsequent benefit assessment (see options with varying probabilities of success).

Working with natural processes

Read more

Working with natural processes can deliver flood and erosion risk management benefits, environmental benefits, and can help reduce the costs of options. Options that work with natural processes recognise and work within environmental limits to produce solutions that are more flexible and more resilient. It is important when identifying options that, where possible, you include those that work with or re-establish natural processes. You should consider the extent to which options identified to address the problem could work with natural processes. Figure 6.2 illustrates what is meant by working with natural processes. For more information on working with natural processes, see the natural processes supporting document.

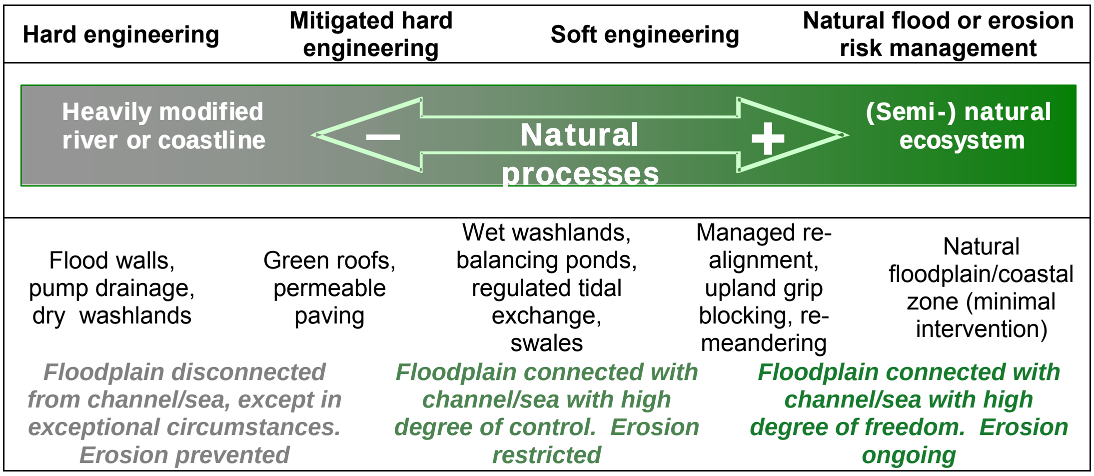


Figure 6.2 A conceptual model of what 'working with natural processes' means (adapted from RSPB, 2010)

Adaptation to future changes in risk

Read more on adaptation

Options should be considered in terms of how they could react to future changes in risk, for example if they are inflexible (once implemented they cannot be amended to take account of increased (or reduced) impacts of future changes). Adaptation also embraces options that enable communities to adjust to increasing risk through actions such as relocation or re-distribution of land use to tailor vulnerability of use to flood or coastal erosion risk.

Adaptation options should consider precautionary versus managed adaptive approaches and whether (and which)

6.3.2 Main guidance: Identify a wide range of options

actions need to be taken now (including whether actions can be delayed) to improve the extent to which an option can respond to future changes (and uncertainty associated with predicting future changes). It is also important to consider whether options constrain the ability of the natural environment to adapt over time, particularly in response to climate change.

Read more on options that restrict the environment's ability to adapt

Options that address the consequences may be considered more adaptable to future changes because they reduce reliance on defences. In such cases, it is the population at risk that adapt to the future changes, rather than the option being proposed (although clearly the option should encourage or facilitate adaptation of the population).

Options with varying probabilities of success

Any option that requires one or more actions to be undertaken to deliver the predicted benefits has a varying probability of success. The overall probability of success will depend on the individual probability of success of all the actions required to deliver the predicted performance. For example:

- flood warning: actions required include (i) forecast generated (ii) warning given, (iii) warning received, (iv) warning acted upon.
- manual closure of flood gate: (i) flood forecast or detected (ii) command to close flood gate given (iii) personnel mobilised (iv) personnel arrive at flood gate, (v) flood gate closed.
- temporary defences: (i) forecast generated (ii) command to erect temporary defences, (iii) resources (manpower, plants and materials – including defence sections mobilised) mobilised, (iv) temporary defences arrive on site, (v) temporary defences erected.
- washland: (i) flood flows overtop weir, (ii) washland is sufficiently empty to accommodate flood flows.

Options such as planning constraints may also have varying probability of success, defined by the extent to which the planning requirements are enforced.

Read more

Estimating probabilities

To estimate the overall probability of success, you will need to assign a probability of success (and failure) to each action. It is unlikely that studies will have been undertaken to estimate the probabilities of success. You may have to establish them through discussions within the appraisal team, drawing on the expertise of those who have worked with similar options wherever possible. These probabilities will be used to develop the options during short-listing.

6.3.2 Main guidance: Identify a wide range of options	
Innovative options	You should consider the potential for identifying innovative options, tailored to the problem being addressed. This may involve combinations of other types of options, technical advances or using new techniques or approaches. However, the uncertainties associated with innovative options must also be taken into account.
Consideration of opportunities	Consideration should also be given to identifying opportunities associated with the options, for example, by joining up schemes with other projects (such as road or bridge construction, opening up a floodplain or restoring intertidal areas). It may be difficult to define opportunities at the option identification stage, but considering them early on in the process will help identify where there are potential additional benefits that could be delivered.
Screen out non-starters	Remove at an early stage any options which are definitely not practical or feasible. You should consider legal and technical issues. Options should not necessarily be excluded because they may not attract funding. Options that could provide multiple benefits should be sought by working with project partners to examine the potential for multiple funding sources. It is also important to ensure that the best available environmental option and options that would provide sustainable social benefits are not screened out, unless they are clearly (and justifiably) unviable. Even then, as many of the attributes as possible should be incorporated into options being taken forward. Providing justifications for the removal of any non-starters ensures accountability and shows that consideration has been given to a wide range of options. This only needs to be as detailed as necessary. It also helps when engaging with and explaining decisions taken to stakeholders and to secure support for the final decision. Make sure that you have a do-nothing (where you are undertaking a CBA) and do-minimum option. Do-minimum is usually taken as the minimum amount of action (maintenance and minor repair) to retain some defences or protection works. If major capital works would be required in the future (for example, to replace defences) then this would not be classed as do-minimum. This may mean that do-minimum would revert to do-nothing when it is no longer feasible to continue maintaining the defences.
Read more on why you screen	

6.3.2 Main guidance: Identify a wide range of options

Example of a proportionate approach to screening

The Appraisal should be of options that will work. This should not screen out imagination but neither should it include or waste time on the preposterous.

Thinking about what options might be appropriate within a well argued framework can save a lot of time and paper.

Screen out options that are technically inappropriate but also think about function:

- flood proofing properties that are at risk from erosion is inappropriate (but the principle that the solution may be a local one may not be).
- an offshore breakwater to deal with fluvial flooding risk is inappropriate (but the principle of influencing the impact of energy/flow may not be).
- raising the crest level of a wall that is already being undermined is inappropriate (but be aware of opportunities to do minimum maintenance or improvements if appropriate).

Discuss, think and screen the generic approaches before getting into the details. A logical argument covering the thinking in a sensible way should save a lot of repetitive discussion that: a concrete sea wall is inappropriate, that a rock revetment is inappropriate, that a gabion wall is inappropriate, that a masonry wall is inappropriate, when actually what is meant is that a linear defence is unacceptable.

Screen out options that are technically impractical (but think whether in principle they really are!):

- a diversion channel over a hill may be impractical when there are obviously more sensible approaches such as channel works, purely because the hill is 100m high. However, on a large enough scheme could a tunnel be used to divert water through to a different catchment area?
- a major flood storage reservoir to protect a small village, where the extent of the storage embankment would be many times the length of defence through the village. However, is there opportunity for some wash-land creation to assist in alleviating flows.
- nourishment on a promontory where the sediment is continuously swept offshore.
- an offshore breakwater in 20m of water to protect a small village. But are there other ways of modifying wave behaviour or retaining sediment?

6.3.2 Main guidance: Identify a wide range of options

Screen out options that have real constraints:

- use the principles set out in Construction (Design and Management) (CDM) to assess health and safety constraints. Considering options is part of the design process. - Access to construct, improve and maintain a channel though backyards when there is a natural opportunity upstream for storage.
- legally not possible, not fulfilling legal requirements.
- impacting adversely on designated habitats when there are obvious alternatives.
- urgency, there is little point in delivering a solution that will take years to approve and deliver, when in the meantime the town would be lost to erosion. (There may be staged approaches which could deliver longer term benefits?)

Even unrealistic, impractical options may trigger thoughts on innovation that may then inspire modified alternative options that could be considered.

Screening is a time for developing ideas not a time for dismissing them.

Combine option identification with screening of non-starters

The identification of a wide range of options and screening out of non-starters can often be combined and undertaken as part of a workshop. It is important to draw on the results of Chapters 3, 4 and 5 so the identification of options is based on the definition of the problem and baseline, takes account of the key constraints and opportunities and tries to meet as many of the project objectives as possible.

Move to develop a short-list of options OR
Check you have completed all the expected outputs

6.3.3 Explanations and further guidance: Identify a wide range of options

Identify Options

Understanding the problems and setting the objectives will start the process of identifying options. The identification of options should not be limited by previous assumptions or past practice, although previous experience usually means that structural options are the easiest to identify. Consideration of a broad portfolio of options should help identify different approaches to managing the risks and is likely to result in more innovative approaches. It may also be possible to deliver more objectives and opportunities and develop options that provide greater benefits.

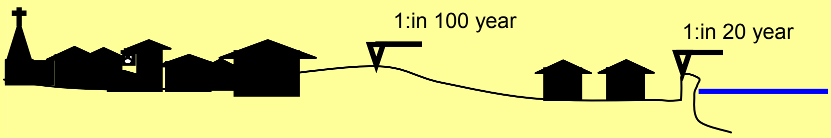
Return to main guidance

6.3.3 Explanations and further guidance: Identify a wide range of options

Focusing efforts when identifying options

i) There is an area J that is dominated by a tidal flood plain. The nature of the flooding is such that the flooding starts to occur in the 1 in 25 year event and by the 1 in 75 year event most of the damages are realised, due to the flat land. As the events get larger there is not a significant difference in water levels due to the expanse of the land and the available volume for flood plain storage having initially flooded. The difference in levels between the 1 in 75 and 1 in 200 year levels are say 0.15m, which is a smaller difference than the modelling accuracy. The options considered have a variety of defence standards. Above the 1 in 75 year event there is little difference in the scheme to provide a 1in 500 year scheme due to the small increase in water levels. If there really is not much difference between a 1 in 75 year scheme and a 1 in 200 year scheme then it is pointless assessing a 1 in 100 and 200 year scheme. Time would be better spent looking at say 1 in 20 and 1 in 500 year options; it is not worth time investigating intermediate schemes that provide 1 in 100, 150, 200 etc, year standards.

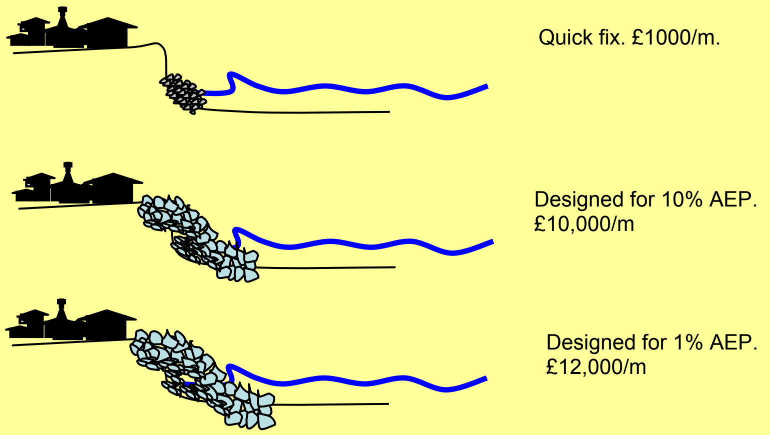
ii) Town G has developed in two areas of lower lying land separated by a ridge. The main town lies behind the ridge, with few properties to the front. In identifying potential options, the level of the ridge, may determine the options considered



ii) Town A, is at risk from erosion. Considering potential options:

- To provide an immediate solution buying a few years of time might cost £1000/m.
- To design a structure suffering little damage under a storm condition with 10% AEP might cost £10,000/m.
- To design a structure suffering little damage under a storm condition with 1% AEP might cost £12,000/m.

6.3.3 Explanations and further guidance: Identify a wide range of options



The real choice of options is whether to provide a quick fix or a longer term solution. The long term option might be further considered at a later stage in the appraisal process, considering supply issues, maintenance and whole life costs between different design standards.

Engagement

Engagement with stakeholders can be invaluable in identifying (and later developing) a wide range of options and associated constraints and opportunities. It can also provide useful historical and background information about previous options considered within an area, how the risk works and what the stakeholders consider needs factoring into any option taken forward.

Return to main guidance

Consider the source→ pathway→ receptor model

It can be helpful when identifying options to look at a problem from the source → pathway → receptor model. It is useful to consider options that change the source, modify the pathway or manage the receptors as this provides the basis for generating a wide range of possible options that could address the problem in different ways.

Options that modify the source can be difficult to identify. They often have significant environmental impacts and can be politically contentious. Modifying a river (for example, widening the channel) may be inconsistent with the requirements of the Water Framework Directive and may cause significant impacts on bed and bank habitats. Care should be taken before screening out such options, with proper consideration given to whether the impacts are short-term and whether there are practical alternatives.

Options that modify the pathway are typically structural options, but they also include maintenance options that reduce the risk of failure (such as maintenance of sluices or

6.3.3 Explanations and further guidance: Identify a wide range of options

barriers, vegetation management, vermin control or repair of breaches as they occur). Options such as river restoration may provide opportunities to work with natural processes, delivering environmental gains alongside risk management.

Options that modify or manage receptors to reduce the consequences of flooding or erosion may need more thought and not be immediately obvious. Options that modify or manage receptors can be tailored to the problem and the receptors at risk.

Examples of options that manage or modify receptors

i) flood warning is a key option for reducing consequence, although it requires action to be taken by those receiving the warning if the consequences are to be reduced (see: options with varying probabilities of success). The benefits from improvements in a flood warning system are the expected value of reductions of flood losses with the proposed system compared to the existing situation. This is dependent on the recipient receiving and understanding the warning and choosing to act as well as the technical feasibility of the new system. Potentially a new system will not reduce risk to a community risk if they are not aware of what it means, how to act, when to act and what to expect from others. Increasing flood awareness should be linked to community engagement so they are empowered to act and therefore reduce the consequences of the risk being faced. It will be important to consider flood awareness campaigns (such as the Environment Agency's floodwise campaign) where awareness is low if the benefits of flood warning are to be realised.

ii) property acquisition and demolition can reduce consequences although it may only be appropriate where there is a small number of properties that need to be removed or targeted at specific locations (such as hydraulic pinch-points);

iii) planning constraints can be used to prevent an increase in consequences over time, by restricting development in certain areas, only allowing water compatible uses in the floodplain or requiring all new build to be flood-proof (see also PPS25 or TAN 15).

Return to main guidance

6.3.3 Explanations and further guidance: Identify a wide range of options	
Why work with natural processes? Return to main guidance	Options that work with natural processes can deliver a multitude of benefits, such as (the following list is not comprehensive): • greater sedimentation helping to stabilise defences; • erosion that releases sediments for deposition elsewhere; • support to defences making them more resilient; • carbon capture and storage; • fish nurseries; and • nature conservation benefits. These benefits illustrate that greater working with natural processes should not be seen as an 'environmental option'. There also is the potential for economic and social benefits from working with natural processes (see the natural processes supporting document).
Adaptation Return to main guidance	Adaptation is a process whereby natural change is typically enabled, supported or allowed to occur (for example, as a result of climate change). It is important to consider how options would perform into the future if the risks associated with flooding or erosion change. This if often done using managed adaptive approaches, where information from monitoring and better understanding of risks (for example, as a result of research) is used to determine if and when intervention is required. Managed adaptive approaches require the preceding intervention or management approaches to be flexible enough to accommodate or enable necessary adjustments when future changes occur. The alternative is to take a precautionary approach where intervention occurs as early as possible with the solution itself intended to capture the predicted increase in risk. There is a risk with precautionary approaches that an option could be identified as preferred over the appraisal period of 100 years, but would only perform as predicted for a much shorter period. This can mean that additional money has to be spent in the future to make sure that the benefits can be provided. The overall result is that the risk management measures end up costing a lot more. If you consider how future risks could affect your options, you will more likely to provide a solution that is adaptable to future changes in risk. This may increase costs now, but could reduce costs in the future. Options that allow for future, managed adaptation are more likely to result in no regrets actions.

6.3.3 Explanations and further guidance: Identify a wide range of options	
Options that restrict the ability of the natural environment to adapt Return to main guidance	Hard engineering options can restrict the extent to which the natural environment can adapt to changes. At the coast, sea walls prevent intertidal habitats such as saltmarsh, mudflat and saline lagoons from migrating landwards in the face of rising sea levels. They can also result in lowering of land levels behind the defence and increased erosion alongside the defence. This puts the existing defences at increased risk of damage from increased wave action, potentially increases erosion in areas adjacent to the defence and can result in substantial losses of important habitats.
Varying probabilities of success Return to main guidance	When considering options that require operational activities to be taken to be successful (including floodgates to be closed, pumps to work, temporary defences to be in place in time to be fully effective), there is a chance that those actions will not be complete. As a result, the potential benefits may not be realised. For example, residents may receive a warning but they may not take any action; one of a series of pumps may fail such that the pumping station cannot work at full capacity or the manpower needed to erect demountable defences may not be available or able to reach the site in time. The reduced reliability of such options needs to be assessed by considering the probability of success in order that the options are compared on a fair basis (more information on developing these options and estimating probabilities of success is given in 6.4.2 Main guidance: Develop a short-list of options).
Why screen out non-starters? Return to main guidance	Removing any options which are obviously not going to be beneficial avoids time and money being wasted in appraising them. It also means the assessment can concentrate on those options which are practical and may have significant benefits. But make sure that the decisions are transparent and recorded in an auditable manner. This is crucial to explain how the project has progressed to others and to secure support for the final decision. **Move to develop a short-list of options** OR Check you have completed all the expected outputs

6.4 Develop a short–list of options

6.4.1 Expert summary: Develop a short-list of options	
Develop a short-list of options Read more	You should develop options to understand what they involve, their broad costs and impacts (positive and negative), and where it is helpful to combine options (or aspects of options) or refine options to reduce negative impacts and include opportunities. Short-listing may also involve taking good aspects of rejected options and incorporating them as necessary in remaining ones. Use a comparison of costs and impacts (positive or negative) to identify a short-list of the most promising options. The level of detail required will vary according to the stage of the appraisal and the significance of the costs and (positive or negative) impacts in question. Provide and record justifications for the selection or removal of options (or aspects of options). The do-nothing option needs to remain in the short list as a baseline against which to compare all the other possibilities, where you are undertaking a CBA. A do-minimum option must also be included (this will be the baseline for CEAs but is usually also included in CBAs).
Engagement Read more	Engagement would normally be undertaken before confirmation of the short-list of options, so stakeholders can see how their initial inputs and concerns have been taken into account. As a minimum, accurate auditable and transparent recording of decisions is needed as well as delivery of the Stakeholder Engagement Plan requirements.
Refine options Read more	Consider the extent to which the options can be improved by combining and refining options (or parts of options). Try to maximise the extent to which options work with natural processes and focus on delivering multiple benefits and objectives. Consider whether there is additional scope for managed adaptive approaches that may be better able to adjust to future changes in risk. Ensure that you engage with stakeholders during option refinement (taking account of how working in partnership with other organisations could bring in funding from other sources). Check you have completed all the expected outputs

6.4.2 Main guidance: Develop a short-list of options	
Develop and short-list options	Developing a short-list of options involves an iterative process to build up solutions to the problem. It involves: 1. identifying the broad costs and impacts (both positive and negative) of options; 2. combining and refining options to reduce the negative impacts and including opportunities to increase the positive impacts; and 3. ensuring that do-nothing (for CBAs) and do-minimum are included in the short-list. Options should include early consideration of mitigation for known physical changes through design and combinations of options. Read more on why you develop a short-list of options
Read more	
Link back to the project objectives	It is easy to lose sight of the overall aims when dealing with the detail of the assessment process. You will need to refer back to the objectives identified at the outset of the project to verify that the preferred option meets the objectives covering policies and duties, with the potential to also meet some of the wider objectives. In some cases, this may result in additional costs, but these may be offset by funding brought in by project partners. In other cases, there may be overall cost savings (not necessarily to the project itself, but for project partners) by combining activities and making efficient use of materials and plant while they are on-site (or being brought to the site). You should aim to deliver wider objectives wherever possible. Look for 'extra' benefits over and above the flood or coastal erosion risk management benefits. Take care though to identify that any additional costs that would be incurred are outweighed by the benefits and/or that contributions will be provided by project partners. It is also important that any 'extra' benefits do not compromise the flood and coastal erosion risk management objectives.
Engagement	Engagement with stakeholders may be integral to explain how the project has progressed and the short listing decisions have been made to others and to secure support for the final decision. Stakeholders and project partners should be engaged in line with the stakeholder engagement plan to provide input when determining the short-list of options. Undertaking engagement before confirmation of the short-list of options allows stakeholders to see how their initial inputs and concerns have fed into what now is to be taken forward

6.4.2 Main guidance: Develop a short-list of options	
	for detailed appraisal and ensure nothing has been missed out or fallen through the process. Engagement activities, such as a public exhibitions, are likely to be required as part of the short-listing exercise, in particular before the final short-list is confirmed.
Justifying the short-list	Record justifications for the selection and removal of all options for the short list. The justification only needs to be as detailed as necessary to provide clarity. As a minimum, accurate auditable and transparent recording of decisions is needed as well as delivery of the Stakeholder Engagement Plan requirements.
Identify the broad costs of options	You will need to make an estimate of the whole life costs of options including asset replacement, operation and maintenance at an appropriate level of detail to inform short-listing. High level or standard cost data sources can be used for the wide range of options increasing to more detailed specific information as the short list is developed (see: Chapter 7: describe, quantify and value the costs and benefits for guidance on estimating the costs of options at different levels of detail).
Identify the broad impacts of options	The positive and negative impacts of the options are appraised at different levels of detail during development and short-listing. This can range from basic qualitative descriptors through to full monetary valuation. The level of detail required will vary according to the stage of the appraisal and the significance of the impacts in question. Chapter 7 (describe, quantify and value costs and benefits) provides guidance on assessing the impacts at different levels of detail. Care should be taken to avoid estimating the impacts in too much detail; a balance is needed between how much information is required to identify whether an option (or aspects of the option) should be developed further and included in the short-list of options.
Combine and refine options	Combining and refining options involves using information on the costs and impacts (positive and negative) with the aim of reducing any negative impacts, building on positive impacts and to deliver additional opportunities and objectives. You should also consider technical issues such as phasing (managed adaptive approaches) and the probability that options will successfully manage the flood or erosion risk. You should also consider uncertainty over the performance of options. You will need to follow an iterative approach to combining and refining through Chapter 7: describe, quantify and value costs and benefits.

6.4.2 Main guidance: Develop a short-list of options	
Read more	The process of refinement should not require significant amounts of reappraisal, or collection of new data since refinement builds upon the benefits of the options it combines. However, care will be needed to ensure that any additional costs that may be incurred can be justified by the additional benefits or contributions found from funding partners. Also a record of how and where options have been combined and refined is required to explain any changes and secure support from stakeholders for the refinements that are being made.
Engagement	Make sure you manage stakeholder expectations by keeping them informed of and involved (as appropriate) during refinement of options especially where implications, potential problems and uncertainty affect timescales.
Record justifications	Record any changes to the options or any new options generated through refining, along with full justifications for these. This information must also feed back into the environmental assessment and SEP so that you manage stakeholder expectations through further engagement if required. Records do not have to be extensive but they must capture the key points that support the decisions being made.
Revise the ASTs	Ensure full information is available on the refined options, and update the ASTs so they provide a complete record of the options appraisal.
Combining based on costs	As options are combined and amended, the costs are likely to change as it may also be possible to benefit from efficiencies of scale. As well as the need to revise and update the capital and maintenance costs of implementing the option, you should also consider mitigation measures and the additional costs that may be incurred. Opportunities to amend the options such that negative impacts are removed could reduce mitigation costs. See also 7.3: Describe, quantify and value costs.
Combining based on impacts	Environmental assessment should identify the type and extent of impacts. Negative impacts can be used to help identify which options (or aspects of options) need to be amended (or, where mitigation of impacts is not possible, rejected). Positive impacts provided by options (or aspects of options) can be used to help you combine and improve options where reasonable in terms of costs and when balanced across all environmental aspects. See also 7.4: Describe, quantify and value benefits.

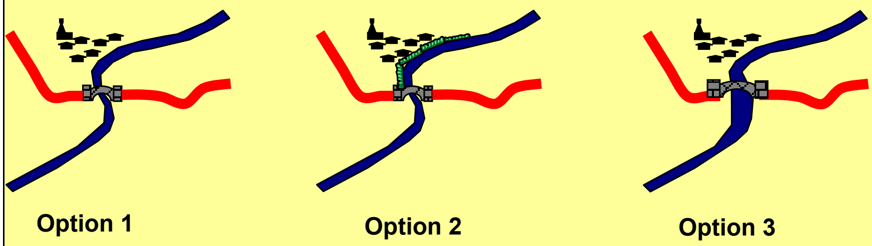
6.4.2 Main guidance: Develop a short-list of options	
	Project objectives should be referred to when combining, assessing and evaluating options to deliver more of the project objectives, working with project partners to identify potential contributions.
Combining based on technical issues: phasing (managed adaptive approaches)	You should consider the implications of climate change (for example, sea level rise) when making comparing and refining to take account of predicted increases in risk (and consequently the damages). The best time to implement the option in technical and adaptation terms needs to be considered. If possible, you should consider managed adaptive approaches as these are typically better able to adjust to differences to the predicted increases in risk. This is because delaying certain actions provides the opportunity to better respond to future changes as they happen, rather than trying to predict them and respond in advance (as would be required when using precautionary approaches). They may also be economically more attractive as costs can be spread over longer periods of time. At the options identification stage the potential for adaptation should be explored consistent with (but not to the same level of detail) as using a Real Options approach (see HM Treasury, 2009). For example, where there are existing flood or coast protection assets, it may be more efficient to undertake maintenance and delay replacement or refurbishment until the risk of failure has increased to make better use of the residual life of the existing asset. At the time of replacement or refurbishment, the change in risk should be better understood such that the action taken may differ from that which would be taken now. However, there is likely to be a need for monitoring or research to be undertaken in the meantime to help improve the understanding of the risks. There are also economic reasons for holding back investment until further into the future. A project that cannot be justified now may well be worthwhile later since holding back significant investment until some time into the future reduces the whole life costs when measured from today due to the effect of discounting. You will, though, need to make sure that you reflect any increase in risk of flooding or erosion in the damages.
Read more	

6.4.2 Main guidance: Develop a short-list of options

Example of a more adaptable future

A town is in the flood plain upstream of a main road bridge. The bridge constrains flows increasing flood risk to the town. The defence to the town provides an adequate standard of defence but the existing embankments require large scale maintenance. With climate change the standard of defence would potentially become inadequate in 20 years. Options considered were:

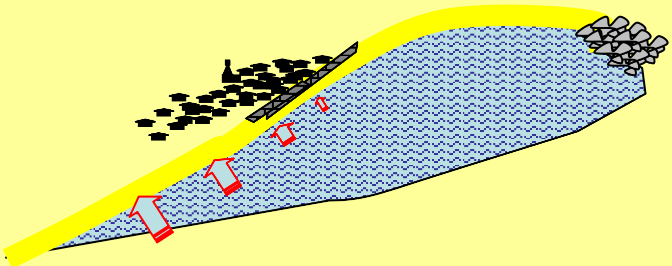
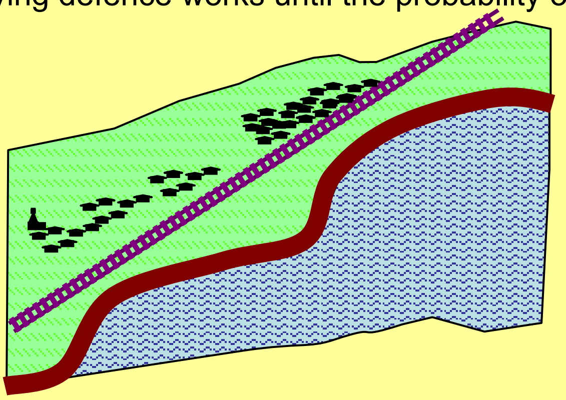
- Do minimum – undertake repairs to defence. Shortlisted, with highest BCR.
- Raise defences – effectively construct a new embankment. Shortlisted with good BCR and incremental BCR of 3.
- Replace bridge – shown to substantially reduce flood risk but not shortlisted due to uncertainties with respect to long term planning and need for collaborative funding.



Option 2) although being economically worthwhile would be less adaptable in the future. By choosing Option 1) and reconsidering option 3) in combination may offer opportunities to explore a more adaptable joint funded approach in the future; with the alternative of delaying raising defence if this were still not practical.

Delaying investment in coast protection projects

For coast protection projects, erosion in the early years may not involve significant loss of property and it may be more efficient to delay major investment until loss of higher valued assets is imminent. Care is needed though to ensure that this does not cause irreversible changes or mean that the costs of protecting on the new line would be significantly higher. It is also important to note that erosion of a promenade could result in amenity/recreation losses. There may also be blight due to the reduction in market value of at-risk properties. These impacts should be included in the damages if investment in coast protection works is to be delayed.

6.4.2 Main guidance: Develop a short-list of options	
	Delaying investment in coast protection projects a) A town is situated on the coast within a bay fixed by a rock headland. Over the main frontage of the town the coast suffers from minor erosion and is protected by a revetment. The pressure for erosion increases further around the bay but property is set back further. There is a risk that the end of the revetment might be outflanked and suffer damage under a severe storm and even that some property might suffer damage due to wave overtopping. However, the risk of this is very low. Continued erosion would encourage a more sustainable position for defence.  b) A length of eroding cliff is backed by a railway line behind which a large area of development. There is coastal width between the cliff and the railway at present. Despite the low immediate risk options, managing the alignment of the shoreline may provide a more sustainable approach than delaying defence works until the probability of loss is greater.  In comparing options due regard needs to be taken of the future options that might then be excluded.
Combining based on technical issues: probabilities of success	You should have identified the probabilities of success of options during option identification (see: options with varying probabilities of success). During development and short-listing, you can use these probabilities to help you improve the overall probability of success. For example, if the probability of mobilising personnel is low, additional personnel could be trained to close the flood gate. They could be based in a different location such that the probability that they would not arrive at the flood gate in time to close it

6.4.2 Main guidance: Develop a short-list of options

is also reduced. Where this is a very critical frequently used structure, an operator could be housed close to the gate structure (although this may give rise to new issues that need to be considered). Practice closures during regular maintenance could reduce the probability of problems closing the gate. Such actions could be included as operational instructions with the option to improve the overall probability of success (but of course will have cost implications).

Read more

Example of using probabilities to estimate success

The closure of a flood gate may have probabilities of success – p(s) of:

(i) command to close flood gate given: p(s) = 0.99 (based on flood warning being available and delivered);
(ii) person sent to close flood gate: p(s) = 0.99 (based on one person in the depot always being assigned this task should the warning arrive);
(iii) person arrives at flood gate: p(s) = 0.9 (based on potential traffic problems getting to the flood gate from the depot – the probability could vary considerably depending on the time when the person needs to drive to the flood gate, this would also be linked to the lead time given by the flood warning); and
(iv) flood gate closed: p(s) = 0.95 (based on potential for vandalism, rust (time since last closure) and potential for blockages in gate mechanism).

The above example has high p(s) for each individual action. When they are combined (multiplied since each action has to be a success for the flood gate to be successfully closed), the overall p(s) is 0.84. Therefore, for every £1 million of benefits generated by closure of the flood gate, only £840,000 should be claimed since there is a risk that the flood gate would not be successfully closed on every occasion.

Care needs to be taken in how probabilities are combined. The numbers represent actual outcomes; think beyond the numbers. In the above case:

The chance of a successful command being given is 99 times in 100.

In those 99 successful cases there is a 99% chance that someone will be sent to close the gate (99% of the 99

6.4.2 Main guidance: Develop a short-list of options

successful commands = 98 times out of the original 100 events will someone be sent).

Of those 98 successes from the original 100 events only 90% of the time will someone arrive at the flood gate (90% of the 98 successful times someone is sent will someone arrive = 88 times).

Of the 88 times someone arrives, only 95% of the time will they be successful in closing the gate (95% of the 88 arrivals is successful = 84 times out of the original 100 will the gate be shut).

In this case it also highlights where the main risk of failure is (getting there on time). This approach can and should be taken when considering any defence system option. Looking for the strengths, looking for the weaknesses and iteratively improving from the original option to consider potential better choices.

Read more on how to estimate probabilities of success

Uncertainty

Take account of uncertainty where you include options that delay investment - the uncertain nature of erosion and flooding makes it very difficult to predict losses for individual years. There is also uncertainty associated with predicting timing of failures of defences. This may make phasing options until immediately before the defences are predicted to fail a risky approach. You should therefore take a reasoned approach based on a best case. It may be worthwhile assessing how the damages would vary if the time to failure were shorter, for example.

You should consider the uncertainty surrounding the performance of all types of options when combining and amending options (not just those with varying probabilities of success or where actions are delayed).

For structural solutions performance under load should be taken. Methods may include using fragility curves or 'freeboard' allowance added to the height of the defence.

Non-structural options should be assessed on their potential performance and may require more subjective judgements that can be tested under a sensitivity analysis.

Where uncertainty is related to the understanding of the future position or change, flexibility with respect to the phasing of works as well as the decision-making regarding option assessment for each phase could allow for a reduction in the time related uncertainty. Care is however required to

6.4.2 Main guidance: Develop a short-list of options	
Read more	ensure decisions are made in plenty of time to enable assessment and implementation of the options to occur to maintain optimum risk levels. Check you have completed all the expected outputs

6.4.3 Explanations and further guidance: Develop a short-list of options	
Develop and short-list options Return to main guidance	The development and appraisal of options is an iterative process leading to several solutions. Technical aspects, costs, benefits, environmental and other impacts are assessed and appropriate allowances made for any uncertainty. Engagement, with stakeholders, will help assess the benefits and impacts, refine the options and build consensus for the choice of options taken forward to full assessment. The appraisal should take account of any policy identified in high-level plans but should not be unduly constrained by solutions if these are from large-scale studies which have not considered all reasonable alternatives in sufficient detail. The amount of detail required will vary as options are developed, from mainly qualitative for the wide range of options to mainly quantitative as the options are developed into a short list. Information can be gathered from previous SMPs, CFMPs and strategies if available. An audit trail of assumptions and decisions made during all stages of options selection is important to maintain a transparent appraisal process. It is important therefore that explanations are provided of how options (or aspects of options) have been developed, combined and amended, or rejected. This not only helps with questions during stakeholder engagement when difficult questions on options can be expected but also gives the background to the decision if at a later date conditions have changed which would have altered the short-listing process. Recording decisions made is crucial to explain how the project has progressed to others and to secure support for the final decision.
Why develop a short list?	Developing a short list enables options which are definitely less suitable to be rejected, but allows the good aspects of options to be retained and combined with other options. Development of options also means that options are revised and refined to help ensure that the short-listed options offer the best possible level of benefits. This reduces the risk that good options are rejected at an early stage in the appraisal.

6.4.3 Explanations and further guidance: Develop a short-list of options	
Return to main guidance	In this way short-listing helps the appraisal to focus on reasonable alternatives to addressing the problem and can be used to help manage stakeholder expectations. This saves time and money in the assessment process, thus ensuring there are sufficient resources to appraise the remaining set of options in detail. Short-listing also provides an audit trail for justifications needed, for example, under the Water Framework Directive and Habitats Regulations. The number of options to take forwards to more detailed appraisal will depend on the type of scheme or strategy being appraised. However, you must remember that the greater the number of options the more time and cost involved in gathering the information required for the more detailed examination. As a guide six options including do-nothing (for CBAs) and do-minimum can often provide enough options to cover a range of risk management scenarios (either reducing probability or consequence or both).
Why compare and refine options? Return to main guidance	Refinement of options provides an opportunity to deliver more of the project objectives and to provide real added value to a project. It also allows you to make improvements by comparing the costs and benefits of individual options. You should have already considered the potential to develop and refine options that can provide multi-functional solutions, so here you should ensure that the 'best' possible solution is being proposed. There may also have been developments relating to the feasibility of certain projects, for example, knowledge derived from detailed site investigations for project scale appraisals. Although refining the options can cause a delay in term of finalising the appraisal, time spent revising options now may result in a saving later as you will be a in a better position when it comes to selecting and reporting on the preferred option. Refining options also gives you an opportunity to reduce any residual impacts, thus providing a better option (you will, though, have to give full consideration to the cost implications).
Identifying the best time to invest	Economically it may be more efficient for the project, and therefore the wider FCERM programme, to delay investments until the risk of failure has increased to make better use of the residual life of existing assets. The timescale to be considered depends on the particular circumstances and the options being appraised. The

6.4.3 Explanations and further guidance: Develop a short-list of options

residual life of defences, coast protection works, sluices or pumping stations can be used as a guide to when replacement or improvements could or should be undertaken. Investments that cannot be justified now may be more worthwhile at a later date.

Identifying the best time to invest

Where sea walls have a residual life estimated at 25 years, there may be little benefit in replacing the defences now. It may be preferable to continue maintaining the defences over the short-term, reviewing and reassessing their condition to identify if and when it may be necessary to replace the defences. This is also a more adaptable solution since you are avoiding taking action now that might not be necessary in 20 years time. Beware though, as sea level rise could mean that the risks would have increased significantly by year 20. Increased sea levels might also hasten deterioration of the defences such that they have a higher risk of failure, as well as overtopping.

Where the reliability of the electrical gear in a pumping station is decreasing but where the pumps would need to be replaced in 10 years time. It may be worthwhile persevering with the electrical gear and replacing this at the same time as the pumps (taking advantage of efficiency savings from doing both at the same time). The impact of reduced reliability of the electrical gear can be taken into account using probability of success (or failure) (see: options with varying probability of success).

Return to main guidance

Options with varying probabilities of success

In reality, all options have varying probabilities of success. A wall could fail, an embankment could breach. Managed realignment could 'fail' if saltmarsh does not develop as predicted, such that additional costs may be incurred revetting the retired defence. The impact of varying probabilities of success will be greatest where:

- a large number of actions have to be carried out successfully for the option to provide the predicted benefits; and/or
- where one (or more) actions have a probability of success of 0.9 or lower.

Return to main guidance

Flood warning and flood awareness

The objective of flood warning is either to increase the likelihood that action will be undertaken to reduce the effects of a flood or enable more successful action to be taken A better warning is one that makes successful

6.4.3 Explanations and further guidance: Develop a short-list of options

action more likely or increases the reduction in losses that can be achieved. Such an improvement can be achieved in one of three ways:

- awareness of flood risk: a warning can only reduce risk where those at risk are signed up to receive a warning and know what it means;
- timeliness of the warning: the warning lead-time, or the lapse of time between the issuing of the warning and the arrival of the flood, needs to be sufficient. The receipt of the warning is also important. If the recipients are not available to receive the warning, then the warning has failed;
- the information it gives: it is important that to be effective warning must contain the information necessary for the recipient to respond effectively. If it does not, then the warning will be ineffective; and
- reliability: primarily, the probability that an effective warning is received but also the probability that the warning is followed by a flood.

Estimating probabilities of success

Each action should be allocated a probability of success p(s). However, you have to be careful when breaking down the actions required as, the more actions you identify as being required, the lower the overall success of the option is likely to be. Compare, for example, an option requiring three actions each with p(s) of 0.99 with an option requiring six actions. The first option would have an overall p(s) of 0.97; the second would have an overall p(s) of 0.94. You should focus on the steps that define the actions, making sure that all the probabilities are independent.

Return to main guidance

Example extension of the flood gate example set out in the main guidance:

(i) flood forecast or detected: p(s) = 0.99 (based on forecast being made);
(ii) command to close flood gate given: p(s) = 0.99;
(iii) command to close flood gate received: p(s) = 0.99 [this action is not necessary since the person would not be sent to close the flood gate if the action had not been received, therefore the success of this action is already included];
(iv) personnel sent to close flood gate: p(s) = 0.99 (based on one person in the depot always being assigned this task should the warning arrive);
(v) personnel find keys to van: p(s) = 0.95 [the p(s) of this action is already included in the p(s) of arriving at the flood gate];

6.4.3 Explanations and further guidance: Develop a short-list of options

(vi) personnel able to negotiate traffic: p(s) = 0.95 [again the p(s) of this action is already included in the p(s) of arriving at the flood gate];

(vii) personnel arrive on site: p(s) = 0.9 (based on potential traffic problems getting to the flood gate from the depot – the probability could vary considerably depending on the time when the person needs to drive to the flood gate, this would also be linked to the lead time given by the flood warning);

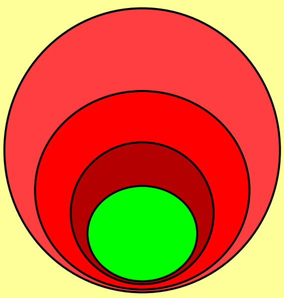
(viii) personnel able to negotiate wind and driving rain to reach flood gate: p(s) = 0.95 [again, the p(s) of this action is included in the following action]

(ix) flood gate closed: p(s) = 0.95 (based on potential for vandalism, rust (time since last closure), and potential for blockages in gate mechanisms).

If you multiplied all the above actions, you would arrive at an overall p(s) of 0.56 (or £560,000 out of a possible £1 million benefits). This is equivalent to a reduction of £270,000 benefits (from the £830,000 benefits estimated using the four main actions).

The overall probability of success or failure is related to the number of steps:

i) sequential independent actions

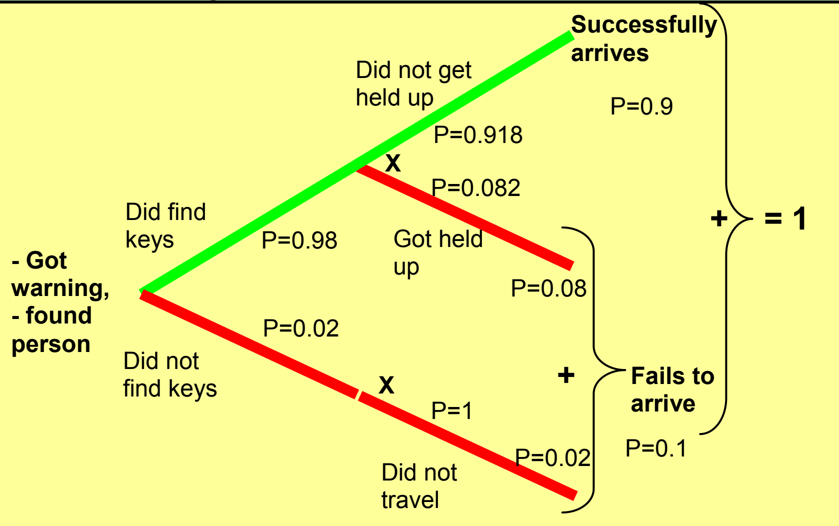


- the greater the number of independent sequential actions the greater the chance of failure.
- Success depends on the success of previous actions, the opportunity for a successful outcome reduces with each action.
- The probability of success is the product of the probability of success for all actions.

$P_{s1} \times P_{s2} \times P_{s3} \times P_{s4} = P_{\text{successful outcome}}$ (Ps)
$P_{f1} \times P_{f2} \times P_{f3} \times P_{f4} = P_{\text{failure of successful outcome}}$ (Pf)
Ps + Pf = 1 there is always an outcome success or failure.

ii) the successful outcome of individual actions may depend on mutually exclusive events.

6.4.3 Explanations and further guidance: Develop a short-list of options



iii) The same thinking has to apply to other options in terms of probabilities and outcomes.

The crest wall of a sea defence may be overtopped with a probability of 0.01. In year 0 the probability that a wall may fail might be 0.1 and the probability it would then be overtopped would be 0.05. During year 1 there are two possible outcomes:

- it is overtopped as a result of two mutually exclusive events: wall fails or wall does not fail; Pf.o + Po = (0.1 x 0.05) + (0.9 x 0.01) = Overtopping probability of 0.014.
- it is not overtopped : the wall fails but does not get overtopped or the wall does not fail and it does not get overtopped = (0.1 x 0.95) + (0.9 x 0.99) = probability of not overtopping, 0.986.

In considering realistic options, the focus is on the outcome and options to deliver different outcomes.

Using probabilities to estimate and improve success

A decision tree developed around the probability of success and probability of failure of each action can help identify where the key issues may lie. It can also help avoid decisions being made during implementation of an option that could reduce the probability of success. For example, identifying that temporary defences have a p(s) of 0.9 of being able to be brought to the site when required needs to be balanced against where the temporary defences will need to be stored. The justifications behind the assigned probabilities will be important and should be used to ensure that any options with varying p(s) that are implemented are done in such a way that the p(s) estimated in the appraisal are realistic but take account of the range of uncertainty.

[Return to main guidance]

6.4.3 Explanations and further guidance: Develop a short-list of options	
Uncertainty Return to main guidance	It should be remembered that all data on the options and their impacts are based on estimates. It is important that an appropriate level of detail is considered when comparing and refining the options. You may need to collect additional data in some cases to reduce the level of uncertainty where this is affecting the choice of preferred option. Check you have completed all the expected outputs

6.5 Checkpoints and outputs: Identify, describe and short-list options

Checkpoints	Assess whether it is worthwhile continuing with the appraisal in its current form by answering the following questions: **1. Is there a legal condition(s) that means that there are no viable options?** If the constraints imposed by a legal condition(s) means that there are no viable options, you may need to pause the appraisal and investigate why the legal requirement means that the project cannot go ahead. This may require detailed interpretation of the legal condition(s). You should also verify that you have scoped the possible options as widely as possible and considered whether it is possible to overcome or rescind the legal condition. **2. Are there options available that would wholly or partly meet some or all of the objectives?** If no, check that you have considered all possible solutions, including options implemented outside the immediate project area. You may need to engage further with stakeholders to mange expectations and accept that it may not be possible to meet all the objectives. **3. Have you considered a wide portfolio of options to meet the objectives and considered issues such as sustainability, adaptability, working with natural processes, and the best environmental option when identifying options**? You should ensure that the refined options have optimised key objectives of MSfW and the Defra policy statement. This should include: • consideration of a wide portfolio of measures; • sustainability of options; • adaptability of options; • the extent to which options can (and do) work with natural processes; and • incorporation of approaches to ensure you are considering the best environmental option. You should engage with stakeholders when identifying and developing options to ensure you have scoped the possible options as widely as possible. See 6.3 Identify a wide range of options.

6.5 Checkpoints and outputs: Identify, describe and short-list options

Outputs

Typically, to complete the identification and short-listing of options you should have:

- identified a wide portfolio of options (see: 6.3 Identify a wide range of options);
- screened out any non-starters (see: screen out non-starters);
- developed a short-list of options (see: 6.4 Develop a short-list of options);
- provided justifications as to why options (or aspects of options) have been developed, combined or amended, or rejected (see: justifying the short-list); and
- engaged all relevant stakeholders appropriately in a timely manner so that they have the opportunity to input to the decisions and can understand and hopefully accept the decisions that have been made. This should be done by delivering your Stakeholder Engagement Plan.

All outputs complete: options have been identified, developed and short-listed

Move to Chapter 7: Describe, quantify and value costs and benefits

7. Describe, quantify and value costs and benefits

7.1 Key Principles: Describe, quantify and value costs and benefits

Costs include the design, capital, operational, maintenance, monitoring, mitigation and compensatory habitat costs associated with implementing the option (whole life costs). Negative costs (such as income from sale of excavated material) should be deducted from the costs.

Damages (associated with flooding or erosion of properties) are defined as negative impacts. Negative impacts also include loss of environmental quality (for example, reduced amenity, loss of habitat, visual impact or unsustainable resource consumption).

Benefits are positive impacts and include damages avoided as a result of implementing an option. **Damages avoided** arise from reducing the likelihood of flooding or erosion and/or by reducing the consequences (for example, through flood resilience measures). Positive impacts also include environmental (including biodiversity) benefits associated with increasing the frequency of flooding or geological and geomorphological benefits from allowing erosion to continue.

Wherever possible and necessary, costs, damages and benefits should be valued in monetary terms. However, it is important that valuations in monetary terms are appropriate. When deciding whether to value impacts in monetary terms, it is important to consider whether the money estimate will capture the whole impact or just part of it and if the money value is likely to be meaningful and reliable.

Proportionality is very important. It is essential to balance the time and resources required to develop options, appraise and estimate costs, benefits and damages with the influence of those costs, benefits and damages during decision-making.

Appraisal Summary Tables should typically be used to record which costs, benefits and damages have been included as well as assumptions and uncertainties. This will then provide a transparent record of the appraisal and help you identify where and how sensitivity analysis should be applied. ASTs also disaggregate the impacts, identifying those who would benefit and those who would be impacted negatively by each option.

Discounting is a technique used to compare costs and benefits that occur at different points in the appraisal period, or over different time periods. It is based on the principle that people prefer to receive goods and services now rather than later. Standard discount rates (see supplementary guidance on discount rates) (as set by Treasury) are used to convert all costs and benefits to 'present values' so they can be compared. Present values are usually calculated in year 0 (the current year) and are intended to reflect the total value of all future costs and benefits in today's prices.

7.1 Key Principles: Describe, quantify and value costs and benefits

The impact of discounting is that costs and benefits which occur in the future are worth less (in present values) than costs and benefits that occur in the short-term. This is because it is assumed that economic growth will mean that future generations are richer such that £1 in today's prices will be worth much less in 100 years time.

Figure 7.1 shows where you are in the appraisal process (orange coloured box). Follow the hyperlinks to move back to previous chapters of the guidance if you need to iterate. Clicking on a hyperlink to another chapter takes you directly to the start of that chapter (to the key principles). Clicking on a hyperlink to a section within Chapter 7 takes you to the main guidance.

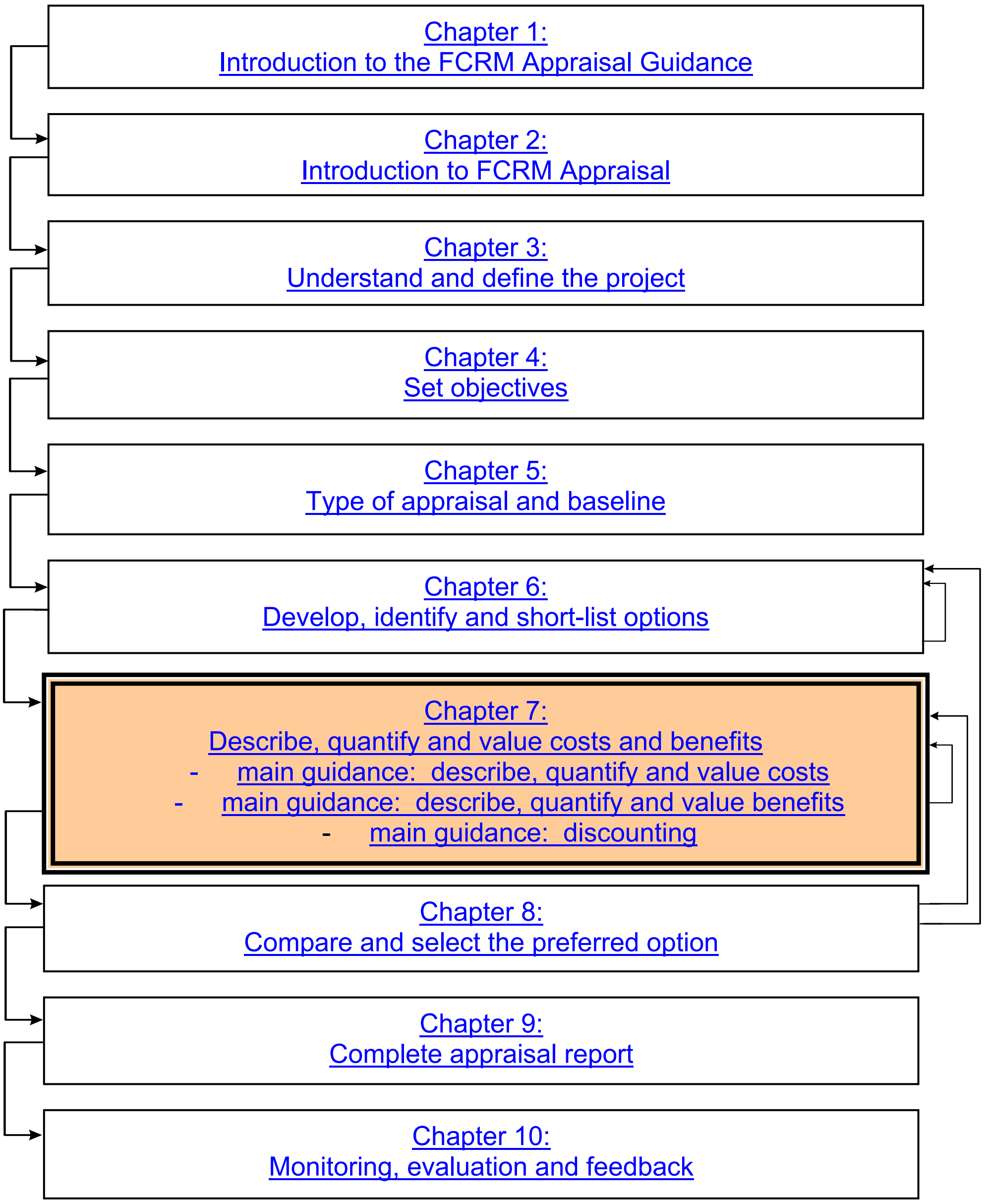


Figure 7.1 Navigation flowchart

7.2 Inputs to describe, quantify and value costs and benefits

Before beginning to estimate the costs of the options and assess their impacts, you need to have completed the following from previous steps of the appraisal:

- identified the type of project being undertaken (5.3: identify type of project required);
- described the baseline (5.4: develop the baseline);
- developed a short-list of options to be considered in detail (Chapter 6: identify, develop and short-list options);
- engaged all relevant stakeholders appropriately in a timely manner so that you have an understanding of their needs, interests, constraints and expectations so that they can feed into the costs and benefits assessment required; and
- reviewed your Stakeholder Engagement Plan (SEP) and managed stakeholder expectations by informing of them of the work you are about to do including why and when, what they can expect from you and how they can input so they influence, understand and hopefully accept the decisions to be made. This should be done by delivering your SEP.

The environmental assessment process should provide sufficient information on significant environmental risks that might affect the selection of the preferred option or present a significant risk to the delivery of the project. Where possible these impacts should be quantified.

7.3 Describe, quantify and value costs

7.3.1 Expert summary: Describe, quantify and value costs	
Option Costs Read more	All costs associated with the project must be included over the timescale of the appraisal period. This will include design, capital, maintenance and operation, mitigation and, where significant, decommissioning costs. Negative costs (such as from sales of excavated material) should be deducted from the costs of the project.
Costs, risk and uncertainty Read more	The best estimate for a project should be the most likely costs, adjusted as necessary to take account of risk and uncertainty. Controlling risk usually involves combining several approaches such as reducing the risk and developing contingency plans, keeping options open and monitoring.
Include optimism bias Read more	Optimism bias or a risk based contingency approach should be used to ensure risk is considered. **Move to describe, quantify and value benefits OR** Check you have completed all the expected outputs

7.3.2 Main guidance: Describe, quantify and value costs	
Estimate option costs Read more	You should include all relevant surveys, design, capital, maintenance and operation, and mitigation costs to assess the whole-life cost of a project. Maintenance costs should include the expected value of the costs of repairs as a result of storm damage and, where significant, decommissioning costs.
Strategy costs and early stages of appraisal	At early stages of appraisal and for strategies, detailed design will not have been carried out. Unit rates can be used to give an indication of the scale of the costs. The experience of the team will be required to be able to assign indicative costs for options. Lessons learnt from post project evaluations indicate that sufficient allowance for error should be made for the uncertain nature of cost estimates at the strategic level. You should also include optimism bias in all cost estimates at the appropriate level.
Cost types to include	You should consider both direct and indirect costs required to achieve the identified objectives for all options, whether or not they are likely to be funded from flood or coastal risk management allocations. Since you should not have identified any illegal options, the costs of infraction proceedings, penalties, or fines do not have to be considered. The only exception is where a decision is made to buy-out, rescind or overcome a legal

7.3.2 Main guidance: Describe, quantify and value costs	
Read more	requirement. Here, you would have to include the costs associated with actions needed to remove the legal requirement. This approach is only applicable to local legal agreements.
Use appropriate cost data	Wherever possible, you should base your estimates on appropriate cost data assembled from recent tenders, completed projects, published articles and estimating price books, estimates and quotations from companies for specialist work and the estimator's own experience.
Take account of how the works would be carried out	It is important that cost estimates are carried out following an assessment (no matter how broad) of how works would be carried out. You should: • recognise the difficulties involved with works in particular circumstances, for example the high cost of working in confined spaces, within or adjacent to private properties, gas, electricity or communications services in urban areas; and • include additional sums if they are likely to be required for particular aspects, for example, dealing with poor ground conditions, areas with high risk of archaeological deposits or contaminated land. General contingencies should be estimated as part of optimism bias. This will enable associated access, plant, temporary works, transportation and material issues to be considered. This may sometimes show that conventional methods may not be applicable due to some physical, access, environmental or health and safety constraint. The involvement of a contractor or cost consultant at the later stages can be helpful.
Focus efforts onto key cost components	Particular components may constitute a large proportion of a project cost, or the cost of those components may be expected to vary in real terms over time. For example, the supply cost of shingle for a beach recharge scheme may be expected to increase if sources become scarcer. It may be necessary to make a careful assessment of quotations and estimates obtained from operators who have commercial experience in that sector. In such cases, sensitivity analysis, with variation in the future real cost of shingle supplies, could be used to explore the implications for option choice.

7.3.2 Main guidance: Describe, quantify and value costs

Approaches to costing

It is important to set out clearly what has been costed and where estimates have been made. It is also important to be consistent between options. An evidence/application approach may sensible; where has the information come from and how has this been applied to specific options

Examples of Baseline information applicable to all options.
i) Strategy

Work	Rate	Source
Shingle Recharge	£18/m^3	Recent scheme 2005 (updated to 2009) (Ref……)
Rock Groyne Maintenance	£63,000/ year	Taken from maintenance record (Ref….)
Increased rock groyne maintenance	£100,000/ year	Taken from above but increased as set out in appendix c.
Seawall Construction	£4,000/m	Recent scheme 2007 (updated to 2009) (ref….)
Seawall Maintenance	£80,000/10 year	Taken from maintenance record (Ref….

ii) Scheme where options all have similar components.

Source of Commercial data
The estimate has been built up from first principles using the best data available.
Costs have been derived from recognised industry price books, such as Spon, 2009.
Validity;
All costs and rates are valid for work to be executed in the May 2009.
No allowance has been made for future inflation.
Contractors Preliminaries:
These have been included @ 15% of the measured work which is typical for work of this nature.
The following items are typically included in this section:
• Establishment & Running Costs of Contractors Site Offices / Toilets / Mess Facilities. • Mobilisation & Demobilisation of Construction Equipment. • Provision of site vehicles (4x4s, cars…) • Contractors Site Management Team • Provision of Stores & Warehousing including labour & plant. • Surveys, permits & insurances

Rates:			
Item :	Description	**Unit**	**Rate(£)**
Demolition & earthworks			
	Break out surface & base course	m2	1.26
	Load & dispose	m3	17.04

7.3.2 Main guidance: Describe, quantify and value costs

Landfill tax	tonnes	2.50
Excavate other materials	m3	2.87
Backfill assume type 1 sub-base	m3	26.61
Disposal	m3	17.04
Landfill tax	tonnes	2.50
Construction		
Precast concrete culvert 2.4m x 1.5m	m	250.00
In-situ concrete	m3	120.00
Formwork	m2	55.00
Rebar	tonnes	1,000.00
Railing	m	200.00
Surface course	m2	8.98
Replace kerbs	m	20.00

The level of detail needs to be proportional to the options being considered; necessary to provide a robust comparison of options. In example ii) the baseline costs might focus on key items of work – such as concrete, rock, earthworks.

For each option the simplest way of displaying costs would be in the format of a traditional bill of quantities. This allows a transparent approach to be demonstrated, highlighting the level of detail, what items have been included and where contingencies have been allowed.

Where there are items that are specific to one option this should be recorded.

Ford Improvements	
	The Retaining walls on both sides are to be constructed using LX12 Larsen Piles with a pile cap on it on both sides of the channel
	The volume of Excavation includes the breaking up of the pavements and excavation for the channel widening
	The channel bed is made up of 150mm thick gravel bed.

Dam Construction	
	The sheet piles used at the centre line of the dam are AZ19.
	The cost of constructing a haul road has been included.

Relocation of Services	
	The improvement works at A, B and D all require the relocation of existing services. Allowances have been included to cover the cost of these works, however whilst they are thought to be reasonable it should be

7.3.2 Main guidance: Describe, quantify and value costs

	noted that the since the route / method of relocation has not yet been determined then there is scope for these costs to increase. We would recommend that the appropriate utility companies are contacted in order to obtain a more accurate cost and methodology for these elements of work. Option C does not require relocation of services.

Disruption to Local Residents	
	Some disruption to the local residents is inevitable and in particular the piling work at the ford and the overpumping operations required during the construction of the culverts will be noisy operations. We have assumed that piling can take place during a normal 10 hour working day however overpumping will be required on a 24 hour basis.

What has or has not been included in each option needs to be recorded.

Sub Total Construction Cost		**£ 1,145,366.00**
Contingency	30%	£ 343,609.80
Total Construction Cost	**Total**	**£ 1,718,049.00**
Design Supervision and Management	15%	£ 257,707.35
Total Capital Cost	**Total**	**£ 1,975,756.35**

Note: in the above example the contingency relates to items not included in the main bill of quantities. This might be to cover general landscaping at the end of the works, such as hand railing. Those items that one is aware of but at the level of detail of the appraisal have been grouped together as a sum of additional works that might also be required. This is different to the risk based contingency discussed in subsequent sections.

Costs should include whole life costs for each option, including operation and maintenance over the full appraisal period. The presentation of costs will differ from appraisal to appraisal. The format should be adapted to provide clear transparent presentation of the costs in the most appropriate manner. This will also assist in undertaking sensitivity analysis between options.

7.3.2 Main guidance: Describe, quantify and value costs	
Optimism bias Read more	Optimism bias is the tendency for appraisers to be overly optimistic in early assessments of project costs, time scales and benefits in comparison to the final values. To counter this HM Treasury issues guidance in the form of a percentage to increase the costs by depending on the uncertainty surrounding the estimates. An optimism bias of 60% is typically used for projects at an early stage of consideration (including strategies). At the more detailed project stage, a figure of 30% is more commonly used. This percentage is added to the original estimate and used in the cost-benefit calculations.
Applying corrections for optimism bias	You should follow the steps below if determining optimism bias values that differ from 60% (for strategies) or 30% (for schemes) : (1) ***strategy costs***: base cost estimates on broad assumptions: • step 1: identify best estimates of capital, operating and maintenance costs for each option; • step 2: assume an optimism bias of 60% of total present value costs (including capital, operating and maintenance costs over the whole life of the option); • step 3: refer to the supplementary guidance on Optimism Bias which sets out key components of risk. Assess whether the contributions of these components should be higher or lower. Where demonstrable action has been taken to minimise individual risks, the relevant component(s) may be reduced. Conversely, if a project is riskier than average in certain areas (perhaps because of innovation), then the relevant risk component contributions should be increased. If there is no evidence either way, leave the default risk component percentages unchanged; and • step 4: rework the overall optimism bias factor including any revisions. Apply the revised optimism bias factor as a percentage uplift to total present value costs (in place of any contingency estimate). (2) ***scheme costs*** (outline design): base major cost items on detailed assessments of the breakdown of activities required to obtain planning and other consents, design, construct, operate and maintain each option. Follow steps 1 to 3 (above) as for strategy costs, but use a starting optimism bias factor of 30% in step 2 before applying the relevant risk component guidelines given in the supplementary guidance on Optimism Bias.

7.3.2 Main guidance: Describe, quantify and value costs	
Optimism bias: alternative using the Monte Carlo approach	The Monte Carlo type risk valuation approach requires a more detailed understanding of the risks and mitigation measures but can provide a more informed assessment to the simple optimism bias approach. If the Monte Carlo type has been applied, then the 95% confidence level estimate should be used to derive the optimism bias factor. Where necessary, the approach to applying optimism bias should be used for all present value costs not included in the risk approach, such as long-term maintenance. These adjustments should then be added to the 95% confidence risk-based results.
Use of risk based contingency in place of Optimism Bias	If you have not applied optimism bias, a risk based contingency approach may be taken. However, as optimism bias is an HM Treasury requirement the use of any other type of contingency will have to be fully explained.
Developing confidence in the value of a contingency	You should use a risk management framework to assemble values for costs and benefits. (See also CIRIA special publication 125) Assess each risk to enable identification and evaluation of appropriate financial contingencies. Identify residual risks, or those remaining after practical control actions. You should use contingencies of at least 20% to 30% at detailed appraisal stage or apply Monte Carlo or a similar risk tool when estimating contingencies.
Use of price indices	The year used as the basis for pricing should always be indicated in the analysis. Price indices may be required to convert historical prices to the same base. When price data are not available for the base year of the analysis, you will need to use appropriate price indices to convert historical prices to the same base. For construction costs, cost indices are available from the Department for Business, Industry and Skills (BIS) Construction Price and Cost Indices). Sensitivity analysis should be used to explore the implications for option choice of changing costs. **Updating prices and projecting costs forward** i) Updating values. An index is used to increase or decrease values to a different date from when they are estimated. A scheme option was priced for competitive tender in May 2005. This scheme has many similar elements to a scheme that is being estimated and therefore the prices are used as a basis of the estimate.

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The cost of the option being considered is £63,000 based on cost evidence derived in May 2005 costs.

The variation in the indices is given month by month since May 2005.
5-2005 – 99.4 (a)
6-2005 – 100.0
7-2005 – 100.1……..
11-2009 – 154.3 (b)

Increase in the index between 5-2005 and 11-2009 is (b-a) = 154.3 – 99.4 = 54.9

The proportional increase related to 5-2005 is (b-a)/a = 54.9/99.4 = 0.55 (or 55%)

The factor is the original cost (x1) + the amount the original cost has increased (x0.55) = 1.55

Therefore estimated cost now is = £63,000*1.55 = £97,650.

All options should be considered on an equal basis, all costs and damages should be adjusted to the same base date. This should be recorded.

ii) Future costs.
All future values should be taken as existing values (no allowance for inflation) unless there are good reasons to suppose that one element of an option may increase disproportionately.

- A sea wall costing £1M should be taken as costing £1M in 10 years, in 50 years or in 100 years.
- Beach recharge material is also taken at the cost now as in the future, unless there is evidence to show that at present it comes from a diminishing supply source and in the future and in the future it would have to come from a more expensive source. Then the cost in the future would be taken as the cost it would cost now if it now came from that different source.

Inflation and price indices are used to bring values to a common value. That value is assumed not to change in the future unless specific supply circumstances change.

7.3.2 Main guidance: Describe, quantify and value costs	
Real Options approach	Using information on phasing of options for adaptation to climate change, consider which costs would and would not be required if climate change were more or less significant than predicted. You will need to assess which elements of options would need to be included under high and low climate change scenarios and whether costs would increase under the high climate change scenario (see the climate change supporting document).
Discounting	You need to ensure that all costs are discounted using the same discount rate as used for the benefits. See 7.5: Discounting.
Sunk costs Read more	Any expenditure which has already been incurred and which consequently cannot be changed as a result of any decision about future options is a sunk cost. Sunk costs should not be included in the appraisal. Sunk costs include previous investments in defences and expenditure on feasibility studies. They are excluded since they cannot be changed as a result of decisions in the appraisal.
Sales offsetting the costs of construction	Sales that offset the costs of construction are negative costs (and deducted from the costs of the project). This includes the sale of sand or gravel excavated as part of a channel widening scheme, or charges raised for the incorporation into the scheme of arisings from others.
Multi-functional projects Read more	You should have identified opportunities for partnership working, wider multi-functional objectives and options that could deliver these in previous steps of the appraisal. You need to make sure that the costs of providing these objectives are estimated even where the costs are to be provided in full or in part by project partners. You will need to discuss the costs with the project partners and involve them during estimation of the costs.
Contributions Read more	All benefits and costs need to be included in the project appraisal so that the resultant cost-benefit analysis shows the project as a whole is justified. Where contributions come from private, NGOs or other sources, you will need to subtract them from the total costs of the project during decision-making. It is important, therefore, that you disaggregate the costs, so that contributions are kept separate (not netted off the total costs). Where developers, highway authorities or others contribute towards project costs, these contributions generally affect the distribution and not the total resources required (see the Environment Agency's contributions policy).

7.3.2 Main guidance: Describe, quantify and value costs	
Environmental costs Read more	Negative impacts identified through the environmental assessment process should be included as damages. However, you may be able to design out these impacts or either fully or partially mitigate them. In these circumstances, the cost of mitigation should be included as part of the option costs. The residual impact (the impact that remains following mitigation) will need to be described, quantified and, where appropriate, valued as damages. If mitigation is not possible and actions are required to compensate, then these costs should also be included in the option costs. As a reminder, the detailed impact assessment will take place once the preferred option is selected and a best estimate to inform option choice is sufficient at this stage (see the environmental assessment supporting document). **Examples of environmental costs** i) A scheme proposes a sheet piled wall to prevent erosion of a river bank. This lies close to a retirement home. The noise is unacceptable. To mitigate this silent piling is used causing a 10% increase in costs over ordinary piling. ii) A new embankment requires the clearance of a copse. As a result, this is mitigated by planting a hedgerow to provide a wildlife corridor in addition to reinstating the copse.
Residual life and residual value Read more	Some assets may have a lifetime beyond that used in the analysis. These residual values should be taken into account in the estimation of costs and benefits only where this is required to ensure equality of assessment between different options. Where required, a straight-line depreciation over the asset life, which presupposes a decision to continue use of the asset, will usually be appropriate. For many options, the residual value may be very small (such as where the defence is close to the end of its useful life) unless the defence has a high residual value. In addition, discounting means that residual values will be even smaller. Consider, therefore, whether the residual value is going to be significant in terms of the whole life cost and hence whether it is worthwhile spending time calculating it.

7.3.2 Main guidance: Describe, quantify and value costs

Equitable comparison of options

i) A sluice costing £100,000 was replaced in year 89 with an expected life of 20 years. This means that it still has 10 years of useful life at the end of the appraisal period (year 99). To be correct, the estimated cost of the option should subtract the residual value of the sluice. Assuming the sluice loses 5% of its value each year (linear decrease in value over the 20 years of its useful life) means it would have a residual value of £50,000 in year 99. The discount factor in year 99 is 0.052. This means the residual value in Present value terms is just £2,600 (£50,000 x 0.052). It is unrealistic to assume that future works would be undertaken in year 89 rather than year 80. If the result of the appraisal depended on such spurious precision, consideration should be given to more critical factors as to the choice being made.

ii) A pumping station costing £12 million was replaced in year 69 with a residual life of 50 years. In year 99, it would have a residual life of 20 years. Assuming linear decrease in value, the residual value of the pumping station would be £4.8 million. In year 99, the Present Value of the residual life would be £250,000. As in example i) the Present value of residual life is of the order of 2% of the initial value of the asset. It may be more appropriate to re-assess the appraisal period if all options have a reinvestment period in about 70 years.

Greenhouse gas emissions

There are two elements associated with greenhouse gas emissions that need to considered:

- that associated with construction; or
- that associated with impacts following flooding or coastal erosion through the need for maintenance, repair (both of defences and flooded assets) and emergency management.

It is the balance of the two that needs to be considered, particularly when you are comparing options that would provide different levels of risk management or where options involve significantly different on-going operation and maintenance costs.

Read more

Move to describe, quantify and value benefits OR
Check you have completed all the expected outputs

7.3.3 Explanations and further guidance: Describe, quantify and value costs	
Costs Return to main guidance	The need to get costs 'right' cannot be over emphasised. They are one part of the cost-benefit equation and should therefore be given the same consideration as the benefits. If the costs are incorrect (over- or under-estimated), there is a significant risk that the best solution to the problem may not be identified. Under-estimation of the costs is more likely to lead to overspend on the project, or worse, lead to abandonment of the project following further abortive costs, when it becomes clear that the project is not affordable or economically justifiable. On the other hand, over-estimation of the costs either through over-design, over-specification or overly pessimistic assumptions can prevent a worthwhile project from attracting funding, to the benefit of less economic ones. Over or under-estimation of different types of construction or operational management activities could also favour one option over another, potentially affecting which option is selected. Well justified, reasonable assumptions are therefore required to provide a best estimate of the costs, given your knowledge and understanding of the area. You should also be prepared to record your cost assumptions and test them as part of sensitivity analysis as this will help identify how your assumptions are affecting the choice of preferred option.
Type of costs to include Return to main guidance	Cost must include all capital costs (including any replacement costs over time), periodic and regular maintenance as well as any costs associated with buying land or obtaining agreements. If mechanical plant or other operationally reliant infrastructure (such as temporary defences) is involved, running costs must be included and you should consider if these costs would increase costs over time to take account of wear and tear. The types of costs will vary according to the type of project being assessed and the level at which it is being assessed (strategy versus scheme level). You should also consider costs associated with delivering opportunities or enhancements. You will need to identify partner of third party contributions or show that the benefits outweigh the costs during decision-making (see Chapter 8: Compare and select the preferred option).

7.3.3 Explanations and further guidance: Describe, quantify and value costs

Examples of typical costs and factors to consider

Typical costs:

- Capital:
  - materials;
  - compensation;
  - land;
  - legal fees;
  - design; and
  - mitigation.
- Phasing, additional construction in future years;
- Operational;
- Running (Fuel, staff);
- Maintenance;
- Decommissioning;
- Monitoring;
- Refurbishment; and
- Loan repayments.

Typical factors:

- site size, conditions, location and access;
- complexity;
- risks, programming and timing constraints;
- resource requirements and availability;
- construction methodology/design;
- environmental constraints;
- client costs;
- specification;
- conditions of contract.

Optimism bias

HM Treasury require that optimism bias is included in all projects that require public funding to reduce the risk of overspend. Reducing the risk of overspend should help ensure that there is fairer allocation of funds (where funds go to the projects that provide the most benefits for the estimated costs, rather than to projects that are later shown to have significantly under-estimated the costs).

Return to main guidance

Sunk Costs

It is essential that sunk costs are excluded from the appraisal, otherwise the costs of the project will be incorrect. Clear descriptions of what is already in place (including existing defences and resilience measures) and what 'extra' is required should help you identify what are/are not likely to be sunk costs. It can be more difficult to identify how those sunk costs are affecting the benefits. Where existing defences (or other measures) provide some protection, you will need to consider how that protection would change over time. This would be included under your do-nothing baseline (see Chapter 5: define the baseline).

Return to main guidance

7.3.3 Explanations and further guidance: Describe, quantify and value costs	
Contributions Return to main guidance	The impact of contributions needs to be dealt with very carefully in terms of how it affects (i) the costs of the project and (ii) the average benefit-cost ratio. For example, a project that is not economically worthwhile (benefits less than the costs) should not be topped up with contributions to make it acceptable. This is because there is a risk that more affluent communities who are better able to afford to provide contributions could otherwise provide additional funding that could result in 'their' project being prioritised over one for a less affluent area. Taking account of external contribution and therefore the consequential reduced use of FCERM budget is more of an issue for prioritisation than for appraisal (see Environment Agency's contributions policy).
Multi-functional projects Return to main guidance	The inclusion of wider objectives in flood and coastal erosion risk management projects may result in multi-functional projects, which generally provide a range of facilities at a lower cost than if each were provided separately. In cost-benefit analysis, all benefits and costs should be included and the question of who benefits and who pays can be used to help identify where there may be the potential for contributions from those who are benefiting from the project. Project partners should be able to help you estimate these costs from their experience of providing projects to deliver similar objectives.
Environmental costs Return to main guidance	It is important that the cost of the options clearly identify which environmental costs are to be mitigated and that the costs of mitigation measures are included. A clear indication of which environmental costs are to be mitigated is essential to help avoid: • double counting of impacts: where environmental costs are included as negative impacts but where mitigation measures have also been included in the cost estimates. Including the environmental costs twice would reduce the average benefit-cost ratio of the option; or • impacts being omitted from the appraisal: where the assessment of impacts assumes negative effects have been mitigated but the cost estimates do not include mitigation costs. Here, the assessment would be incorrect and would suggest that the option has a higher average benefit-cost ratio than it should.

7.3.3 Explanations and further guidance: Describe, quantify and value costs	
Residual life and residual value Return to main guidance	Residual life of assets occurs because of the 100-year time period that is usually used for appraisal. Unless a defence, pumping station, or sluice reaches the end of its useful life at the end of the appraisal time period, it will have some residual value. By using residual values you can stop the appraisal in year 100 without having to worry that one option would continue to provide benefits over a longer time period when compared with another option. It helps to ensure that you are comparing options on a fair basis. As a result, you only need to apply residual values where there are significant differences between options in terms of the residual lives of defences, pumping stations or sluices.
Greenhouse gas emissions Return to main guidance	Carbon footprints are becoming increasingly important considerations of projects. Options that have lower greenhouse gas emissions over their life will become more preferable where carbon footprints are taken into account. This can help promote options that are more adaptable and flexible.
	Move to describe, quantify and value benefits OR Check you have completed all the expected outputs

7.4 Describe, quantify and value benefits

7.4.1 Expert summary: Describe, quantify and value benefits	
Quantify and monetise impacts Read more	If you are undertaking a cost-effectiveness analysis (CEA), you only need to consider describing, quantifying and monetising negative impacts of options if there are significant variations between the options. Consider whether one (or more) options would result in negative impacts that could result in additional damages that would affect which option is the least-cost option. If you are undertaking a CBA, you will need to describe, quantify and value the significant impacts. You should draw on information gathered during the EIA or SEA to help you identify which impacts need to be included. Add other categories as necessary. These could include damages to properties, critical national infrastructure, geomorphology and sediment transport and impacts on businesses.
Use AST Read more	Use an AST to record the description of impacts, quantified data and monetised estimates of the impacts. Draw on the SEA or EIA for the environmental and social impacts. Consider whether other impacts, such as economic, need to be included. Tailor the AST to your specific project. Include key assumptions and record uncertainties. This will help inform sensitivity analysis. You should engage with stakeholders during the identification, description, quantification and valuation of impacts.
Monetising impacts Read more	Use appropriate guidance when monetising impacts (see AST supporting document for links to approaches for valuing impacts). Where guidance is not available, consider whether it is appropriate to use scoring and weighting (see scoring and weighting supporting document), the environmental valuation handbook or whether you should undertake research using, for example, contingent valuation surveys.
Take account of climate change Read more	Consider how the impacts might change under high and low climate change scenarios. Record ranges for the most significant impacts. This information will be used during decision-making (see also the climate change supporting document).
Spend most time on the most significant impacts Read more	You should describe, quantify and value, where appropriate, all significant positive and negative impacts. It is important, though, that the approach to describing, quantifying and valuing the benefits is proportional. Assess which impacts are likely to be most significant to the choices being made between options and focus your efforts onto these.

7.4.1 Expert summary: Describe, quantify and value benefits	
Consider knock-on effects Read more	Consider knock-on effects from loss of assets such as properties and businesses but make sure that you only include those that are significant at the national level in decision-making.
Apply capping Read more	Make sure that damages are capped where necessary at the regional market value to avoid the estimated impacts exceeding the market value of the assets.
Assessing flood risks Read more	You will need to take account of the risk of breaching and/or overtopping when assessing flood risks.
Assessing erosion risks Read more	To determine the probability of asset loss due to erosion, first estimate the rate of erosion over time. Where they exist, estimate the probabilities that coast protection structures may fail. Erosion contours can be drawn based on predicted erosion rates to determine when properties and other assets are expected to be lost.
	Check you have completed all the expected outputs

7.4.2 Main guidance: Describe, quantify and value benefits	
Which impacts? Read more	Impacts of options can be both positive and negative. The types of impacts to consider and level of detail required will depend upon: 1. whether you are undertaking a CBA or CEA; 2. the significance of the impacts; 3. how far you have developed the options; and 4. the level of detail used in other parts of the appraisal.
Use the SEA or EIA and engage stakeholders	You should engage as you have planned in your SEP. You should also include the categories from the SEA or EIA to ensure that all relevant, significant impacts have been captured in the appraisal. Ensure engagement covers all statutory bodies as well as other interested parties.
CBAs Read more	In a CBA, you should consider both the negative and positive impacts of the options. In all cases, these should be compared with the impacts caused under the do-nothing baseline. You will need to ensure that mitigation measures are taken into account where these have been included in the costs of the options.
CEAs	In a CEA, you will need to consider if there are any significant negative effects caused by one (or more) options that may result in damages. Any such damages should be added to the costs of implementing that option. You will need to

7.4.2 Main guidance: Describe, quantify and value benefits

ensure that mitigation measures are taken into account where these have been included in the costs of the options. It is usually assumed in a CEA that all the options will deliver the same or similar levels of benefits. However, you should assess whether there are significant differences between the options that need to be considered as part of decision-making.

When using CEA for projects whose main purpose is to fulfil legal requirements, you will also need to identify and describe the benefits that would be derived.

Read more

Assessing the benefits of legal requirements

The benefits of legal requirements need to be identified and described and, where it is proportionate and appropriate, valued in monetary terms. Where you are appraising a scheme, you can use information on the benefits from the strategy. Where there is no strategy, it is sufficient to identify and describe the benefits (and who benefits) for a scheme. At strategy level, you may need to undertake a high-level assessment of the benefits (and their distribution), potentially quantifying and valuing the benefits where information is available and reliable. You may be able to draw on the Impact Assessment undertaken when the legislation was implemented.

You should include information on:

- the benefits that occur as a result of fulfilling the legal requirement (direct benefits); and
- identify who (or what) else benefits (indirect benefits).

Information on the benefits of legal requirements should be reported separately in the PAR/StAR.

Example approaches to estimating the benefits of legal requirements

Habitats Regulations:
- direct benefits from fulfilling the legal requirement would be the number of hectares protected and/or enhanced by the project;
- there may be indirect benefits to properties that are protected from flooding or erosion as a consequence of the works that fulfil the legal requirements. Visitors to the site would also benefit.

7.4.2 Main guidance: Describe, quantify and value benefits	
	Legislation requiring maintenance of existing structures (where you are using CEA): • benefits from fulfilling the legal requirement would be the damages avoided (where the damages are associated with not maintaining the structure); • indirect benefits could include environmental benefits, avoiding disruption to road/rail transport, maintenance of community interactions or navigation/recreation benefits. **Legislation (typically local legal agreements) requiring a particular standard of protection or specified level to be provided (where you are using CEA)**: • benefits from fulfilling the local legal agreement would be the damages avoided (where the damages are associated with do-nothing and a lower standard of protection or defence height); • indirect benefits could include environmental benefits, avoiding disruption to road/rail transport, maintenance of community interactions or navigation/recreation benefits. **Water Framework Directive**: the legal requirement under the WFD is 'no deterioration' in status of a waterbody. Your appraisal should consider the costs and benefits of each option and should include an assessment of the implications under the WFD. You should also be looking to provide options that could improve the status of water bodies where possible. Therefore, assessment under the WFD is an important part of the appraisal process (linked with SEA/EIA). Consideration of disproportionate costs is undertaken as part of decision-making (see: Chapter 8: compare and select preferred option).
Determining the significance of impacts	Appraisal requires you to describe, quantify and value the impacts that would be caused by an option. However, this only needs to be done where those impacts highlight differences between the options and where those differences are significant to decision-making. This should be done through links with the environmental assessment (EIA, SEA or equivalent). You should also consider: • impacts which occur earliest in the lifetime of the project (because discounting means that benefits and costs that occur further in the future are much smaller in present value terms); and • those impacts which have the highest probability of occurrence (because benefits that are less likely to occur, or damages that would occur less frequently may have less effect on the total benefits and damages).

7.4.2 Main guidance: Describe, quantify and value benefits	
Read more	You should describe, quantify and, where possible, value in monetary terms all significant impacts.
Developing options	At the early stages of option development, it is usually sufficient to identify which types of impacts are expected under each option. The amount of detail required will increase as options are developed, combined and refined.
Consider uncertainties from other parts of the appraisal Read more	Where an appraisal needs to involve different types or forms of benefits, it is worth putting a good balance of effort into each part, depending of their relative scales and importance. For example, it makes sense to spend less money in carrying out surveys to characterise properties by social class when very broad hydrology or flood spreading has been done, and a motorway or major railway flooding is not properly assessed.
Taking account of impacts	Impacts need to be described, quantified and, where appropriate, valued in monetary terms. Appraisal Summary Tables (ASTs) are used to act as a record of the appraisal.
Use an AST to record the impacts Read more	ASTs are intended to capture impacts that might occur and are used to record: (i) whether any impacts are expected under each category for each option and whether these impacts are considered significant (or not); (ii) who is affected by the impacts (such that the damages and benefits can be disaggregated[4]); (iii) a description of differences in impacts (qualitative, quantitative and monetary, as appropriate) across the options being appraised[5]; and (iv) any key assumptions or uncertainties associated with the description of the impacts.
Tailor the appraisal to your project	Qualitative, quantitative and monetary values of the impacts should be recorded in the Appraisal Summary Table (AST). The AST can be used to identify, describe and value impacts. It can also be used to record the flow of benefits and damages between different categories and stakeholders showing who are the main beneficiaries. This information can then be used to identify potential contributors to a project

[4] The AST categories should be sub-divided to show effects on different groups or assets. This can then be used to identify those who would benefit and, hence, who may be potential contributors to the costs.

[5] It is only necessary to record differences between options in the ASTs as it is these differences that will be used to choose between options.

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Read more	(in a similar way to how the objectives can be used to identify potential project partners). This information should be included in the PAR/StAR.
Using ASTs	The impacts of each option are usually recorded in one column of the AST. The AST should include qualitative and quantitative descriptions, monetary valuations (where appropriate), assumptions used and uncertainties associated with the descriptions of impacts and their valuation in monetary terms.
Illustrative example of use of an AST	An example AST (see AST supporting document) shows how the AST can be used to record the impacts of the do-nothing baseline (see also use the problem to help develop the do-nothing baseline for a description of the problem used as the basis for this example).
Describing the impacts	Make sure that you have considered at least the following broad categories: • economic impacts: impacts on national and local economy and the infrastructure and businesses (including agriculture) that support it, including impacts associated with relocating infrastructure and businesses through adaptation Read more; • environmental impacts: impacts on habitats and species, water (quality and quantity), natural processes, geology and geomorphology, landscape and the historic environment Read more; and • social impacts: impacts on people, their health and well-being and their communities, including impacts associated with relocating people Read more.
Read more	It is important to engage with stakeholders in order to access the best, most up to date, qualitative and quantitative information on the impacts. This should help you obtain multiple perspectives and will be beneficial to your assessment of the impacts.
Information to include when describing the impacts	Technical issues and uncertainty also need to be assessed and recorded in the AST. These issues should also have informed your approach to short-listing options (see Chapter 6: Identify, develop and short-list options). The description of impacts should cover changes in both probability and consequence when compared with the baseline and include: • number/length/area affected;

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Read more

- type(s);
- designations (where relevant);
- when the impacts are expected to occur;
- significance of impacts (national, regional, local); and
- knock-on effects outside of the project area.

Example of baseline description where a similar impact occurs across all options (including the baseline) but where the timing of the impact varies

- BASELINE: Grade II* listed World War II gun emplacements would be lost in year 10
- Option 1 (do-minimum short-term beach recharge): gun emplacements protected until year 20
- Option 2 (significant beach recharge): gun emplacements protected throughout life of project

Example of baseline description where the impacts vary across the options (including the baseline)

- BASELINE: 60 ha of freshwater habitat designated as SSSI lost in year 5 due to breaching of defences. Over time this is likely to be replaced with an equivalent area of intertidal habitat (probably mudflat but there is potential for some saltmarsh colonisation) which will extend from its current limited (and undesignated) extent in front of the defences
- Option 1 (do-minimum maintain defences): freshwater habitat protected until year 50 when it is no longer possible to maintain defences (without considerable capital works). Loss of remaining intertidal habitats in front of existing defences by year 20 due to coastal squeeze. Potential creation of 60 ha of intertidal habitat once defences breach in year 50
- Option 2 (improve defences): protection of SSSI freshwater habitats until year 99. Loss of intertidal habitats in front of defence line by year 20.

Including environmental impacts

It is essential that the appraisal includes information on impacts based on appropriate environmental assessment. Identifying the best option requires careful consideration of environmental issues alongside economic and technical ones. An effective appraisal process:

- gives early consideration to the environment and stakeholder engagement and uses this, and the results of the scoping exercise, to shape the direction of the appraisal;
- pays attention to timing and programming, identifying

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when environmental information can best advise, guide or inform the decision-making to avoid excessive environmental data collection or abortive technical and economic work; and

- integrates the skills and knowledge of expert environmental advisors and stakeholders (including statutory consultees to the EIA or SEA process) to effectively inform the technical requirements of the work and make sure the environment issues inform the decisions taken.

Consider specific legal environmental obligations

If the project conflicts with the objectives of environmental legislation there may be legal obligations that determine:

- how such a conflict can be justified;
- the extent to which the conflict should be mitigated; and
- the requirements to compensate for adverse effects that can not be avoided

This should inform the need to consider whether to include new options or refine existing ones as part of the option development process in Chapter 6: Identify, develop and short-list options. The Water Framework, Habitat and Birds Directives include such requirements, and consideration should be given to whether any more recent legislation make similar provisions.

If the project causes deterioration from or prevents the achievement of WFD objectives it is a legal requirement that better environmental options are assessed. They can only be ruled out on the grounds of technical feasibility or disproportionate cost. You may need to consider whether to include new options in the appraisal or refine the options identified in Chapter 6: Identify, develop and short-list options.

Consider the implications of climate change

Identify and record where the impacts could vary under high and low climate change scenarios. For the most significant impacts (those that make up 10% or more of the total damages), record ranges of impacts. This information is required as part of real options analysis, which is undertaken as part of decision-making. You will need to use the guidance set out in the climate change supporting document to help you identify the high and low scenarios.

Read more

Describing changes in risk

Options result in impacts because they change the risk of flooding and/or erosion, thus you should describe impacts due to:

- change in probability: measured as frequency of flooding or time until erosion; and

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- change in consequence: measured as the damages or benefits caused by flooding and/or coastal erosion.

Options can affect both probability and consequence, probability alone or consequence alone. You will, therefore, need to describe, quantify and value (where possible) the impact of changing probability and/or consequence in the AST.

Changing probability and changing consequence

i) Changing probability
a) A flood wall would reduce the probability of flooding of a village from 0.1 to 0.01. On events greater than 0.01, there are no significant reductions in velocity or flood depths compared with the do-nothing option.

b) Repairing a sea wall will reduce the probability that it will fail. The loss of the property behind would still occur if the wall fails. The risk to the property is however reduced.

ii) Changing consequence
Flooded properties in the village are to be repaired to be more flood resilient. This will not change the probability of flooding, which will stay at 0.01, but the resilience measures will mean that the properties can be reoccupied much sooner. This reduces the consequences in terms of disruption to family life as well as reducing the costs of repairing the property following a flood.

ii) Changing probability and consequence
a) A floodwater management option reduces the probability of flooding from 0.1 to 0.02 by redirecting floodwaters away from the village. In addition, the option would reduce flood velocities and depth to properties in the village on events from 0.02 to 0.005 thus reducing the consequences by reducing the damages. As a result, damages to properties would be reduced on events up to 0.005. Above 0.005, there is no reduction in velocity or depth compared with the do-nothing option.

b) A brackish water habitat is at risk from lack of saltwater input. Under an option that would maintain, but not improve the defences, the area would flood more frequently due to sea level rise. The increased probability of flooding would result in benefits to the site by providing saltwater input, helping to maintain a gradient across the site from freshwater to saline water. As a result, biodiversity on the site is predicted to increase.

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Quantifying changes in risk Read more	Quantifying changes in probability is relatively easy as it is often used to define the level of risk management that an option would provide. This information can be included in the appraisal spreadsheets to assess average annual damages (AADs). Quantifying changes in consequence can be more complex as it is often difficult to identify how and to what extent the impacts may be reduced (or increased). There is some guidance in the Multi-Coloured Handbook/Manual that will help you quantify (and value) reductions in consequence resulting from flood warnings and reduced depths. You should also consider the number, length or area affected, the timing and duration of impacts and how these could change. Estimates of the reductions in losses that can be achieved by flood warning given specific lead times are available in the Multi-Coloured Manual (FHRC, 2006a). There is weak evidence that warnings reduce the stress experienced from floods, and, in consequence, that the other non-monetary losses from flooding are also reduced. In some areas it may also be reasonable to consider flood warning as a prime element in the avoidance of loss of life, although quantification of the relative risks can be difficult. To avoid double counting, the benefits derived from flood warning should be deducted from the assessed benefits of flood alleviation schemes carried out in areas where a flood warning service is provided. Data may also be available from research undertaken by the Environment Agency on the effectiveness of the Floodwise campaign. **Examples of reducing consequences** i) An option to evacuate people following flood warning on the coast would reduce the consequences in terms of risk to life (death, injury). The probability of flooding is not affected. In this case, the benefits would result from lives saved and injuries avoided. It would be assessed by calculating the difference between the number of people that would have been at risk without evacuation and the number at risk following evacuation. ii) Flood warning given three hours in advance allows people to move their more valuable possessions (such as televisions, DVD players, or photographs) upstairs. The probability of flooding of their home is not affected. In this case, the benefits would result from a reduction in damages to their moveable possessions and require the householder to take action. There would be no benefit to fixed items,

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	such as kitchen units or carpets. iii) Following flooding, houses are repaired so they are more resilient to future flooding. For example, electricity points are raised, floors are tiled rather than carpeted, kitchens are replaced with plastic/steel fittings rather than chipboard and no-return valves are installed to prevent water backing up in the property. The probability of flooding is not affected. The benefits are calculated as the reduced costs to return the property to habitable condition. Additional benefits are generated due to reduced family disruption as the property can be repaired quicker, reducing costs of temporary accommodation.
Nationally significant impacts	The AST should highlight the likely significance of impacts. Impacts that are significant at the national (or international) level are likely to be of greatest importance (see also transfer payments). You should consider whether the impacts caused by the options would be significant at the national level (including effects on critical national infrastructure) and what the knock-on effects could be. Engagement with operators/owners of critical infrastructure may be required to understand the implications.
Locally significant impacts	The AST can also be used to record local effects, even where these cannot be included in the average benefit-cost ratio for the project because they would be transfer payments (see also transfer payments). Engagement with local stakeholders will help you better understand the local impacts and whether these are likely to be significant at the national level. Inclusion of local impacts and local beneficiaries will also be useful when identifying potential contributors.
Valuing impacts in monetary terms Read more	Impacts can be valued in a number of different ways, with the most appropriate method often determined by the type of damage or benefit being considered. The approach to use will vary by type of impact being assessed. The AST Supporting document lists typical impacts that can result from projects that manage flood or erosion risk and whether guidance is available that would allow the impacts to be valued in monetary terms. It is important to recognise that this list is not comprehensive. You should include other impacts where these are important to your project. In addition, not all of the impacts may be relevant and can be excluded. Approaches such as scoring and weighting can be used to value impacts where there is no guidance available or where the existing guidance does not cover impacts of your project.

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Quick approaches to valuing impacts in monetary terms	For small projects or those requiring a supported or simple change CBA, affected assets can be grouped to enable damage estimation. The Multi-Coloured Handbook provides summary data on damages that can be used to provide a simple approach to estimating the benefits. This includes Table 4.4 of the MCH (FHRC, 2006) for residential properties (weighted average annual damages) and Table 5.1 of the MCH (FHRC, 2006) for non-residential properties (also weighted average annual damages). Other impacts may require more time to value in monetary terms. The MCH covers approaches to estimating impacts on agricultural land (FHRC, 2006), while the environmental valuation handbook sets out approaches to valuing ecosystem services. You may also need to adjust for distributional effects (following the supplementary guidance).
Take care though not to introduce too much uncertainty Read more	Care is needed when using high level data as the estimated monetary values can introduce a considerable degree of uncertainty. You should therefore use data that are appropriate to the project being appraised, going into more detail where this will help improve the decisions that are being made. Table 4.3 of the MCH (FHRC, 2006) provides guidance on the approaches that might be most appropriate for different types of appraisal. You should always, though, assess whether you need more (or less) data for your specific project. When deciding whether to go into more detail, consider the levels of uncertainty, the significance of the impacts to the decision being made, the magnitude of differences between options (where, for example, smaller differences could require more detailed approaches) and the likely effect of the additional detail on reducing uncertainty or making differences between the options clearer such that it actually takes you closer to deciding on the preferred option.
Time required to value impacts Read more	When deciding whether to spend time valuing impacts in monetary terms, it is useful to consider how significant the impacts under each category may be in relation to property damages (since property damages are relatively quick and easy to calculate). Where you believe the damages to be of a similar magnitude, it may be useful to consider these impacts in more detail. Where the damages may be small in magnitude, when compared with property damages, it may be sufficient to describe them in the AST, note differences between options and move onto the next impact. Since the appraisal process is iterative, you will need to look at those impacts in more detail should they become important when choosing between options.

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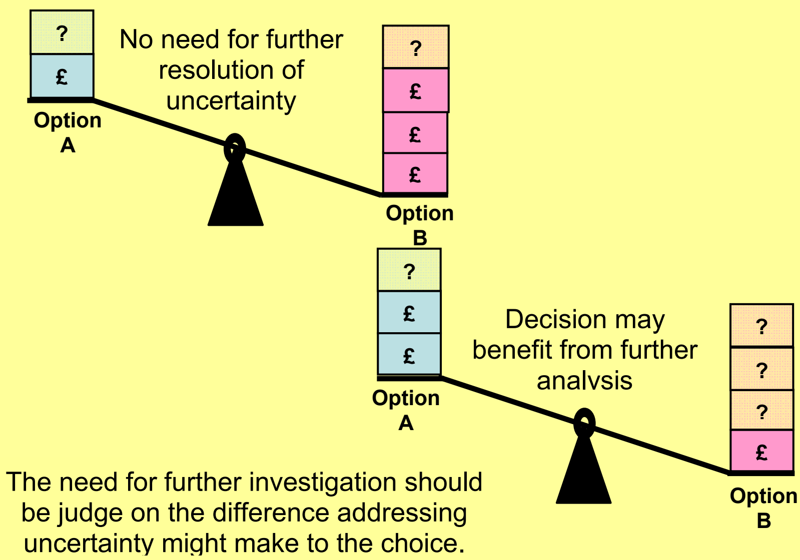
Proportional assessment of benefits

Using uncertainty to decide when to do more

i) It can take a long time to estimate the damages from diversions that are caused by flooding of a road. It is unlikely to be appropriate to spend time valuing these damages where the roads affected are B roads, or even single carriageway A roads where the diversion route is short.

ii) The costs of valuing recreational benefits or non-use values are largely fixed if willingness to pay values are to be used (through benefits transfer). Where the environmental valuation handbook needs to be used or new research work (such as surveys to identify specific willingness to pay values for the project area) is to be carried out, the cost of assessment is generally independent of area affected so would be most appropriate/more proportionate for larger project areas.



Read more

Whether to value or not

When deciding whether it is likely to be proportional (in terms of the time and effort required) to value impacts in monetary terms, you should consider the following questions:

- ***are the impacts significant in terms of the overall damages or benefits?*** Impacts that are likely to make a significant contribution to the overall damages (or benefits) are likely to be worthwhile valuing in monetary terms (the definition of significant will vary according to the project and impacts being considered, but could be:
  - for economic (and monetised impacts): those impacts that may exceed, say, 10% of the property damages;
  - for environmental impacts: impacts of major or

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moderate significance; and – for social impacts: impacts of major or moderate significance (or impacts where the wellbeing of people vulnerable to social exclusion noticeably deteriorates or improves compared with the do-nothing option). • ***will valuing the impacts in monetary terms help you make a better decision?*** Even impacts that are not very significant could be worth valuing in monetary terms if they will help you choose between options. Also, if choices are so close that they can be switched by very small changes in one item, perhaps the decision should be based on the consideration of wider issues, not just one single item. Take care though as it is not necessary to value everything in monetary terms for it to inform decision-making; qualitative descriptions and quantitative measurements of impacts should also be considered. • ***are approaches to value the impacts available and do you have the information necessary to apply the approaches?*** If approaches are available and you have the necessary information, you should be able to estimate monetary values relatively quickly. Be careful though that the information you have and the approaches available will give you a reliable estimate of the monetary value of the impacts. Consider the likely level of uncertainty when deciding whether to apply the approaches and, therefore, if monetary values of the impacts will really help you when it comes to choose between options. Where you do not have information readily available, it may be worthwhile collecting more data where the impacts are significant. This may require you to undertake new studies (for example, contingent valuation surveys). You should investigate the likely time and costs involved, as well as the outputs that might be available when making this decision. In carrying out further analyses, you should be mindful of the time and resources needed for each type of benefit assessment and ensure very time consuming or costly analyses are only carried out when the scale justifies it. • ***if approaches are not available and/or you do not have the information required but you believe that the impacts are significant and should be valued, consider whether to use scoring and weighting***. Some of the impact categories can be difficult or time consuming to assess in terms of money. An alternative approach is available that will allow you to estimate all the impacts in monetary terms; this is based on scoring and

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weighting. The scoring and weighting methodology has been developed over the past few years for Defra and the Environment Agency. It is based on the principles of Multi-Criteria Analysis (MCA) but it is now known as scoring and weighting to better reflect the approach that is involved and because it can be used to provide monetary estimates of impacts that can be combined with other monetised benefits to feed directly into the cost-benefit analysis. Follow the flowchart in Figure 7.2 to assess whether it is likely to be worthwhile applying scoring and weighting. Separate guidance is provided that describes how to undertake scoring and weighting.

Read more

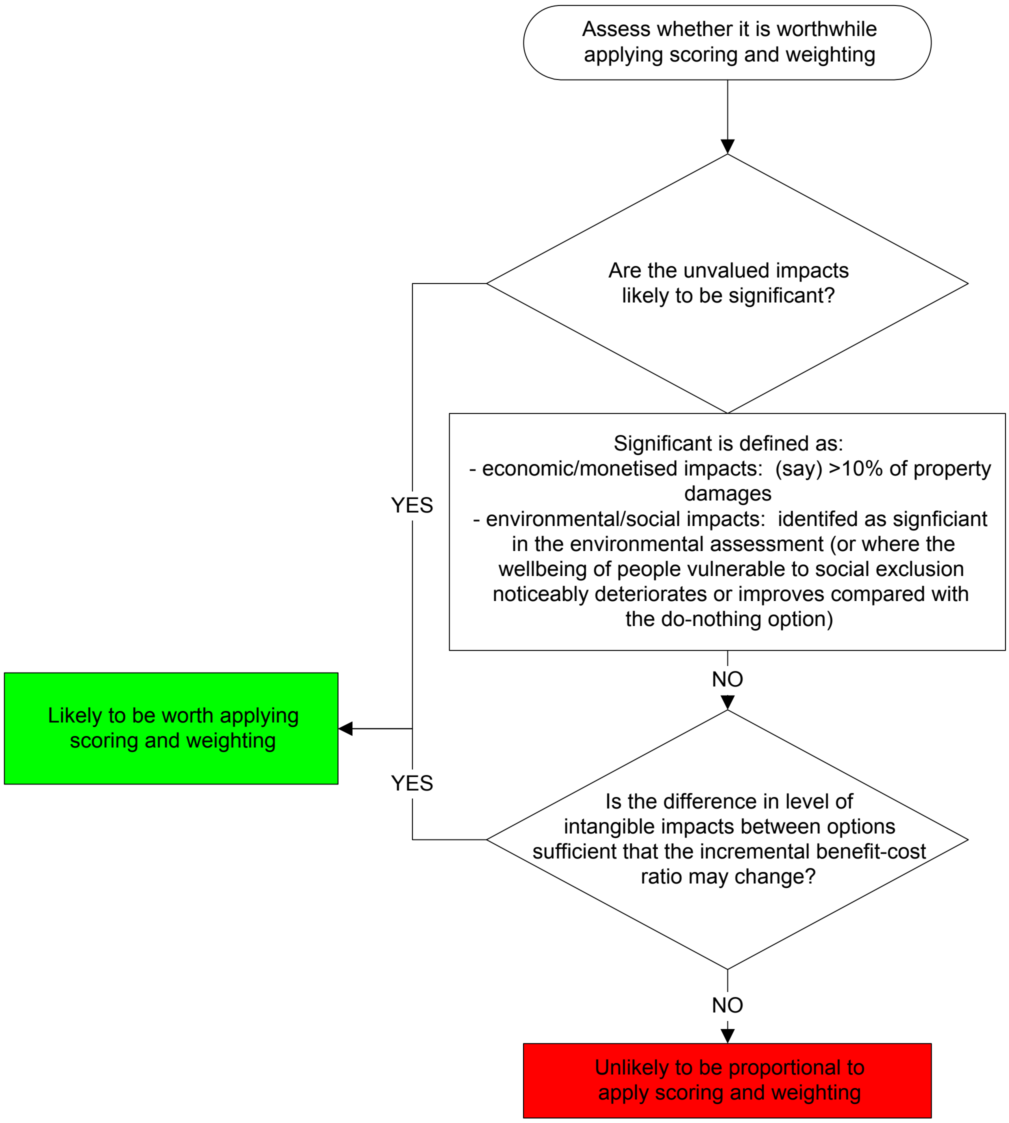

Figure 7.2: Assessing whether it is likely to be worthwhile applying scoring and weighting

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Transfer payments	An economic appraisal for national funding should consider only those benefits and costs accruing within the national boundaries, and treat localised effects, which are offset by gains or losses that occur elsewhere, as transfer payments. Local and regional impacts are likely to be important to project partners and will need to be described and quantified to ensure that they are reflected in the appraisal and to help identify potential contributors and/or make the case for contributions. You should consider whether an impact is likely to lead to a loss to the nation as a whole or to the region or local area when describing and quantifying the benefits. Any impacts that could reduce activity in one place, but where this activity could occur somewhere else are treated as transfer payments. Thus, output from a biscuit factory or visits made to the beach where there are other biscuit factories and beaches in the UK would all be assumed to be transfer payments. In reality, there may be some loss of business due to a reduction in number of trips made or additional costs incurred (for example, travel to a supermarket that is further away) such that some losses may occur. In such cases, you would need to identify the proportion of business or trips are lost (for example, measured as a percentage). This assumption would need to be justified.
Read more	**Is it a real loss to the nation?** i) Flooding of a supermarket may cause considerable losses in terms of stock and fixtures and fittings. These are national losses as the stock is lost. However, lost business (for example, income to the supermarket) because it is closed for three months is not a national impact as another supermarket would benefit from increased business. In reality, some business may be lost where the other supermarket is further away or business may be picked up by smaller, more local shops. In most cases, these changes are too detailed to be reflected in appraisal. You should only consider including them in the appraisal if they are key to the choice of option and where you can justify why the impacts are not transfer payments. ii) If local moorings are lost due to the loss of a breakwater that also provides protection to properties, the loss of properties would be a direct loss to the nation, but the boats may be moved to a nearby harbour. If however the

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moorings are an integral aspect of the village and in losing them there would be damage to the cohesion of the village or if they supported a fishing fleet it may be necessary to consider additional travel time and loss of fishing effort.

Write-off of properties

Properties that are flooded on average more than once every three years are usually considered to be written-off unless they are flood resilient or water compatible (as described in PPS25 or TAN15). This is because is unlikely to be sufficient time for the property to be repaired and return to full use following the previous flood before the next flood occurs. As a result, repairing the property would be a waste of money.

Write-off values are taken as the risk-free market value of an asset. It is important to use risk-free market values because the actual market value of the at-risk property could be lower (where the risk is known, there may be lower demand for the property or higher insurance costs such that the market value is reduced).

Capping of damages

Capping is different to write-off. Capping occurs because the cumulative damages are sufficient to exceed the market value of the asset. Thus, damages to a property valued at £100,000 that is flooded once every ten years or so with damages of £35,000 on each flood would only be counted to a maximum of £100,000.

Read more

How to apply write-off and capping

Write-off and capping both use the ***risk-free regional average market value*** to ensure that the risks are not already reflected in the market value of the property. For non-residential properties you may need to use the rateable value multiplied by a factor that reflects the added value or percentage from that property, typically 10, but with yields of around 8%, a multiplier of 12.5 would be appropriate.

Capping the value of loss

i) where assets (such as properties, infrastructure, land) are flooded more frequently than once every three years or eroded they are written-off.

ii) where assets (such as properties, infrastructure, land) are flooded less frequently than once every three years, it is assumed that damages are incurred on each flood up to the point where the damages equal the risk-free market value of the asset. Once the damages have been capped, no further damages are estimated even though flooding may still continue.

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ii) where assets (such as properties, infrastructure, land) are flooded occasionally over the first part of the appraisal period and are written-off at a later date as the frequency of flooding increases (as is usual under the do-nothing scenario), the approach is to determine when properties might be abandoned (flooded so frequently that their whole value would be lost) and discount their write off value. Add to this the damages that would occur in terms of average annual damages up until the time of write off. You may need to cap the total damages where they exceed the market value of the property.

Property A is flooded occasionally (on average every five year). However in year 20 it is expected that due to deterioration of the flood defence and due to climate change the property will be flooded once every three years. The property would be written off in year 20. Take the average annual damages over the first 20 years + the write off value of the property (discounted from year 20).

Assessing damages from flooding

Damages from flooding can occur because defences have failed (breached) or been overtopped. Different return period events can result in a greater or smaller number of assets being flooded such that damages can vary. For example, a 100 year flood event (one with an annual probability of 0.01) is likely to cause more damages than a 10 year flood event (probability of 0.1). Average Annual Damages (AADs) are calculated as the area under the loss-probability curve (with loss/damage on the y-axis and probability on the x-axis) (see Figure 7.3).

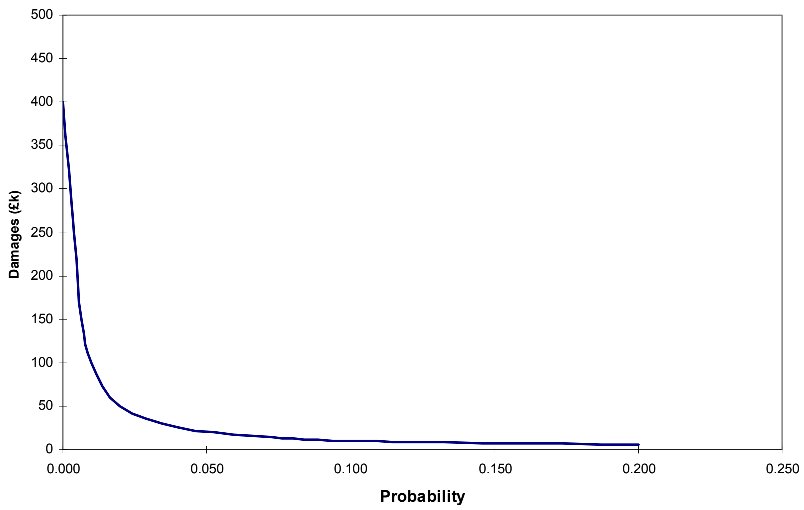

Figure 7.3: Loss-Probability curve

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The average annual damages should be calculated using a minimum of three events (preferably five) and the choice of those events should be considered carefully. Use the description of the problem to help you identify appropriate events. The overall form of the curve, and the area under it, is then calculated by drawing straight lines between the calculated points. This is a simplification which can introduce uncertainty into the estimate of average annual damages. The same basic approach can be used to estimate damages to other impacts than just properties, such as protection of habitats.

Read more

Example of the use of loss-probability curves

i) Sea Defence works currently provide protection against a 1:100 flood. By year 99, this standard is predicted to decline to 1:10. To determine the current damages it is necessary to consider at least one event greater than 1:100, probably two events 1:200 and 1:500. For future flood risk it would be necessary to consider events ranging from 1:10 through to 1:500. This is demonstrated in the following Loss Probability Curve.

Average Annual Damages are determined by the area under each curve; such that:
AAD present = Ap1 + Ap2
= ((0.01 – 0.005)x (200k + 500k)/2) + ((0.005– 0.002) x (500k + 1000k)/2) = £4k

AAD future = Af1+ Af2 + Af3 + Af4 + Af5
= £17.5k + £22.5k + £12k + £7.25k + £4.65k = £63.9k

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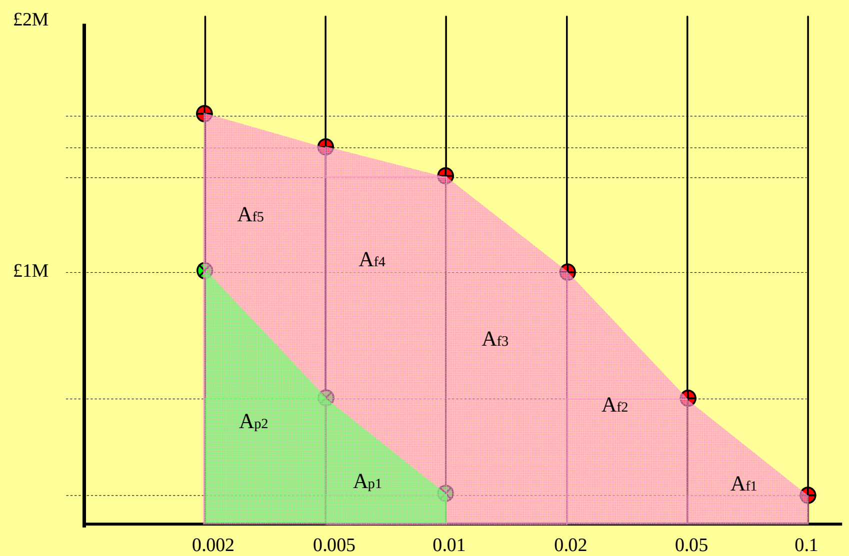

Probability	0.1	0.05	0.02	0.01	0.005	0.002
Return	1:10	1:20	1:50	1:100	1:200	1:500
present damages £(1000)	0	0	0	200	500	1000
future damages £(1000)	200	500	1000	1400	1500	1600

ii) Adapting the above example to comparison of options for improvement of defences might give the following case.

The Do Nothing (DN) option has a risk of flooding under a 1:10 year event and a do something (with scheme WS) option increased the defence to a 1:100 year level.

In this case it has been taken that the flood damages on the higher return periods under the with scheme option are the same as the Do Nothing option. This would imply that once the new defence was overtopped the level of flooding would be to the same depth as it would have been under Do Nothing. If this were the case the AAD values would be:

AAD Do Nothing = Adn1+ Adn2 + Adn3 + Adn4 + Adn5
= £17.5k + £22.5k + £12k + £7.25k + £4.65k = £63.9k

AAD with scheme = Aws1 + Aws2
= ((0.01 – 0.005)x (1400k + 1500k)/2) + ((0.005– 0.002) x (1500k + 1600k)/2) = £11.9k

Understanding where damages (benefits) accrue allows you to consider the sensitivity of a flood risk system and

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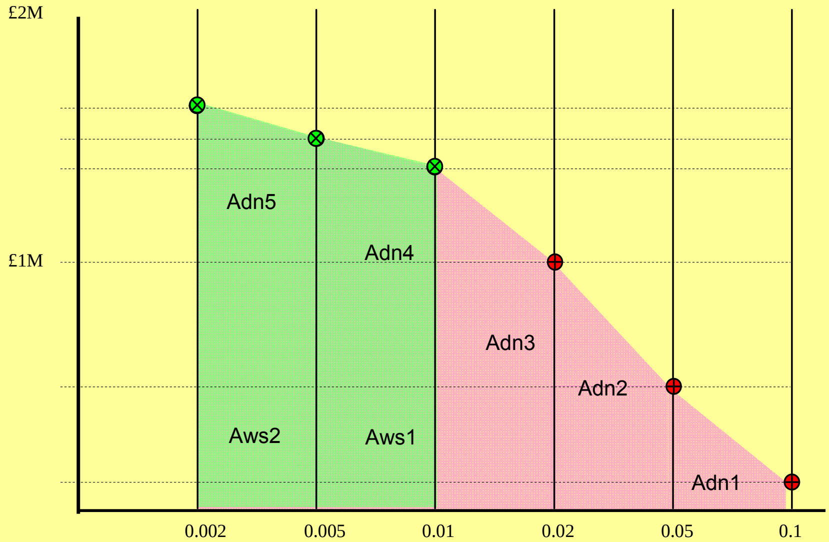
enables you to select options that may provide significant differences in approach to management of that risk.



Probability	0.1	0.05	0.02	0.01	0.005	0.002
Return	1:10	1:20	1:50	1:100	1:200	1:500
WS damages £(1000)	0	0	0	1400	1500	1600
DN damages £(1000)	200	500	1000	1400	1500	1600

Assessing damages from erosion

Read more

Damages from erosion usually consider the time until assets are directly affected (until they are eroded or at imminent risk of erosion). You should consider whether services supporting assets would be eroded (where they are located in roads that would be eroded) and whether access to assets would be lost.

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Erosion mechanisms Read more	Erosion can occur in a number of different ways, all resulting in loss of land and any assets that the land supports: • direct wave action: where the repeated action of waves erodes the base of cliffs. Eventually the undermined cliff collapses due to a loss of support. This can be a slow, gradual process in sheltered areas or a catastrophic process resulting in losses of many metres of cliff at once during or after storms; • freeze-thaw effect of ice: where water enters into cracks in the cliff. When it freezes it forces the crack to open wider. Eventually, the seaward side of the crack disconnects from the main cliff and collapses into the sea; • impact of groundwater: the lubricating effect of groundwater within the cliff can reduce the strength of the cliff and result in a slip. Where the slip is removed from the base of the cliff by wave action, on-going erosion could occur. Even if the slip remains at the toe of the cliff, there may be impacts on assets present on the cliff top.
Coast protection Read more	Components of coast protection should be seen as interdependent. For example, a beach may protect a sea wall which protects an eroding cliff. These components delay, but generally do not eliminate the loss of land and assets. Loss of the beach could undermine the sea wall and may hasten its collapse. This would then allow waves to erode the cliff (or coastline). This could result in benefits as well as negative impacts (such as to geomorphology or geology, or as a result of sediment moving down the coast).
Probability of erosion Read more	Determining the probabilities of erosion for each of the options enables the impacts of erosion (including losses of assets) to be described. Where there is an existing protective structure such as a sea wall, you will need to estimate the probability of this structure failing in any given year. This probability of failure is likely to increase with time. This assumption is important as it is only once the defences have failed that erosion is assumed to begin.
Onset of erosion Read more	Yearly estimates of the probability of failure may be based on detailed assessments, but will often rely on informed engineering judgement. It is rarely appropriate to assume that coast protection structures will fail in year 0, unless they are in very bad state of repair. If structural failure of the seawall leaves substantial debris, then this may still protect the base of the cliff. However, it is unlikely that any debris (unless in very large quantities) would provide any significant additional protection, especially if coastline is exposed to storms or surges.

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Erosion contours Read more	For property and other assets with direct use values, the simplest method of calculating expected values is to plot 'erosion contours', which are predictions of where the coastline will be every 10 (or 20 years, say) based on erosion rates. The definition of 'coastline' will vary according to your project and could be the cliff top, cliff base or mean high water. The erosion contours should be thought of in probabilistic terms as the most likely position of the coast in the specified year. Where erosion contours are used, they should be defined for several periods in the future. Losses that occur in the early years contribute most to the damages under the do-nothing option. The method for constructing erosion contours is set out in the Multi-Coloured Manual (FHRC, 2006a).
Safety margins Read more	Probabilities should be assigned to reflect the likely timing of loss of an asset. This can be done deterministically (for example, assuming that Beach Café will be lost in year 10 with an assumed probability of 1.0) or deterministically (where it is assumed that Beach Café has a probability of 0.1 of being lost in year 5, 0.5 of being lost in year 10 and 0.4 of being lost in year 15). The latter approach allows uncertainty over erosion rates to be picked up explicitly within the estimated damages but care is needed that this is not assumed to be the 'certain' answer. It also takes more time to assess losses probabilistically, so you will need to balance your approach to reflect the levels of uncertainty associated with erosion rates and number of assets affected. You will also need to take account of safety margins (a minimum acceptable distance between the cliff top and the asset at risk; see also 7.3 of the Multi-Coloured Manual (FHRC, 2006a)).
Expected value of losses from erosion Read more	Once probabilities of loss have been determined for the assets, values can be attached to these losses. The risk-free market value is usually used for properties. For other assets, you may need to use surrogate values based on replacement, rebuild or relocation costs. For any option, the expected value of the loss in a given year is the sum, across the different assets or properties, of the probability of the loss in that year multiplied by the value of the loss. The present value of the benefits of a coast protection option can later be determined by the difference in losses between that option and the do-nothing option. The critical difference between the options is the likely timing of the loss of particular assets. This has implications for the phasing of interventions (see also 6.4: Develop a short-list of options).

7.4.2 Main guidance: Describe, quantify and value benefits	
Combining flood and erosion losses	Combinations of flood and erosion loss can occur, for example when erosion of higher ground leads to increased risk of flooding to areas behind, or when erosion of saltmarsh or foreshore threatens the integrity of a flood defence structure. The probabilities of flood and erosion damage should be combined so double counting is avoided. If an asset is lost through erosion, it is no longer susceptible to flood damage. If a property is affected by progressively more severe and frequent flooding, the property may become uninhabitable before it is actually lost through erosion. This is taken into account by assuming a one-off property loss (write-off) instead of annual average flood damages. Check you have completed all the expected outputs

7.4.3 Explanations and further guidance: Describe, quantify and value benefits	
Describe, quantify and value the impacts Return to main guidance	Impacts are the negative effects (damages) and positive effects (benefits) that are caused by an option. They need to be included in the appraisal as they should be taken into account when making a decision on which option to implement. If you do not include impacts in the appraisal, they will be ignored and be treated as no impact. **Building the complete picture** i) A decline in water quality could result from one of the options. It would be difficult to attach an economic value to this, but recording it as an impact ensures that it is taken into account during decision-making. Such impacts could be very significant because they could lead to deterioration in status under the WFD. If there are mitigation measures that have to be put in place then these might be valued. ii) Landscape values are often difficult to value. A sea front promenade may have a high perceived value in terms of its visual aspect of the coast. This should be recognised within the objectives but should be recorded as part of the assessment of different options. Maintaining the view may be a benefit, increasing the height of a defence may be a damage to the area. It may be possible to actually value this through public surveys but this can be a costly exercise. This does not mean that damage would be insignificant in making the choice between options. There would still need to be evidence provided to support the assertion that it is important. This might be taken from consultation in comparison of options.

7.4.3 Explanations and further guidance: Describe, quantify and value benefits

iii) Monetary values can be placed on heritage structures and features. However, such values are often taken as the need for surveys or moving the feature. In broader terms this may not fully reflect the heritage or cultural value of the feature within its existing context. It would not be double counting to daw upon the additional benefit provided in maintaining the feature in its existing location.

iv) Caravan parks are often treated in monetary terms as something that can be moved, allowing loss of fixed infrastructure and the cost of moving caravans. However, in specific cases, the caravan park may provide important support to other feature such as tourism or revenue supporting operation of, for example, an associated harbour. Moving the caravan park may not be possible within the local area and may therefore have significant impact on the sustainability of other values in the area. It is important that the overall interaction of features are identified and recorded. While it may not add strongly to the general do something argument, it may be very significant in drawing comparison between options.

Features, and the benefit or damage associated with their loss or removal from the risk area, have to be considered as part of a whole ecological or socio-economic system. This has to be reflected in the objectives for the appraisal but also needs to be described as part of the overall story that is being developed in the appraisal.

CBA

Cost-Benefit Analysis (CBA) requires both the costs and benefits to be appraised. This is because there is a need to show that a project is worthwhile doing: the benefits have to be shown to outweigh the costs. In addition, the average benefit-cost ratio (supplemented by discussion on any benefits or costs that cannot be easily expressed in monetary terms) can be used to help choose between options. CBA is the approach required for supported change, simple change and complex change projects (see also 5.3: identify type of project required). CBA is also used where you are looking at the costs and benefits of wider objectives, or going beyond the minimum legal requirements.

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CEA

Cost-Effectiveness Analysis (CEA) is used for Sustain Standard of Service (SOS) projects and for projects whose main purpose is to fulfil a legal requirement. In these types of projects, you are looking to identify the least-cost method of meeting the objectives. It is important to remember that

7.4.3 Explanations and further guidance: Describe, quantify and value benefits

least-cost should include any negative impacts that might occur (including social and environmental impacts). CEAs do not require the benefits to be estimated though as it is assumed that all the options would provide the same (or similar) level of benefits. If you are concerned that options would provide different levels of benefits, you may need to undertake a CBA to ensure that the differences between the options can be taken into account during decision-making.

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The importance of proportional approaches to appraisal

Appraisal of impacts requires them to be described qualitatively, quantitatively and valued in monetary terms. This is so you can better understand the consequences of implementing (and not implementing) an option. However, it is important to ensure that the appraisal is proportional. This means focusing on the most significant impacts and only quantifying and valuing impacts where they would influence decision-making. Otherwise, there is a risk that a lot of time and effort could be spent in collecting information, quantifying and valuing impacts in monetary terms that have little or no effect on the choice of solution.

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What is proportionate?

It is not possible to state exactly what is proportionate and what is disproportionate. This will vary by project and by the impacts that are being considered. In all cases, you will need to ensure that the appraisal is reliable with sufficient information provided to ensure that the 'best' solution can be identified. There are a number of rules of thumb though that you can consider:

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What could be considered a significant impact?

- ***are the impacts significant?*** Property damages are estimated reasonably quickly. Monetised impacts that are likely to be around 10% (or more) of the property damages could have an impact on the overall estimated benefits and it is likely to be worthwhile spending time looking at these impacts in more detail. It is often worth considering damages to non-residential properties in more detail as they can vary significantly, particularly where what has been assumed in MCM/MCH is significantly different from what is at risk. Often 20% of properties could be commercial, and still account for 80% of all property damage or benefits. In such circumstances it is likely to be worth looking at non-residential damages more closely. The significance of environmental and social impacts should be identified in the environmental assessment. Significance for the Water Framework Directive and Habitats Regulations may vary from these definitions. Identifying significant impacts ensures that they are all taken into consideration, whether the

7.4.3 Explanations and further guidance: Describe, quantify and value benefits	
	available data are quantitative or qualitative. It also focuses the assessment on the main effects of the options, and facilitates short-listing of the options.
Return to main guidance	• Focusing purely on the significant impacts could result in some impacts being missed from the assessment. In addition, the use of non-monetised impacts to alter decisions based on economic analysis can bring considerable uncertainty into the process. This needs to be balanced against uncertainty that could be introduced by attempting to apply monetary estimates when a large number of assumptions have to be made (and which can be lost or forgotten once the damages have been estimated in monetary terms).
How do impacts vary between options? Return to main guidance	• ***do the impacts differ across the options being appraised?*** Detailed assessments should focus on differences between options as it is these differences that will help you decide which are preferred. Where impacts are very similar across all or most options, there is unlikely to be much value to the decision-making in considering these impacts in a lot of detail. Such impacts will be considered in the environmental assessment, so you will be able to draw on this information should you find you need more detail as the options are developed further. Sometimes combinations of impacts can result in cumulative impact. The cost of mitigation for cumulative impacts may need to be taken into account in addition to or instead of mitigation. Where impacts cannot be mitigated, these will need to be taken into account.
How much uncertainty is there in predictions of risk? Return to main guidance	• ***how much detail/accuracy/precision is available in other approaches?*** There is very little advantage in spending a lot of time looking at impacts in detail if the approaches that have predicted those impacts are coarse. For example, if a model predicts flood levels of 0.5m ±0.1m, it would not be worthwhile spending time describing differences in impacts that could occur based on 0.4m to 0.6m flood depths. This is because the uncertainty from the model means that the impacts on options with 0.4m and 0.6m flood depth need to be treated as similar.
How much time is needed to value the impacts?	• ***how much time is required to describe, quantify or value the damages?*** It can take a considerable amount of time to estimate the monetary damages of some impacts. For example, disruption to roads requires a large number of assumptions to be made (including

7.4.3 Explanations and further guidance: Describe, quantify and value benefits	
Return to main guidance	amount of road traffic, speeds before/after the event, diversion routes and impact on speeds on diversion routes). You may find that you spend a lot of time collecting data to inform these assumptions and then that the damages estimated are small. It is essential that you consider how significant the impacts are likely to be before you spend time collecting data and estimating the damages. The sections on each category give an indication of the level of damages that may be estimated for some impacts; use this as a guide to help you identify whether it is worthwhile monetising the impacts. Remember that you can always come back and monetise them later if you find that differences between the options on any one category could affect the choice of preferred option.
Are approaches available to value the impacts? Return to main guidance	• ***are there approaches available that would allow the impacts to be valued in monetary terms?*** Not all of the impacts will be easy to value in monetary terms. However, this is not an appropriate reason for excluding impacts. It is important to remember that you are valuing impacts at £0 if you exclude them from the appraisal. If significant impacts cannot be valued in monetary terms, it is important that they are described and quantified so they can be taken into account during decision-making.
Taking climate change into account Return to main guidance	Climate change and the impact that it has on future flooding and erosion risks needs to be taken into account during the appraisal. This will help to reduce the potential that the option identified as the best solution during decision-making turns out to be a poorer option than predicted. It is unlikely to be proportional to consider costs and benefits of all the options being appraised in detail against (a minimum of) two climate change scenarios. It is proposed instead to describe, quantify and value, as appropriate, where climate change would have the greatest effect (increasing the consequences of flooding or erosion). This will provide you with the information you will need in Chapter 8 (compare and select the preferred option). You should consider proportionality when assessing impacts of climate change. Remember that you will be able to collect more data at a later stage should you need to.
The AST	The AST can also be used as a record of the appraisal to date, with the option to collect more information and refine the assessment of options as the appraisal proceeds. This can help avoid the temptation to assess everything to a high level of detail at the outset. The AST can get quite long. It

7.4.3 Explanations and further guidance: Describe, quantify and value benefits	
[Return to main guidance](#)	is important to balance how much information is being recorded in the AST and the amount of information that is needed at the decision-making stage. The length of the AST will need to be tailored to your project. Make sure it includes enough information that the choice of preferred option can be justified. Recording of the decisions made is crucial to explain how the project has progressed to others and to secure support for the final decision, the AST can do this. Completion of an AST can help to reduce the time required to complete the appraisal as it provides a framework to record justifications and assumptions to help identify the preferred option. A completed AST also provides an auditable and transparent record of the impact assessment part of the appraisal and helps to ensure that a wide range of economic, environmental and social impacts have been considered (at least to determine whether they are considered likely to occur or not). Recording of the decisions made is crucial to explain how the project has progressed to others and to secure support for the final decision. ASTs help you do this.
Tailor the AST to your project [Return to main guidance](#)	The AST is organised around three main types of impact (economic, environmental and social). Should you wish to emphasise a particular impact, you can sub-divide the AST to reflect specific impact or interest. It is not generally necessary to assess every type of impact individually. For example, at the strategy level properties could be sub-divided into residential and non-residential, but it may not be appropriate to divided residential further into different detached, semi-detached, terraced, bungalow, flat and prefab). It is usually important to identify the type of non-residential properties affected (such as hospitals, schools, and types of commercial premises) even at the strategy stage.
Why is it important to link back to the project objectives? [Return to main guidance](#)	The project objectives should go beyond just those related to managing flood and erosion risk. It is important to make sure that you have assessed the extent to which achieving more of the objectives would realise additional benefits (as well as resulting in greater costs). It is only by including this information that you will be able to determine whether it is worthwhile delivering more. The process of engagement through out the project can be instrumental into identifying and exploring these. You can also use the costs and benefits to help convince project partners of the benefits of contributing to the costs. It also helps to explain decisions to stakeholders as it sets them in context.

7.4.3 Explanations and further guidance: Describe, quantify and value benefits

Identifying who benefits and who loses

Sub-division of the categories within the AST also provides information on who benefits and who loses under each option. This approach, known as disaggregation, can be used to assess distributional issues (where different groups of people are affected differently by the options). The information can also be used to help you identify potential contributors to the costs of implementing the option as you will know from your appraisal who the beneficiaries are.

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Sub-dividing the AST

An investment programme may already be under way, suggesting the need for 'development' to be specifically included as an economic impact.

The environmental impacts may need to be sub-divided to reflect the categories covered in the SEA/EIA. This may include different types of habitat (freshwater versus saline), to reflect the extent to which options work with natural processes, and to capture impacts on geology and geomorphology.

Record uncertainties

Note that whatever method is used to estimate the expected impacts, the contents of the AST will be subject to uncertainty. This should be remembered, especially when determining the scale of the costs and comparing small differences between options. It is useful to record key sources of uncertainty in the AST as these can then be tested in the sensitivity analysis.

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Consider damages avoided for the do-something options

The impacts resulting from the 'do-something' options will be compared with those occurring under the baseline. Consequently, it is helpful to complete the AST with expected impacts (or assets affected) under the do-nothing option, and assets protected (in comparison to do-nothing) under all the other options. This means that the AST records damages avoided (in the same way that monetary impacts are presented as damages avoided). For example, if do-nothing could lead to the flooding of 50 properties, but option 1 might only flood 10, do-nothing would read '50 properties flooded' whilst option 1 would read '40 properties protected' (in comparison to the do-nothing option). This may make it easier to see which options provide the most benefits in comparison to do-nothing. Additional benefits (such as those generated through working with natural processes and/or by delivering multiple objectives) would be recorded as benefits.

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7.4.3 Explanations and further guidance: Describe, quantify and value benefits	
What is an appropriate description of an impact? Return to main guidance	As with many other factors, what is appropriate will depend upon the project you are appraising, the type of impact you are describing, how much data are available and how reliable those data are. See the AST worked example for an indication of the type of information that would used to describe the impacts.
Types of impact Return to main guidance	There is a very wide range of different types of impacts that could be caused by flooding and/or erosion. It is not possible to give a comprehensive list. However, some examples are provided below.
Economic impacts	Typical economic impacts include: • property damages: impacts on residential and non-residential properties caused by flooding or erosion. • infrastructure (including critical national infrastructure): impacts on infrastructure that is important to support the economy and the way that the country runs. This includes utilities (including electricity, gas, water, sewage, and telephones), emergency services, transport infrastructure (including airports, ports, road, rail), social infrastructure (including hospitals, schools, universities, town halls, law courts). • land use: agricultural land (following the supplementary guidance), forestry, potential for development and regeneration (take care though with transfer payments). • knock-on effects: these could include impacts on other businesses outside the flooded/eroded area because transport infrastructure is closed/blocked, because electricity, water, sewage or telephone services are unavailable.
Return to main guidance	More information on the types of impacts and how to describe, quantify and value them is provided in the AST supporting document.
Environmental impacts	Impacts on the environment should be identified through scoping undertaken as part of the environmental assessment and would typically include issues such as: • habitats and species: this may include designated and/or protected habitats and species as well as undesignated habitats and species. • water: impacts on water as a result of flooding/erosion of areas that may release contaminants or due to changes in river or estuary water quality or impacts on abstraction points or aquifers. You will also need to consider

7.4.3 Explanations and further guidance: Describe, quantify and value benefits

impacts that could affect the status of the water body under the Water Framework Directive.

- natural processes: impacts can occur because of a change to the natural functioning of watercourses, estuaries and/or the coast, including transport and release of sediments. It is important to assess the extent to which options work with natural processes. This will require understanding of the natural processes when developing, assessing and refining the options.
- geology and geomorphology: designated sites for geodiversity, geomorphological processes sustaining designated interest features, hydromorphology and habitats.
- landscape: covering cultural, ecological, environmental and social understanding and interaction with the landscape, including sense of belonging.
- historic environment: including archaeology, buildings, monuments, conservation areas and their contents.

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Social impacts

Social impacts should also be covered in the SEA or EIA but you should typically consider the following when identifying which impacts to describe in detail:

- people's way of life: how they live, work, play (recreation) and interact with one another on a day-to-day basis.
- their culture: their shared beliefs, customs, values and language or dialect.
- their community: its cohesion, stability, character, services and facilities.
- their political systems: the extent to which people are able to participate in decisions that affect their lives, the level of democratisation that is taking place, and the resources provided for this purpose.
- their health and wellbeing: health is a state of complete physical, mental, social and spiritual wellbeing and not merely the absence of disease or infirmity.
- their personal and property rights: whether people are economically affected, or experience personal disadvantage which may include a violation of their civil liberties.
- their fears and aspirations: their perceptions about their safety, their fears about the future of their community, and their aspirations for their future and the future of their children.

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7.4.3 Explanations and further guidance: Describe, quantify and value benefits	
Describing, quantifying and valuing reductions in consequence Return to main guidance	Inclusion of options that are more adaptable, that bring in wider objectives, that work with natural solutions and/or that focus on reducing residual risks require detailed description of changes in consequences. Much of the available guidance, especially that designed to help you value impacts in monetary terms, is based on changes in probability. Some thought needs to be given as to how you can use this information to begin capturing the benefits associated with reducing consequences. Potential approaches that can be used include: • ***consider whether the depth of flooding would change***: you can then apply lower depth-damage values from the MCM or MCH; • ***consider whether the timing of flooding or erosion would change***: this could be due to change in the onset of flooding or erosion. The value of the change in consequences will then be derived from discounting (see guidance on discounting); • ***consider whether there are benefits in terms of the duration of impacts***: for example, the time over which floodwaters are present on land could be reduced, people may be able to move back into their homes more quickly. This could reduce direct damages, for example, by reducing time for land/habitats to recover or the cost of temporary accommodation and stress due to disruption of family life; • ***consider whether those at risk would change***: assess whether more vulnerable people, habitats or higher quality agricultural land would be protected reducing risk to life, biodiversity impacts or impacts on agricultural outputs; • ***consider whether floodwater velocities would be decreased***: this, in conjunction with flood depth and rate of onset, could reduce risk to life, risk of scouring of habitats or land with implications for increased recovery; and • ***consider whether erosion rates would be decreased***: this could increase the time over which properties could be occupied, businesses run, and roads or services used.
Why should impacts be valued in monetary terms?	It is not necessary to value impacts in monetary terms for them to inform the decision-making process. However, the Treasury Green Book suggests that impacts should be valued in monetary terms ‘to the extent possible’. Valuing impacts in monetary terms can also help make a good case for investment (by increasing the average benefit-cost ratio).

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By including more of the impacts in the same unit of measurement (money), it can also make choosing between options seem much easier. However, you need to be careful to make sure that you understand and record the uncertainties associated with monetary values. Using the AST will help you to keep monetary values of the impacts disaggregated, minimising the risk that you will lose information on uncertainties.

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The importance of retaining information on uncertainty

The potential risk with valuing impacts in monetary terms is that the impacts can then be aggregated to give an overall estimate of benefits. This example highlights how this can become potentially misleading as information on uncertainty is lost.

Option	Benefits		
	Properties	**Risk to life**	**Recreation**
1	£5 million ±5%	£0	£50,000 ±50%
2	£10 million ±5%	£0.5 million ±20%	£200,000 ±50%
3	£30 million ±5%	£1.5 million ±20%	£800,000 ±50%

Option	Costs	Benefits	BCR
1	£0.5 million	£5.05 million	10.1
2	£2.1 million	£10.7 million	5.1
3	£3.3 million	£32.3 million	9.8

The example suggests that Option 1 is 'best' (based on average benefit-cost ratio). However, the benefits of Option 3 should be recorded as £30.1 million to £34.5 million. This would give ABCRs of between 9.1 and 10.5. This compares with ABCRs for Option 1 of 9.6 and 10.7. Since these two sets of ABCRs overlap, it is not possible to choose between them in terms of impacts valued in monetary terms.

What is scoring and weighting?

Scoring and weighting can be used to estimate the money values of impacts where other approaches are not available or are not appropriate for the impacts predicted under the options being appraised. Scoring and weighting is used to estimate monetary values of the impacts where the impacts themselves are difficult to estimate in money terms. To use scoring and weighting you will need at least one category (preferably several) where the impacts have been quantified and valued in money terms. This is because it is much easier to assign scores and weights where you have

7.4.3 Explanations and further guidance: Describe, quantify and value benefits	
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What does scoring and weighting involve?	Applying the scoring and weighting methodology requires you to assign scores to reflect the impacts on each option (from best to worst) and weights to reflect the difference in impacts from best to worst option (swing weighting). The scores and weights are best assigned by the project team, including stakeholders where possible. The scores and weights are all assigned on a relative basis, they reflect the impacts and categories for your project. It is important, therefore, that the impacts of the options are described, quantified and valued in monetary terms before scoring and weighting begins. Otherwise, there is a risk that new impacts could be identified that would require the scoring and weighting to begin again. If you believe that scoring and weighting is appropriate for your project you must ensure that stakeholders have had an opportunity to feed into and review the ASTs. Full details on how to apply scoring and weighting, with worked examples is given in the scoring and weighting supporting document.
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Avoiding transfer payments	Cost-benefit analysis is only concerned with changes in the total value of benefits and the total cost of the resources used. Economics assumes that people adjust to a flood or erosion loss in a way that minimises the losses they incur. For example, if a beach is lost, then visitors to that beach may visit another beach; or if flooding closes a factory then production may be increased in a factory elsewhere. In either case the total national value is assumed to remain the same. It is important to note though that there may be some losses (reduction in number of beach visitors or due to a change in the level of enjoyment). For example, walkers may be able to go a park rather than the beach such that the number of trips may not be affected. However, the value of a trip to the park may be less than the value of a trip to the beach, such that there is a loss of enjoyment. The Multi-Coloured Manual gives values per trip for some types of recreational visits. A transfer payment occurs when a change simply affects either who gets the consumption or who provides the resources, but there is no change in the national total of either all consumption or all the resources required to generate that consumption.
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Adjusting for transfer payments Return to main guidance	When a physical object (such as a house) is damaged or destroyed by a flood, then a transfer payment is not involved since maintaining current levels of consumption will require the replacement of that object. There will be distributional consequences as well (for example, builders will get more work) but the test is whether there will be a change in the total level of consumption or the resources required, including the need to repair or replace stocks which have been damaged or destroyed. Note that: • VAT and excise duties are always transfer payments and must be deducted. If less petrol is sold, then the Exchequer will simply find different ways of raising taxes; • if a hotel or pub were lost through erosion, the trade would simply transfer to other outlets, the value of any such 'goodwill' element in the market price must therefore be netted out of the analysis. Be careful though as assets that are irreplaceable would result in a national loss. This could include, for example, a heritage site or specialist manufacturing company.
Green taxes Return to main guidance	In some cases, a levy is made in respect of negative externalities, a 'green tax', which is intended to reflect a real economic cost, although otherwise it appears identical to other forms of taxation such as VAT. If, for example, a charge were to be levied on aggregates which reflected the real environmental damage caused by aggregate extraction then this would reflect the additional economic loss resulting from mineral workings. Therefore, an increase in aggregate extraction would result in additional economic losses to the country, in addition to the resource costs of extraction and transportation. Landfill taxes are also a 'green tax' and represent a real economic cost. Ideally these additional economic losses should be quantified and included in the analysis. However, this is unlikely to be practical for most flood and coastal erosion risk management projects and it will normally be reasonable to use the tax rates as a surrogate for the real economic loss in any analysis. Such treatments of indirect taxation depend upon the interpretation of the intent of the tax and advice will therefore be issued from time to time on what taxes can be used in this way as surrogates for real economic costs.
Think about the extent of impacts – transfer payments	When considering if impacts are only likely to occur at the local, regional or national level, think about the potential for there to be alternative sites. It is also useful to consider whether an asset is substitutable or not. Buying a newspaper from a newsagent would be considered substitutable. Production of newspapers by a printing firm

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	may have wider impacts but there are other newspapers, this would also be considered substitutable. If the printing works is written-off as a result of the do-nothing option, the jobs lost there could be created at another works to compensate for increased demand for another newspaper. If the printing firm is the major employer in the town and its loss would mean a significant increase in unemployment, there may be some community impacts (reflected in increased deprivation). Reduction of deprivation may require funding from central government in regeneration projects. Thus, the loss of jobs might result in a national loss where it is significant enough to increase deprivation. The above example highlights that it is not always easy to determine whether an impact is a local, regional or national loss. You need to think about the consequences of the impacts. This again highlights the importance of a realistic assessment of do-nothing supported by logical reasoning.
Return to main guidance	
Capping	Care should be exercised where the total present value of losses exceeds the risk-free market value of the asset. In the case of residential or commercial property, you should assume that the long-term economic loss cannot exceed the current capital value of the property and to cap the damages. In the case of other assets, such as roads, railway lines, pipelines or cables, some very large values can be generated for long-term disruption. You should assume that the maximum economic benefit derived from flood protection is equal to the economic cost, depreciated to allow for the age of the existing asset, of reconstructing an equivalent facility at a higher level or on an alternative alignment which avoids the flood risk. Care is needed when capping the damages of infrastructure to make sure that adequate account has been taken of the service that the infrastructure provides; otherwise, you risk significantly under-estimating the real effects of loss of the infrastructure.
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Capping of damages	The most important fact to remember when considering capping is that the damages associated with repeated flooding over the appraisal period cannot exceed the market value of the property or infrastructure or, for properties or infrastructure which do not have a market value (such as Martello towers, public toilets and gas pipelines) a surrogate value based on moving, replacing or diverting the asset can be used. It is also important that the capping value used is the risk-free value (where the property value does not reflect the risk of flooding or erosion). This can be achieved by using county or regional averages, as discussed above.

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Return to main guidance	You will know if you have a serious capping problem if the damages of do minimum (once you have estimated them) exceed the damages of do-nothing (except where the do thing option leads to significant environmental or other benefits). Less significant capping problems can occur where damage to a small proportion of the total number of properties affected exceeds the market value. Careful description of impacts accompanied by clear, auditable spreadsheets to estimate the damages in money terms should help you to ensure that capping is undertaken wherever it is needed.
Capping versus write-off Return to main guidance	It is important to use the correct term when describing the impacts. This helps someone reviewing the appraisal to understand your logic. Use 'write-off' where assets are 'lost' because they are flooded too frequently to be useable for their particular purpose. Use 'capping' where the damages of repeated or occasional flooding mean that the total damages over the whole appraisal period exceed the market value of the asset.
Assessing impacts Return to main guidance	The benefits of reducing flood risk are calculated as the difference between damages under the baseline option and the damages caused by the option being assessed.
Assessing damages from flooding Return to main guidance	The damages caused by flooding are a function of the depth, duration and velocity of flooding, along with the sediment load and pollutants carried by the floodwater. In the UK, floods are usually relatively short in duration and involve low flood velocities so that the primary determinant of the losses for a particular property is the depth of flooding. However, in some small flashy catchments, and where flooding will result from the failure of protective structures, flood velocities can be high and additional losses may result, for example, from partial or complete structural failure of properties. In addition to flood depth and rate of onset, flood velocities can also affect the risk of injuries from flooding as well as risk to life.
Types of damages from flooding	Damages from flooding can occur in three different ways: • assets are flooded so frequently that they cannot recover and provide their original function before they are flooded again (for example, a house may be flooded and before it can be repaired and lived in it would be flooded again). Such assets are written-off; • assets are flooded infrequently so they can recover and

7.4.3 Explanations and further guidance: Describe, quantify and value benefits	
Return to main guidance	provide their original function before being flooded again. Such assets suffer from intermittent flooding and would incur damages each time they are flooded; and • assets are flooded infrequently (as above) but repeated flooding means that the total damages exceed the market value of the asset, such that the damages are capped. Capping is undertaken to ensure that the damages reflect the value of the asset to the nation and to avoid over-estimating the damages of repeated flooding.
Taking account of future changes in risk Return to main guidance	Where changes are anticipated in the expected probabilities of flooding or erosion over the life of the scheme, it is necessary to calculate a number of different average annual benefits corresponding to the different conditions. Such changes include, for example, predicted changes in sea level due to climate change or other expected changes in the catchment which are predicted to change the rate of run-off and the frequency of flooding. Alternatively, changes over time in the use of the flood plain may change the losses expected from a flood of a given magnitude. In these cases, average annual benefits should be calculated for appropriate years, and values interpolated for intervening periods.
Damages caused by breaching Return to main guidance	Where the risk is from breaching (or failure) of a flood defence, it will be necessary to assess damages caused following breaching and the probability of a breach occurring in any one year. In a 'do nothing' situation, breaches are not repaired and affected assets will be written off or will be assumed to have changed permanently. In other cases, breaches will be repaired and the damage may only be temporary but the breach could then recur. The assessment of breach probabilities and how they change over time will depend on the type and condition of the defence as well as other factors such as geotechnical conditions and overtopping rates. Because of uncertainties in the derivation of such estimates it is appropriate to test the sensitivity of any option choice against a reasonable range of breach probabilities.
Using average annual damages (AADs)	Floods are assumed to be random events and it is not possible to predict when they will occur. The expected value of annual flood losses is calculated as the probability of a range of events multiplied by the damages should such an event occur. In practice, the losses from infrequent flooding are measured by the difference in the areas under loss-probability curves for the 'do nothing' and with project

7.4.3 Explanations and further guidance: Describe, quantify and value benefits

Return to main guidance

options (see Figure 7.4). This difference in area is the expected value of the reduction in flood losses each year over the life of the scheme. This is known as the average annual benefits. These are then discounted over the life of the scheme to give the present value of the benefits.

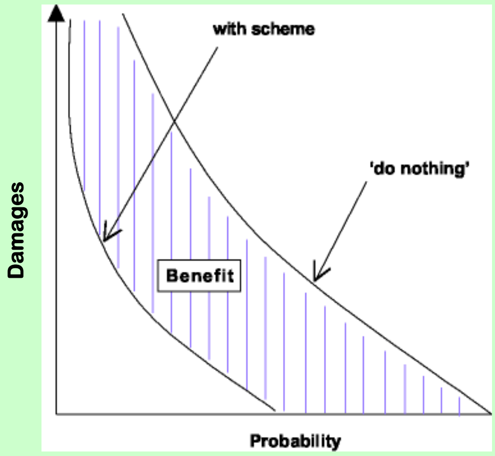

Figure 7.4: showing average annual benefits with the strategy or scheme as the difference between damages under do-nothing and the project

How many probabilities to use?

Determining how many and which event probabilities to include is a sampling problem. The aim is to obtain a reasonably close approximation to the loss–probability curve representing an infinite number of return period events if these were to be modelled. The ideal return period events to use are those which are located at discontinuities on the loss–probability curve (where the gradient of the loss-probability curve abruptly changes):

1. judgement should be used to assess where the discontinuities are likely to be, since these occur, when new assets start to flood. Thus, for example, they can be expected to occur when an existing natural or man-made structure is overtopped or a culvert or bridge reaches its capacity.
2. the greatest proportion of benefits generally arises from the shorter return period events. Consequently, the sample of events included should usually be biased towards these events. Thus, it is likely to be better to include the 5, 20, 25, 50 and 100-year events rather than the 5, 20, 50, 75 and 100-year events when assessing the benefits of a scheme with an expected 1 in 50-year design standard of protection. However, a few judiciously chosen events

7.4.3 Explanations and further guidance: Describe, quantify and value benefits	
Return to main guidance	at appropriate points of discontinuity will generally produce a more realistic result than a larger number of events at standard intervals.
Including low probability events Return to main guidance	The level of flood risk offered by a strategy or scheme will usually be defined in terms of the onset of significant losses. However, many projects will have some effect on the losses from all floods, even the most extreme, and all of these impacts should be taken into account. While it may not always be practical to model the extent of flooding from all events up to the probable maximum flood, it should be possible to draw logical inferences as to how the scheme will respond to such larger events. From this, the likely shape of the loss–probability curve can be estimated. For example, projects that increase the capacity of a river channel or provision of a washland will result in less water flowing out of the bank for all events with the scheme than without. Consequently, the losses from any particular event with the scheme should never exceed those without the scheme and will normally be less. For other projects, for example those involving walls and embankments that may be overtopped, losses in less probable events can be more severe than if no scheme existed. The duration of flooding may be increased, or the velocities of flow resulting from a failure may be greater than from the natural rate of rise of the flood. In this case the negative benefits above the design standard should be subtracted to derive the net average annual benefits.
Assessing damages from erosion Return to main guidance	Erosion damages are usually estimated using the market (capital) value of the asset and the time before the asset erodes. Property values should generally be based on average 'no risk' values for property of the same physical type.
Erosion contours Return to main guidance	Time to erosion is based on an estimated erosion rate (metres per year), which is used to draw up erosion contours showing the extent of erosion every ten years (or so).
Interpolation between erosion contours	Interpolation between erosion contours is dependent on the nature of the coast. Where there is slow, progressive erosion, it is reasonable to interpolate by distance, and assume the asset will be written off when erosion encroaches within a safety margin. However, if the area is subject to catastrophic slides, then in any one year there are

7.4.3 Explanations and further guidance: Describe, quantify and value benefits	
Return to main guidance	different probabilities of slides of different magnitudes. There is a small probability that an event in year 0 will erode the coastline back to the 50 year line. Using erosion contours in such circumstances does not provide a good representation of the problem and it would be preferable to use probabilistic approaches, where possible.
When is interpolation between erosion contours acceptable? Return to main guidance	Interpolation for every individual asset can be a time-consuming exercise. Consideration should be given to whether the additional (apparent) certainty associated with interpolation is appropriate. For example, interpolation is unlikely to be worthwhile where erosion rates have a high degree of uncertainty (for example, where the minimum and maximum suggested rates differ by more than 25%). Remember that discounting will mean that interpolation, variable probabilities or testing changes to assumptions in the sensitivity analysis will have the greatest effect on assets that are lost in the first 20 or so years.
Safety margins Return to main guidance	Safety margins are included to make sure that account is taken as to when an asset would be abandoned. For example, it is unlikely that a house would continue to be occupied right to the point that it falls over the cliff edge. The safety margin is used to ensure that risk to life is minimised.
Sensitivity of damage estimates to assumptions Return to main guidance	The timing of failure of coast protection works, erosion rates and the contours estimated from them are based on assumptions. It is, therefore, important to remember that there is a considerable degree of uncertainty attached to expected loss values. Consider the sensitivity of the damage calculations to assumptions made about erosion rates. Sensitivity analysis should be used to explore the effects of varying the probability of initial failure, the assumptions about erosion rates (and any erosion contours predicted from them) and the timing of asset losses arising from initial failure.
	Check you have completed all the expected outputs

7.5 Discount ing

7.5.1 Expert summary: Discounting	
Discounting Read more	You should apply the discount rate to all monetised costs and benefits, which are to be taken as accruing in the middle of the year in which they occur. The Treasury discount rate should be applied. Discounting costs and benefits enables all values to be compared in present day terms. Check you have completed all the expected outputs

7.5.2 Main guidance: Discounting	
The impact of discounting	Discounting is used to reflect peoples' preferences from benefits today rather than benefits tomorrow. The impact for appraisal is that future benefits and costs are worth less in present value terms than costs and benefits that occur today. For more background information on discounting see Annex 6 of the Treasury Green Book (http://www.hm-treasury.gov.uk/d/green_book_complete.pdf).
The purpose of discounting Read more	Discounting is used to convert all costs and benefits into Present Values. This allows the timing of costs and benefits to be taken into account. As a result, options with very different interventions or that deliver benefits over different timescales can be compared.
Applying discount rates Read more	Applying the discount rate translates all values into present day terms. When using discount rates, you should : • use the discount rate specified by the Treasury for all streams of benefits and costs; • assume that each and every benefit and cost should be taken to accrue in the middle of the year when it occurs; and • calculate present values as for the middle of year 0. You undertake discounting by multiplying the discount factor by the costs and benefits that occur in that year.

7.5.2 Main guidance: Discounting

Example of the impact of discounting

The example below shows how damages of £1 million change over time due to discounting. The discounted damages are calculated by multiplying the damages (£1 million) by the discount factor. The table also shows how discounting affects the damages over time. The discount factors used are based on the discount rate presently set by Treasury (3.5% discount rate in years 0 to 30, 3% discount rate from years 31 to 75 and a 2.5% discount rate from year 76 to 99).

Year	Discount factor	Discounted damages	Discounted damages as % of undiscounted
0	1.0	£1,000,000	100%
1	0.966	£966,000	96.6%
2	0.934	£934,000	93.4%
5	0.842	£842,000	84.2%
10	0.709	£709,000	70.9%
20	0.503	£503,000	50.3%
30	0.356	£356,000	35.6%
50	0.197	£197,000	19.7%
99	0.052	£52,000	5.2%

Use the same base year for all options

The same base year must be used for all options (costs and benefits), generally the first year is taken as year 0. Standard spreadsheets should be used wherever possible as these are already set up to undertake discounting.

Economic efficiency of options

Discounting is used to enable the economic efficiency of options to be compared. This is assessed later in the appraisal process by comparing:

- their average benefit-cost ratios: the present value of benefits divided by the present value of costs; and
- their net present values: the present value benefits less the present value of costs.

Uncertainty

There will be uncertainty attached to all costs and benefits. Applying the discount factor does not remove this uncertainty, but ensures the values are in present day terms and are thus comparable.

Check you have completed all the expected outputs

7.5.3 Explanations and further guidance: Discounting	
Why use discount rates [Return to main guidance](#)	To be able to test the economic efficiency of different options on a comparable basis, it is necessary to discount all of the costs and benefits of the scheme, from the time when they arise in the future, to their present value.
Changes in benefits and costs with time [Return to main guidance](#)	Due to the limitations of comparing schemes with a single indicator, it is good practice to plot the changes in different streams of benefits and costs over time. Discontinuities generally show either a change in conditions or an arithmetic error. The plots can also show that delaying a scheme may be more efficient than undertaking it immediately. For example, consider the 'do-nothing' option for a sea wall system. There is an increasing risk of breach over time as the foreshore erodes and the structure approaches the end of its life. There is also an ongoing risk of flooding through overtopping (although it is assumed that overtopping damage only occurs if a breach has not taken place). Consequently, the expected value of overtopping damages decreases as the risk of breaching increases. In this scenario, there might be some benefit from immediate intervention to limit the damage from overtopping. However, more substantial investment might not be required for several years, when the expected value of the breach damage starts to rise significantly. [Check you have completed all the expected outputs](#)

7.6 Checkpoints and outputs from estimate costs and benefits

Checkpoints	Assess whether it is worthwhile continuing with the appraisal in its current form by answering the following questions: **1. Are the benefits of the options greater than the costs of the options?** If not, you should consider whether it is necessary to look at other options for management of the risk. This could include options that attempt to manage the consequences rather than the probability. You should also consider options that could support withdrawal from funding for defences and/or whether it is possible to combine options. Make sure that you have assessed the potential for contributions from project partners. You will need to return to Chapter 6 (identify, develop and short-list options) to identify alternative types of options. Stakeholder engagement will be key to manage expectations and to keep everyone informed of the decisions being made and why in this situation. **2. Are there significant damages on all the options being appraised?** If yes, you should consider whether it is possible to manage the residual risks as an approach to reducing some of these damages. Consider whether you can combine and/or refine your options to reduce the risks. You may need to reassess some of the costs and/or benefits of refined options. This may require you to revisit some parts of Chapters 6 and/or 7.
Outputs	Typically, to complete the description, quantification and valuation of costs and benefits you should have: - estimated the costs of options including any mitigation measures that may be proposed and any consents that may be required to implement an option (for example, those associated with works near heritage sites) (see: 7.3 Describe, quantify and value the costs); - described, quantified and monetised the significant economic, environmental and social impacts including knock-on effects and the population affected by the impacts (informed by the environmental assessment and engagement of stakeholders) (see: 7.4: Describe, quantity and value the benefits); - applied discounting to estimate the Present Value costs and benefits (see: 7.5: Discounting); and - engage all relevant stakeholders appropriately in a timely manner so that they have the opportunity to input to the

7.6 Checkpoints and outputs from estimate costs and benefits	
	decisions and can understand and hopefully accept the decisions that have been made. This should be done by delivering your Stakeholder Engagement Plan. **All outputs complete: the costs and benefits have been described, quantified, valued in monetary terms and discounted** **Move to Chapter 8: Compare and select the preferred option**

8. Compare and select the preferred option

8.1 Key Principles: Compare and select the preferred option

Having developed and refined options to optimise the project objectives and the wider objectives of Defra and MSfW, **decision-making** involves comparing the costs and benefits of options in order to choose the best overall option. This requires the decision-maker to balance the benefits, damages and costs (including any contributions from other funding sources) to identify which option provides the best overall outcome, usually the option which best meets the project objectives. Decision-making involves choosing a preferred option from a set of possible options.

The aim of the flood and coastal erosion risk management programme is to obtain best value for money for the whole programme, given the limited funds that are available. One way of ensuring it is to maximise the net present value (NPV) of all investment within the programme. This is usually impracticable as it would require an assessment of all options and combinations across projects in the programme. An alternative solution is to maximise the benefit–cost ratio (BCR) of projects being funded informed by the incremental costs and benefits of doing more. This enables project level decisions to be informed by the efficiency aims expected of the wider programme. Generally, in flood and coastal erosion risk management, the latter concept is used.

Usually, particularly in flood and coastal erosion risk management projects, there is a number of do something options under consideration. In these circumstances, it is important to distinguish between the average benefit-cost ratio (ABCR) and the incremental benefit-cost ratio (IBCR). Projects are unlikely to succeed unless both the ABCR and the IBCR are robustly greater than unity. Options showing a high ABCR will not usually succeed unless the IBCR is positive too as additional investments would deliver more elsewhere.. By the same token, although in flood and coastal erosion risk management projects the do minimum option often exhibits by far the largest ABCR, this will not necessarily mean it is the best solution.

The decision-making process for use in flood and coastal erosion risk management projects starts from the ABCR for each project option, orders the project options in reducing probability of flooding, and examines the IBCR of each in turn. The decision process uses increasing thresholds for the IBCR related to the probability of flooding. This approach is designed to link economic efficiency with social justice, encouraging a larger number and wider geographical spread of investments, generally increasing value for money across the programme and reducing risk to more people. The use of increasing thresholds for IBCR reduces the likelihood that the additional levels of investment needed for higher standards on any project might not actually deliver greater benefits if spent elsewhere.

It is essential that contributions are taken into account when identifying the preferred option. This means that funds provided by project partners can

8.1 Key Principles: Compare and select the preferred option
influence the outcome of appraisal and provides the opportunity to deliver more than could be achieved through grant-aided funding alone. It is also important to test the effect of uncertainties, and assumptions made about them, on the option choice. Within economic appraisal, the **purpose of sensitivity analysis and robustness testing** is to determine whether, within the reasonable bounds of confidence: • the project is economically worthwhile (benefits outweigh the costs); and • the option choice is robust (where the option choice would not change to another option under reasonable changes to the assumptions made during the appraisal).

Figure 8.1 shows where you are in the appraisal process (orange coloured box). Follow the hyperlinks to move back to previous chapters of the guidance if you need to iterate. Clicking on a hyperlink to another chapter takes you directly to the start of that chapter (to the key principles). Clicking on a hyperlink to a section within Chapter 8 takes you to the main guidance.

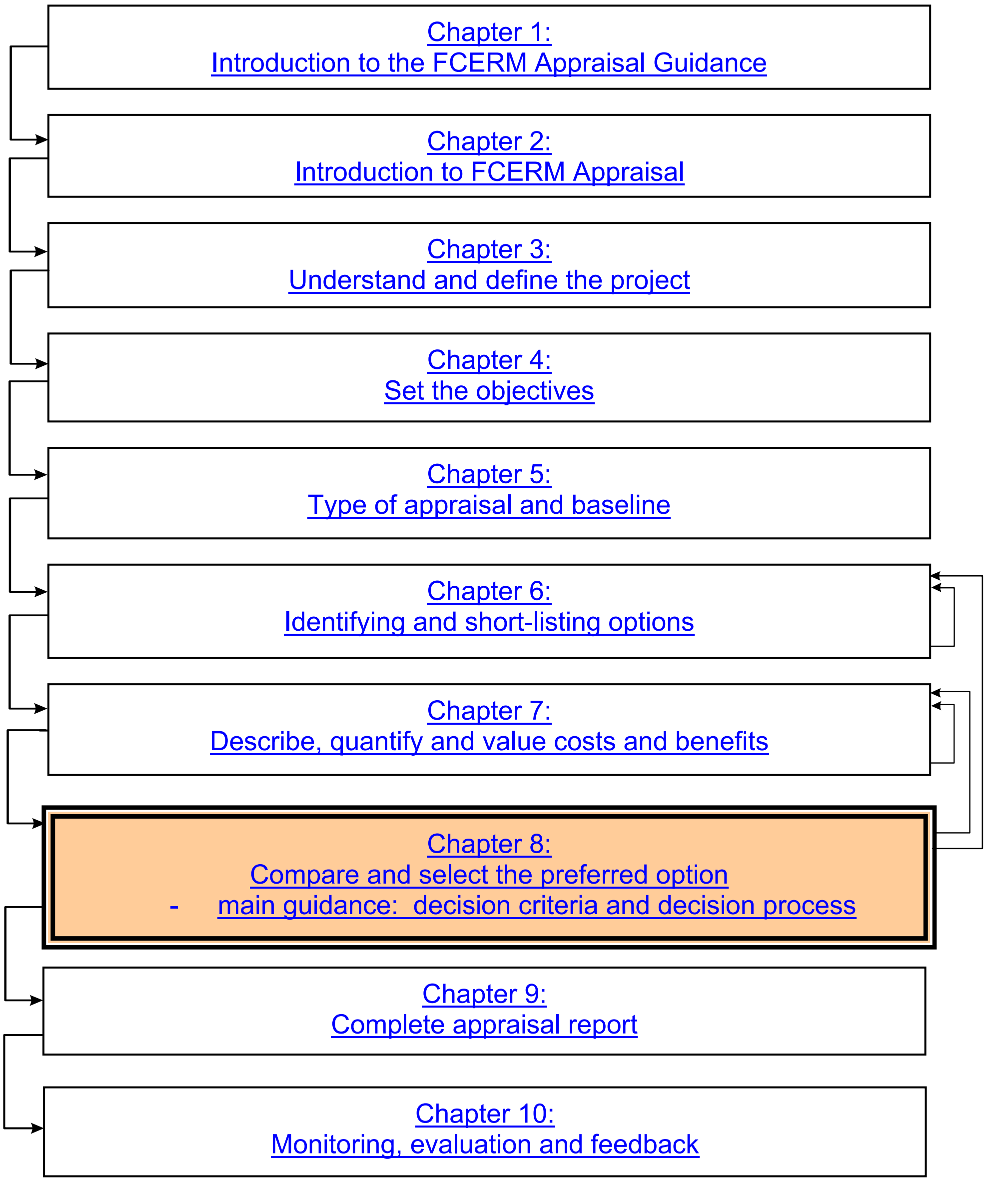

Figure 8.1 Navigation flowchart

8.2 Inputs to compare and select the preferred option

A short-list of options will have been identified, developed and refined to ensure as much is captured as possible of the project objectives, Defra's wider MSfW objectives, opportunities for external contributions to deliver wider objectives and environmental enhancement and mitigation opportunities (from Chapter 6: Identify, develop and short-list options). The associated costs (including external contributions) and benefits of each option having been described and quantified and, where appropriate and proportionate, valued in monetary terms (from Chapter 7: Describe, quantify and value the costs and benefits).

Stakeholder Engagement Plan (SEP): By this stage, by having engaged appropriately and in a timely way with all relevant stakeholders, you should have a thorough understanding of their positions, interests, needs and expectations, and have inputted this into the option development. In selecting the preferred option you must be able to explain how you have considered their concerns/needs/information and how it is reflected in the selection of the preferred option. Your SEP should be up to date for the stage of the appraisal you are now at so you know what engagement you are doing for this stage and how it links to the next to keep stakeholders engaged and to manage expectations.

The **environmental assessment** of options should have taken account of requirements of the EIA and SEA processes and supports later evaluation of the preferred option and documentation of alternative options. For all projects, environmental assessment should include relevant environmental issues and demonstrate a clear and transparent process of assessment of impacts, effects and opportunities, including cumulative effects. This will inform and record the decision-making process and the way in which alternatives have been considered.

8.3 Decision criteria and decision process

8.3.1 Expert summary: Decision criteria and decision process	
Decision criteria and decision process Read more	Use the decision process to identify the preferred option. The approach to use varies according to whether you have used a CEA or CBA and if you are developing a project for delivery in England or Wales: • England and Wales: CEA flowchart or description of decision process for CEA • England: CBA flowchart or description of decision process for CBA • Wales: CBA flowchart or description of decision process for CBA Take account of monetised and non-monetised impacts, the results of the sensitivity analysis, technical issues (including adaptability), undertake activities set out within the Stakeholder Engagement Plan (SEP) and ensure that project partners have been involved during decision-making when justifying your choice of preferred option. Check you have completed all the expected outputs

8.3.2 Main guidance: Decision criteria and decision process	
Decision criteria and the decision-making process	The decision criteria and the decision-making process have been developed to help you to identify the preferred option. The decision-making process allows you to take account of all the impacts (qualitative, quantitative and monetised as recorded in the AST, drawing on the environmental assessment and engagement) and encourages you to investigate key sources of uncertainty that might change the choice of preferred option. For Cost-Effectiveness Analyses (CEAs), the choice of preferred option is based on identifying the most cost-effective approach. This requires the costs of the options, plus any damages (negative impacts) that might occur to be taken into account. For Cost-Benefit Analyses (CBAs), the choice of a preferred option requires all the benefits, damages and costs to be balanced against each other. Use of the standard spreadsheets during your appraisal will help as these will calculate the key economic criteria (net present value, average benefit-cost ratio and incremental benefit-cost ratio for you) (see spreadsheets supporting document). Non-monetised factors such as impacts described in the

8.3.2 Main guidance: Decision criteria and decision process	
Read more	Appraisal Summary Table (AST), technical reliability, adaptability and working with natural processes are considered alongside the key economic criteria and form an important part of the decision process.
Engage with stakeholders and project partners	Undertake activities set out within the Stakeholder Engagement Plan (SEP), ensuring that project partners are aware of the decision-making process and involved during decision-making.
Decision criteria used	The decision-making criteria used within the decision-making process are: • extent to which the objectives have been (or could be) achieved; • whole life costs of the options (taking account of contributions by subtracting funds from sources other than FCERM); • qualitative and quantitative damages, damages avoided and benefits of each option (as recorded in the AST); • average benefit-cost ratio (benefits divided by costs, where the costs include contributions); • incremental benefit-cost ratio (the difference between the benefits provided by two options divided by the difference in costs, where the costs include contributions); • where scoring and weighting has been used, you will have calculated implied values such that you will also have an implied benefit-cost ratio and implied incremental benefit-cost ratio (implied values are estimates of the monetary benefits based on the scores and weights that have been assigned; • net present value (benefits minus the costs, where the costs take account of contributions); • technical issues; and • implications of sensitivity analysis.
Read more	
Use of the decision-making process	The decision-making process is based around five stages: • Stage 1: test to verify that the benefits exceed the costs; • Stage 2: identification of the leading FCERM option(s); • Stage 3: influence of contributions on the choice of option; • Stage 4: influence of uncertainty on the viability and choice of option; and • Stage 5: influence of the extent to which wider objectives and outcomes are delivered. The decision process is also reproduced as a flowchart,

8.3.2 Main guidance: Decision criteria and decision process	
Read more	tailored to those projects that have used either a CEA or a CBA. The same five stages are followed, but the questions within those stages vary slightly according to whether you have undertaken a CEA or a CBA.
Decision-making for CEAs (England and Wales)	The decision-making process for projects that have used CEA is based on the following questions: 1. Stage 1: do the benefits of taking action outweigh the costs? 2. Stage 2: which is the least-cost option? 3. Stage 3: does the option choice change when you take contributions into account? 4. Stage 4: does the option choice change when you take uncertainty into account? 5. Stage 5: does the option choice change when you consider other factors (such as the extent to which wider objectives are delivered)?
CEAs: Stage 1	*Do the benefits of taking action outweigh the costs?* You should have the information needed to answer this question from the supporting cost-benefit analysis (for Sustain SoS projects), and/or from a (brief) description of the benefits (for projects driven by legal requirements). If the answer is **yes**, you can move to Stage 2. If the answer is **no**, but you identified in Chapter 5 (type of project and baseline) that delivering the legal requirement is the main purpose of your project and that this legislation is associated with Directives or other 'general' legislation, you can still move to Stage 2. You will need to ensure that the benefits of meeting the legal requirement are recorded in your appraisal report (see Chapter 9: outputs). Move to Stage 2. If the answer is **no**, and you are undertaking a Sustain SOS project or meeting legal requirements associated with local legal agreements, you will need to reconsider whether a project is likely to be viable and, if so, reconsider your options. This will include the need to consider lower cost options.
CEAs: Stage 2	*Organise the options from least-cost to highest cost*, taking account of any monetised damages you may have identified and estimated. **Identify the least-cost option as the leading FCERM option**. If you have more than one option with very similar costs, you can identify all the similar options as leading options. Move to Stage 3.

8.3.2 Main guidance: Decision criteria and decision process	
CEAs: Stage 3	*Taking account of contributions, does the incremental cost reduce so that another option becomes the leading option?* To take account of contributions, you should subtract any contributions from sources other than FCERM funding from the project costs. This gives costs to FCERM (C_{FCERM}). Considering costs to FCERM funding only (C_{FCERM}) could change the order of your options and a different option could become least-cost (or one of a small number of leading options could clearly become the least-cost option). **You should identify the option with the least costs to FCERM (C_{FCERM}) as the leading option**. Again, if there is a small number of options with very similar costs to FCERM funding, you can identify them all as leading options at this stage. Move to Stage 4.

CEAs: Stage 4
Read more on how to undertake sensitivity analysis
	Does uncertainty affect the choice of leading option?
	
	Using the results of the sensitivity analysis and assumptions recorded in the AST, consider whether the order of options identified above could change. Does a different option become the least-cost option?
	
	• *No, the least-cost option remains the same under all the sensitivity tests*. Verify that the switching points (the increase in costs and damages required to make the *second least-cost* option the *least-cost)* requires a significant change that is unlikely to occur (based on the uncertainties recorded in the AST and tested through sensitivity analysis). Where the switching point test shows that the change required is credible, follow the 'yes' route. Otherwise, select the least-cost option identified in Stage 3 as your leading option. Move to Stage 5.
	• *Yes, a different option becomes least-cost under one (or more) of the sensitivity tests*. Consider whether the results provide a robust and justifiable case for moving to the different option, or staying with the leading option. Is there a justifiable and robust case for moving to the different option?
	  – If yes, select the different option as leading option. You should provide a robust argument why you chosen this option based on the results of your sensitivity tests. Move to Stage 5.
	  – If no, consider which sensitivity tests suggest a different option becomes the least-cost option. Is it possible to adapt the leading option so it performs

8.3.2 Main guidance: Decision criteria and decision process

Read more on the importance of justifying your decisions	better under these sensitivity tests? Or can the leading option be made more adaptable to future changes? Where the uncertainties relate to climate change, consider following the principles of Real Options Analysis (see the supporting document on climate change) before moving to Stage 5.
CEAs: Stage 5	*Would an alternative option be preferred if you were to take other factors into account?* Where there is no clear favourite or where some other options are close to the leading option, consider the extent to which it is possible to deliver more of the project objectives, wider FCERM objectives, desirable environmental enhancements and/or provide approaches that are adaptable to future changes in risk. To decide whether you should recommend an alternative option (rather than the leading option). Include non-monetised benefits within this assessment.
Read more on why it is important that all impacts are taken into account during decision-making.	You should take account of both monetised and non-monetised benefits when assessing if the benefits outweigh the costs. You will need to explain the reasoning for your decision to justify your choice (especially where you are relying on the non-monetised benefits to argue that the benefits of delivering more outweigh the costs). Do the benefits of the best alternative option(s) exceed the costs? • Yes: it is worthwhile delivering the additional benefits. You should recommend the alternative option as the preferred solution. • No: it may not be worthwhile delivering the additional benefits unless additional contributions can be obtained from project partners. Engage with project partners to discuss their priorities and whether additional funding sources can be found. It may not always be necessary for the benefits to outweigh all the costs, there may be some leeway where an alternative option offers enhancements or other benefits at only slightly increased costs. If you can make a justifiable case for moving to an alternative option, you should do so in coordination with your project partners. Otherwise, you should identify the leading option as the preferred solution. Where there is a choice of implementing an option that is judged to be more sustainable (for example, one that

8.3.2 Main guidance: Decision criteria and decision process	
	reduces the need for future interventions, is more in keeping with environmental objectives or one that offers a greater degree of environmental or social enhancement), a decision will have to be made as to whether any additional cost is worthwhile. Such decisions can only be taken on a case by case basis, taking account of all factors including the responses to consultation and the project objectives. There may be opportunities to seek contributions from those who would benefit from the preferred option, particularly where this includes opportunities to deliver more objectives. You should have identified potential project partners and those who may be able to contribute towards implementing solutions that would deliver more objectives.
Read more about subjectivity	Your AST should also include disaggregated costs and benefits to help you demonstrate that the delivery of objectives is worthwhile.
	It is important to be realistic when identifying which of the wider objectives can be delivered. Part of the basis for choosing the preferred option is its benefit-cost ratio. As noted above, you should explore the potential that wider objectives could be achieved through working with project partners (including local councils to help meet social objectives, Natural England or the Countryside Council for Wales to help meet environmental objectives and regional development agencies to help meet regeneration objectives).
	Once you have identified your preferred solution, you should consider the need to manage any residual risks.
Decision-making for CBAs (England)	The decision-making process for projects that have used CBA is based on the following five stages: 1. Stage 1: is the average benefit-cost ratio >1? 2. Stage 2: identification of a leading option by organising the option in one of two ways: o by reducing probability of flooding; or o by average benefit-cost ratio (where options cannot be organised by reducing probability of flooding) 3. Stage 3: does the option choice change when you take contributions into account? 4. Stage 4: does the option choice change when you take uncertainty into account? 5. Stage 5: does the option choice change when you consider other factors (such as the extent to which wider objectives and/or providing enhancements are delivered)

8.3.2 Main guidance: Decision criteria and decision process	
CBAs: Stage 1 (England)	*Is the average benefit-cost ratio >1?* You should have monetised the significant impacts (positive and negative) while following the guidance in Chapter 7 (describe, quantify and value costs and benefits), using tools such as ecosystem services and scoring and weighting where appropriate. You should, therefore, be able to identify if the benefits outweigh the costs. If the answer is **yes**, you can move to Stage 2. If the answer is **no**, you may not be able to justify undertaking any options (meaning that the preferred solution is do-nothing). Make sure that: • the do-nothing option has been fully developed and is realistic; and • ensure that all significant impacts have been captured and that the selection of do-nothing as the preferred solution is robust. Consider whether it is possible and appropriate to manage the residual risks. This can include assessing options that focus on reducing consequences (where these have not already been included), such as flood warning, emergency response, local flood resistance and resilience or development of evacuation routes.
CBAs: Stage 2 (England)	*Organise the options by reducing probability of flooding or by average benefit-cost ratio* ***By average benefit-cost ratio*** Where options cannot be organised by reducing level probability of flooding (for example, where two (or more) options provide protection to a similar level of risk, reduce or remove coastal erosion risk, provide different strategic methods or approaches and/or provide different ways of providing the same outcome), you should organise the options by average benefit-cost ratio. If you have more than one option with similar average benefit-cost ratios, you can identify all the similar options as leading options. As noted in Stage 1, you should have monetised the significant benefits, so you can use the average benefit-cost ratio to identify the leading FCERM option(s). Move to Stage 3. ***By reducing probability of flooding*** Options are organised by reducing probability of flooding to

8.3.2 Main guidance: Decision criteria and decision process

help decide how 'far' the probability of flooding can be reduced. Start by identifying the option with the highest average benefit-cost ratio as the leading option.

Read more on how to calculate the incremental benefit-cost ratio

Calculate the incremental benefit-cost ratio for each option (this will be automatically calculated if you have used the spreadsheets).

You should move through the options (one by one) to assess whether the IBCR is sufficient to allow you to identify a different leading option. You should compare the leading option with the IBCR of the next option. If the IBCR of the next option (the **next option** is defined as the option that provides the next lowest annual exceedence probability (AEP) compared with the leading option) is greater than the thresholds shown below, then the next option becomes the leading option.

The thresholds set out below identify the IBCR that is required at different levels of AEP to change the leading option. You should then consider whether the **next higher option** (defined as the option with the next lowest AEP compared with the previous next option (now the leading option)). It is important to remember that you can only move from one option to the next if the IBCR exceeds the threshold relevant to the level of AEP offered by the next option. You should not jump over options that have an IBCR that is lower than the thresholds (see example).

Once you have identified the leading option using the IBCR thresholds, move to Stage 3.

IBCR thresholds (England)

Read more on why these thresholds are used

Option type/risk level	Minimum requirement for option to be preferred
Options with existing AEP greater than 1.3% (or Standard of Protection (SoP) <1:75)	IBCR > 1
Options with existing AEP less than 1.3% but greater than 0.5% (or SoP between 1:75 and 1:200)	IBCR > 3
Options with existing AEP less than 0.5% (or SOP>1:200)	IBCR > 5

8.3.2 Main guidance: Decision criteria and decision process	
CBAs: Stage 3 (England)	*Taking account of contributions, does the incremental cost reduce so that another option becomes the leading option?* To take account of contributions, you should subtract any contributions from sources other than FCERM funding from the project costs. This gives costs to FCERM (C_{FCERM}). Considering costs to FCERM funding only (C_{FCERM}) could change the order of your options: • *where options have been organised by reducing probability of flooding*, including contributions could increase the IBCR of the next option so it exceeds the threshold; or • *where options have been organised by average benefit-cost ratio*, including contributions could change the order of your options and a different option could now have the highest average benefit-cost ratio (or the average benefit-cost ratio of one of a small number of leading options could clearly become the highest ABCR). **You should identify if the choice of leading option changes when contributions are taken into account and, if so, which option is now the leading option**. Again, if there is a small number of options with very similar average benefit-cost ratios (where costs relates to costs to FCERM), you can identify them all as leading options at this stage. Move to Stage 4.
CBAs: Stage 4 (England) Read more on how to undertake sensitivity analysis	*Does uncertainty affect the choice of leading option?* Using the results of sensitivity analysis, assumptions recorded in the AST and uncertainties associated with techniques used to monetised benefits (such as scoring and weighting) consider whether the leading option changes. Does a different option become the leading option? • *No, the leading option stays the same under all the sensitivity tests*. Verify that the switching points (the increase in costs and damages required to make the *second best* option the *leading* option) requires a significant change that is unlikely to occur (based on the uncertainties recorded in the AST and tested through sensitivity analysis). Where the switching point test shows that the change required is credible, follow the 'yes' route. Otherwise, select the preferred option from the appraisal as your preferred solution. Move to Stage 5.

8.3.2 Main guidance: Decision criteria and decision process

- *Yes, the leading option changes under one (or more) of the sensitivity tests*. Consider whether the results provide a robust and justifiable case for moving to a different option, or staying with the leading option. Is there a justifiable and robust case for moving to a different option?
  - If yes, select the different option as leading option. You should provide a robust argument why you chosen this option, based on the results of your sensitivity tests. Move to Stage 5.
  - If no, consider which sensitivity tests suggest a different option would be preferred. Is it possible to adapt the leading option so it performs better under these sensitivity tests? Or can the leading option be made more adaptable to future changes? Where the uncertainties relate to climate change, consider following the principles of Real Options Analysis and no or low regrets options (see supporting document on climate change) before moving to Stage 5.

Read more on the importance of justifying your decisions

CBAs: Stage 5 (England)

Would an alternative option be preferred if you were to take other factors into account?

Consider the costs and benefits of delivering more of the objectives, providing enhancements, or approaches that are adaptable to future changes in risk. To decide whether you should recommend an alternative option (rather than the leading option), you will need to identify if the benefits of doing more exceed the costs.

You should refer back to the project objectives to assess which options meet more/fewer of the objectives. You should take account of any weighting of objectives that may have been assigned (for example, through discussions with stakeholders), particularly where you have conflicting objectives.

Read more on why it is important that all impacts are taken into account during decision-making

You should take account of both monetised and non-monetised benefits when assessing if the benefits outweigh the costs. You will need to explain the reasoning behind your choice and justify your decision (especially where you are relying on the non-monetised benefits to argue that the benefits of delivering more outweigh the costs).

It may be useful to rank the options based on which is most preferred in terms of the additional benefits that can be delivered. You can use the rankings to help identify which option meets all or most of the policy and duty objectives. Where there is a choice of implementing an option that is

8.3.2 Main guidance: Decision criteria and decision process	
Read more about subjectivity	judged to be more sustainable (for example, one that reduces the need for future interventions, is more in keeping with environmental objectives or one that offers a greater degree of environmental or social enhancement), a decision will have to be made as to whether any additional cost is worthwhile. Such decisions can only be taken on a case by case basis, taking account of all factors including the responses to consultation and the project objectives. There may be opportunities to seek contributions from those who would benefit from the preferred option, particularly where this includes opportunities to deliver more objectives. You should have identified potential project partners and those who may be able to contribute towards implementing solutions that would deliver more objectives. Your AST should also include disaggregated costs and benefits to help you demonstrate that the delivery of objectives is worthwhile. It is important to be realistic when identifying which of the wider objectives can be delivered. Part of the basis for choosing the preferred option is its benefit-cost ratio. As noted above, you should explore the potential that wider objectives could be achieved through working with project partners (including local councils to help meet social objectives, Natural England or the Countryside Council for Wales to help meet environmental objectives and regional development agencies to help meet regeneration objectives). Do the benefits of the best alternative option(s) exceed the costs? • Yes: it is worthwhile delivering the additional benefits. You should recommend the alternative option as the preferred solution. • No: it may not be worthwhile delivering the additional benefits unless additional contributions can be obtained from project partners. Engage with project partners to discuss their priorities and whether additional funding sources can be found. It may not always be necessary for the benefits to outweigh all the costs, there may be some leeway where an alternative option offers enhancements or other benefits at only slightly increased costs. If you can make a justifiable case for moving to an alternative option, you should do so in coordination with your project partners. Otherwise, you should identify the leading option as the preferred solution.

8.3.2 Main guidance: Decision criteria and decision process	
Decision-making for CBAs (Wales)	The decision-making process for projects that have used CBA is based on the following five stages: 1. Stage 1: identify the option with the highest average benefit-cost ratio. 2. Stage 2: identification of a leading option where different options provide different probabilities of flooding 3. Stage 3: does the option choice change when you take contributions into account? 4. Stage 4: does the option choice change when you take uncertainty into account? 5. Stage 5: does the option choice change when you consider other factors that are not adequately captured in the economic analysis, or are not directly related to FCERM?
CBAs: Stage 1 (Wales)	*Identify the option with the highest average benefit-cost ratio* You should have monetised the significant impacts (positive and negative) while following the guidance in Chapter 7 (describe, quantify and value costs and benefits), using tools such as ecosystem services and scoring and weighting where appropriate. You should, therefore, be able to identify which option has the highest benefit-cost ratio. This is your leading option.
CBAs: Stage 2 (Wales)	*Organise the options by reducing probability of flooding* Where options cannot be organised by reducing level probability of flooding (for example, where two (or more) options provide protection to a similar level of risk, reduce or remove coastal erosion risk, provide different strategic methods or approaches and/or provide different ways of providing the same outcome), move to Stage 3. Options are organised by reducing probability of flooding to help decide how 'far' the probability of flooding can be reduced. Start by identifying the option with the highest average benefit-cost ratio as the leading option.
Read more on how to calculate the incremental benefit-cost ratio	Calculate the incremental benefit-cost ratio for each option against the option with the highest benefit-cost ratio. Select the option with the highest SoP that has an IBCR>=1. Once you have identified the leading option, move to Stage 3.

8.3.2 Main guidance: Decision criteria and decision process	
CBAs: Stage 3 (Wales)	*Taking account of contributions, does the incremental cost reduce so that another option becomes the leading option?* To take account of contributions, you should subtract any contributions from sources other than FCERM funding from the project costs. This gives costs to FCERM (C_{FCERM}). Considering costs to FCERM funding only (C_{FCERM}) could change the order of your options: • *where options have been organised by reducing probability of flooding*, including contributions could increase the IBCR of the next option so it exceeds the threshold; or • *where options have been organised by average benefit-cost ratio*, including contributions could change the order of your options and a different option could now have the highest average benefit-cost ratio (or the average benefit-cost ratio of one of a small number of leading options could clearly become the highest ABCR). **You should identify if the choice of leading option changes when contributions are taken into account and, if so, which option is now the leading option**. Again, if there is a small number of options with very similar average benefit-cost ratios (where costs relates to costs to FCERM), you can identify them all as leading options at this stage. Move to Stage 4.
CBAs: Stage 4 (Wales) Read more on how to undertake sensitivity analysis	*Does uncertainty affect the choice of leading option?* Using the results of sensitivity analysis, assumptions recorded in the AST and uncertainties associated with techniques used to monetised benefits (such as scoring and weighting) consider whether the leading option changes. Does a different option become the leading option? • *No, the leading option stays the same under all the sensitivity tests*. Verify that the switching points (the increase in costs and damages required to make the *second best* option the *leading* option) requires a significant change that is unlikely to occur (based on the uncertainties recorded in the AST and tested through sensitivity analysis). Where the switching point test shows that the change required is credible, follow the 'yes' route. Otherwise, select the preferred option from the appraisal as your preferred solution. Move to Stage 5.

8.3.2 Main guidance: Decision criteria and decision process	
	• *Yes, the leading option changes under one (or more) of the sensitivity tests*. Consider whether the results provide a robust and justifiable case for moving to a different option, or staying with the leading option. Is there a justifiable and robust case for moving to a different option? – If yes, select the different option as leading option. You should provide a robust argument why you chosen this option, based on the results of your sensitivity tests. Move to Stage 5. – If no, consider which sensitivity tests suggest a different option would be preferred. Is it possible to adapt the leading option so it performs better under these sensitivity tests? Or can the leading option be made more adaptable to future changes? Where the uncertainties relate to climate change, consider following the principles of Real Options Analysis and no or low regrets options (see supporting document on climate change) before moving to Stage 5.
Read more on the importance of justifying your decisions	
CBAs: Stage 5 (Wales)	*Would an alternative option be preferred if you were to take other factors into account?*
Read more on why it is important that all impacts are taken into account during decision-making	Consider whether there are other impacts or benefits that could not be captured in the economic analysis or that are not directly related to FCERM. In particular, you should consider the implications for people and communities and the additional objectives that an alternative option could deliver. Where these other factors suggest that a different option is preferred to that identified in Stage 2, you should justify how these factors might increase the BCR or IBCR. You may wish to seek advice from WAG to support any final recommendations. Move to consider residual risk.
Consider residual risk	Once you have maximised the potential benefits of the preferred option, you will need to consider the residual risks. The preferred option may still have risks (residual risks) which will have to be managed as the project is implemented. This can be through monitoring and response if the parameters in the appraisal are exceeded and can be both structural (for example, raising a defence or preferential flow paths in the event of overtopping) and non-structural (such as providing additional warning). The need to manage residual risks is particularly true where it is not possible to justify any do-something options, such that do-nothing is preferred or where residual risk would increase compared with current or future risks.

8.3.2 Main guidance: Decision criteria and decision process

There may be cases where the do-nothing option is the only viable way forward. Discussions with Natural England or the Countryside Council for Wales may give rise to a withdrawal option. Any option that involves withdrawal from funding for defences should consider the social impacts and the need for an exit strategy. Note that this does not affect a third party's right to manage and maintain defences.

Assess whether there are adaptation responses that could be introduced to reduce impacts on communities following the decision to withdraw funding or where risks would increase. You should engage with local stakeholders to determine which actions might be more/less acceptable. Stakeholders may be willing to take over responsibility for maintaining the defences or coast protection works. You should discuss with them the most appropriate way forwards.

In some circumstances, the nature of the risk may override economic arguments. Flood and coastal defences are expected by the public to resist high water levels, wave activity and river flows, with acceptably low probabilities of failure. In practice, the consequences of failure may influence the acceptable probability of failure, and possibly the choice of option. A scheme with a failure mode that has a major impact will generally be accepted less readily than one that has only minor consequences.

Read more

Environmental management plans to bridge between consenting phase and design and operational phase

Once a decision has been made on the preferred option, an Environmental Management Plan (EMPs) provides a bridge between the consenting (EIA) phase and the design and operational phase. EMPs define a series of actions based on mitigation measures identified during the appraisal phase (sometimes through EIA, otherwise through consenting process). These mitigations, in addition to any planning conditions associated to residual risks or mitigation measures required to make the project acceptable will be documented in the EMP. This document therefore provides a useful tool for recording measures and actions required to reduce outstanding uncertainty and manage impacts during detailed design and construction. For more guidance on EMPs refer to the IEMA practitioner guide on Environmental Management Plans.

The preferred option may also need to be revisited after the formal consultation process, required as part of EIA or SEA. This could be the case when there is no clear preferred option, where new data comes to light or consultation results in need to review the decision-making process. The

8.3.2 Main guidance: Decision criteria and decision process	
	appraisal process, if done effectively, should limit this risk of revisiting the preferred option but in complex projects where combined options are needed and/or there are large residual impacts (after mitigation) it may be unavoidable. As explained above the EMP can be used to document outstanding actions required to limit uncertainty during the design and construction phase.
Sensitivity analysis Read more	Sensitivity analysis: • is undertaken to determine how uncertainty affects the costs and benefits of options; • should be used in combination with risk assessment as part of the process of dealing with uncertainty; • involves changing the assumptions relating to the options to determine what the choice of preferred option may be sensitive to and, as a result, if there are any consequences for the costs or impacts, and hence the preferred option.
Identify key uncertainties	You should focus on those assumptions, data and estimates that have the greatest uncertainty and those that are most likely to affect the differences between options (you should have recorded information on uncertainty in the AST, this will help when explaining it to stakeholders). Assessments of uncertainty should be made based on knowledge on the sources of uncertainty and natural variability associated with all the options (not just the preferred option). As a general guide, a range of possibilities could be considered for the following factors: • costs (whole life costs - capital, maintenance and management) based on the key cost elements and sensitivity to changes in costs of key materials or resources; • timing to first failure of deteriorating defences (projects are often sensitive to the timing of impacts, particularly write-off of properties or onset of environmental damages); • threshold of flooding (many projects will be sensitive to assumptions about the level, and hence frequency, at which flood damage commences); • rate of erosion (changes in erosion rate will affect the area of land affected and any assets on that land); • processes such as the rate of sediment drift that will have a particular influence on beach management solutions; • calculation of extremes and their probabilities; • changes to major beneficiaries (for example, where

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damages to a commercial property account for more than 20% (say) of the benefits, assess how the damages would change if the commercial property changed use such that the damages would be reduced); and

Read more

- regeneration potential and development planning.

> **Examples of key uncertainties**
>
> When considering a flood or coastal defence, it is advisable to assess the implications of a range of breach probabilities, thus determining the sensitivity of the preferred option to breach probability. Sensitivity analysis can also be used as a way of taking account of the 'goodwill' value attached to commercial properties. This can be done by altering the market values of non-residential properties and determining if the preferred option changes. It is often appropriate to try excluding any indirect impacts on businesses as part of the sensitivity analysis as well.

Quantified and unquantified uncertainties

The effect of uncertainty may be easier to explore where the benefits (and damages) are valued in money terms, since the impact of changes in assumptions between options can be calculated. Qualitative and quantitative descriptions included in the AST should help identify which of the non-monetised impacts have the greatest influence on the choice of option. It is not always necessary to quantify the uncertainties, but it is useful to try and quantify the impacts on the benefits of the options and the average benefit-cost ratio wherever possible. This is particularly important where the scale of the uncertainty is much larger than tangible differences in value between the alternative options. Where it is not possible to quantify the uncertainty associated with each variable, it should be possible to assess the relative scales of the uncertainties compared with the other options. All major risks should be considered both singly and in combination.

Focus on differences between options

It is important to focus on differences between options, as this will help identify which factors are influencing the choice of one option over another. This information can then be used to help choose between options and to justify the choice of preferred option.

Sensitivity of probabilistic analysis

Where a probabilistic analysis of out-turn costs has been carried out (for example using the methods in CIRIA special publication 125, rather than optimism bias as described in 7.3: describe, quantify and value costs), it is usually appropriate to use the 50% estimate of costs for option

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choice. However, the effect of the 5% and 95% range on both overall viability and option choice should be considered in conjunction with other variables. If the project is not economically viable using the 95% estimate of expected costs, then it may be appropriate to reduce the margin of uncertainty, for example by commissioning additional site investigation, before the decision to invest in the project is confirmed.

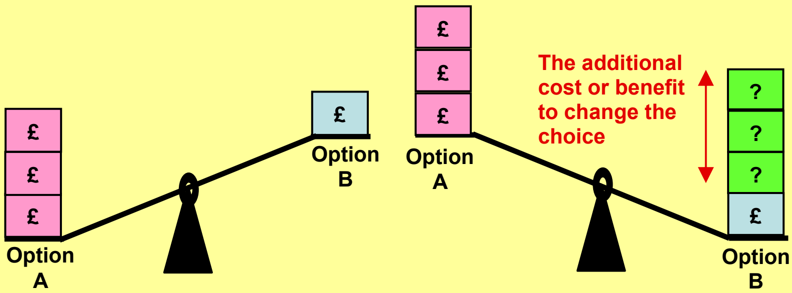
Calculate switching points

It is important to identify switching points where a change in the assumptions (particularly associated with the costs of the options) would change the choice of preferred option. This information can be useful at the implementation stage for strategies as it gives a range of costs over which particular options may (and may not) be preferred. Switching points are points at which the preferred option changes from one option to another (because the costs of the options increase, or the benefits decrease). They are calculated by estimating how much costs would have to increase or benefits decrease to change the choice of option. An assessment can then be made of the likelihood that costs would increase (or benefits decrease) to the point that the preferred option would change. It is important to remember though that the choice of preferred option will include more than just the monetised costs and benefits. As a result, any sensitivity shown as a result of calculating the switching points should be described taking account of the implications of the non-monetised benefits.

Read more

What would it take to change your mind?

a) Realistic values. The difference in choice between option A and option B is three additional units of cost or benefit. Given the uncertainty associated with either option is it realistic that the choice would change?



b) Sustainable defence. A town is protected along one length (3km) by a natural defence and along another by a man made embankment (500m). As long as there is no need to extend the embankment over the full 3.5km, the appraisal shows that it is economically worthwhile maintaining defences to the town. At present the

8.3.2 Main guidance: Decision criteria and decision process

embankment, providing adequate standard of defence, would be 0.5m below the natural level of the adjacent ground. The switching point in the choice between maintaining the defence and possibly taking an alternative approach is in effect determined by 0.5m. Given the uncertainty with respect to climate change what period of time might it be possible to maintain this form of defence? Under a scenario of 1m sea level rise over the next 100 years, this form of defence might be sustainable over 75 years, with future raising of the embankment. Under a scenario of 2m sea level rise over the next 100m (UKCIP H++), this approach may only be sustainable over the next 30 years. Over what time period would it be economically viable to choose the option of the embankment: 10 years, 20, 30, 50, 75, 100? If it is only economically viable when considering potential damages over 100 years, arguably this option may not be a sustainable choice. If it pays for itself when considering preventing damages over 20 years, then it probably is. The switching point is the need to further extend the embankment.

Check you have completed all the expected outputs

8.3.3 Explanations and further guidance: Decision criteria and decision process

Decision criteria

Decision criteria are needed to help you select a preferred option based on the assessment you have undertaken. The use of a consistent decision-making process helps to ensure that the results of appraisals are comparable and helps reviewers and approvers determine that the 'best' option has been chosen.

It is important that the decision-making process includes all the impacts (positive and negative) and costs (taking account of contributions). The decision-making process also needs to take account of the results of stakeholder engagement and draw on the results of the environmental assessment. Qualitative and quantitative impacts that have not been monetised **must** be taken into account when selecting the preferred option, otherwise there is a risk that the option that performs best will not be chosen. This means that the choice of preferred option is not a mechanistic process. Instead, you will need to provide justification for and/or against the selection of particular options. These justifications will need to be robust and guidance is given on how to justify the choice of one option over another in the section on decision-making criteria.

8.3.3 Explanations and further guidance: Decision criteria and decision process	
Return to main guidance	You should also have identified options that could deliver more than just the flood and coastal erosion risk management objectives. The decision-making process allows you to take into consideration benefits from delivering multiple objectives and any other sources of funding that may have been found.
Economic decision criteria Return to main guidance	Decision-making based on the economic criteria of benefit-cost ratio (or average benefit-cost ratio) and incremental benefit-cost ratio is most appropriate where many (or most) of the impacts have been assessed in monetary terms and/or where the choice of option is between provision of different levels of risk reduction. However, not all of the impacts can be valued in monetary terms such and you will need to take account of these impacts as well when choosing the preferred solution. The economic decision-making criteria used in the decision-making process are calculated as follows (in all cases, you should use Present Value (discounted) costs and benefits):
Taking account of those impacts that have not been valued in monetary terms Return to main guidance	It is important that ***all*** the impacts (both positive and negative) of an option are taken into account during decision-making. Use of the decision-making process requires these impacts to be considered to help ensure that the best overall solution is identified. This means that you will need to weigh up those impacts that have not been valued in monetary terms and consider whether they are of sufficient magnitude, significance and/or duration to change the preferred option from that which would be chosen based on the economic criteria alone. This is a decision that has to be made by the project team, based on the evidence collected and recorded in the AST during the appraisal. You will need to justify all your choices and decisions to support your argument. Where the impacts are considered significant, but have not been monetised you should identify whether tools such as ecosystem services or scoring and weighting could be use to monetise the impacts (see 7.4 Describe, quantify and value benefits).
The need for IBCR thresholds	Any option with an IBCR that exceeds one is economically worthwhile. However, if IBCR thresholds are not used there is a risk that while higher standards may be justifiable for a given project the benefits would usually be less than if the additional money had been spent elsewhere. This occurs because the costs of reducing flood risk tend to increase much more quickly than the damages decrease. Therefore, the limited funds available would tend to be

8.3.3 Explanations and further guidance: Decision criteria and decision process	
Return to main guidance	spent on a small number of larger projects. Using the IBCR thresholds increases the potential for more projects to be funded, protecting more people and property and providing a greater overall level of environmental, social and economic benefit.
The importance of justifying your decisions Return to CEA guidance Return to CBA guidance (England) Return to CBA guidance (Wales)	The decision process highlights the need to justify the choice of preferred solution, particularly where this varies from the option suggested by the economic criteria alone (average benefit-cost ratio and incremental benefit-cost ratio). You should explain why your preferred option may vary from that suggested by the economic criteria alone, drawing on: • descriptions of the qualitative and quantitative impacts (including their significance, such as that given in the environmental assessment and from stakeholder engagement); • potential benefits (and funding contributions) associated with meeting more of the objectives; • the results of the sensitivity analysis, and the technical issues. For example, you could calculate how much the qualitative and quantitative impacts would have to be worth (in monetary terms) to increase the incremental benefit-cost ratio so it exceeds the specified thresholds. You could discuss why the residual impacts of options could change the choice of preferred solution (for example, where local stakeholders would like to avoid landscape impacts of raising floodwalls through a town that would reduce views of the river even though this will result in higher flood risk). The objectives identified at the outset of the appraisal and/or engagement with stakeholders may be useful in helping you to justify the choice of an alternative option.
What about subjectivity? Return to CEA guidance Return to CBA guidance (England)	Consideration of how the non-monetised impacts could affect the choice of preferred option is a subjective decision. You can make it more objective by drawing on your justifications. It is important to remember that subjective decisions will have been made throughout the appraisal process (for example, when deciding which parameters to use in modelling, when assessing which monetary values to use when monetising the impacts). All of these assumptions should be recorded in the appraisal report and the AST so their influence on the choice of preferred option can be seen. Whenever you make a decision during the appraisal process you should record

8.3.3 Explanations and further guidance: Decision criteria and decision process	
Return to CBA guidance (Wales)	your assumptions and evidence, so others can understand why you have made that decision (even if they do not agree with your decision). This ensures that the appraisal is open and transparent and can be understood by others especially stakeholders.
What are residual risks	Residual risks are those risks that remain after risk management and mitigation. They may include some level of flood or erosion damage even when a project is in place (due to above standard events) or because of some uncertainty associated with the success of an option (such as use of demountable flood barriers that have a small probability of failure associated with the need to ensure that the barriers are in place in advance of a storm surge or peak flood flows). For example, a barrier may significantly reduce flood risk from storm surges but may increase impacts associated with navigational use of the river (either commercially or recreationally). In this case, the benefits from reduced flood risk have to be balanced against the navigation needs. Refinement of options should mean that you have investigated how to reduce impacts on navigation as far as possible, but some residual effects may remain (such as where a barrier may prevent upstream access for larger boats). Residual risk is also significant when assessing how long-term pressures may develop within the system. For example, it may be justifiable to continue to defend on the existing line over 20, 50 or 100 years or it may be appropriate to accommodate increased pressure on defences by realigning the defences. In either case, consideration has to be given to predicted changes in conditions (including natural processes) and whether there is an opportunity to change those conditions over timescales that extend beyond the appraisal period.
Return to main guidance	
Sensitivity analysis	Sensitivity analysis is important as it allows you to take account of the uncertainties identified during the appraisal. Where data were unavailable or of doubtful quality, it is possible to test the implications of alternative assumptions. This avoids the need to try and collect additional data (thus can help you to keep the appraisal proportionate in terms of the effort and, consequently costs involved). You should have identified key sources of uncertainty during the appraisal (with best practice being to record these in the AST alongside any quantitative and monetary estimates of damages). This will provide you with the information needed to begin changing assumptions.
Return to main guidance	

8.3.3 Explanations and further guidance: Decision criteria and decision process	
Use sensitivity analysis to explore how uncertainty affects options Return to main guidance	It is important to remember that sensitivity analysis is about exploring how uncertainty affects the performance of options. Hence, there is no right or wrong way to proceed. The key is to test the sensitivity of the outcomes of the appraisal (particularly the economic decision criteria such as the average benefit-cost ratio and incremental benefit-cost ratio). The results will then provide you with a clear idea of the type of changes that would affect the choice of preferred option. You can then use the information you have learned about the project area and through the environmental assessment to determine whether you believe that those changes could realistically occur. If not, then the preferred option is likely to be robust.
Testing the robustness of the preferred option Return to main guidance	Sensitivity analysis also allows you to test how much costs and/or benefits would have to change for the preferred option (based on the economic decision-criteria alone) to change. By increasing the costs (and/or decreasing the benefits) you can identify 'switching points'. These reflect the magnitude of change in costs (or benefits) required to move from one option to another. They can be measured in terms of the percentage increase in costs (or decrease in benefits) required to change the choice of option. This information is useful as it allows you to assess whether (based on the data you have collected and used in the appraisal) such a change is reasonable (or not). Sensitivity analysis should help ensure a robust option is selected. If, for example, the average benefit-cost ratio is highest for an option where there is significant uncertainty then it may be better to pursue an alternative with a lower but more certain outcome. Alternatively, where you believe that the preferred option is not robust, you could consider whether the preferred option could be made more robust (including making it more adaptable to future changes, by phasing options to take advantage of managed adaptive approaches or combining options). This may require some reworking of the appraisal, and hence could increase appraisal costs. However, refinement of the options to provide a more robust solution is appropriate provided the reduction in uncertainty can be delivered. You will need to use the knowledge you have gained during the appraisal to determine if this is likely to be a worthwhile exercise.
	Check you have completed all the expected outputs

Calculation of economic decision-making criteria (CEAs)

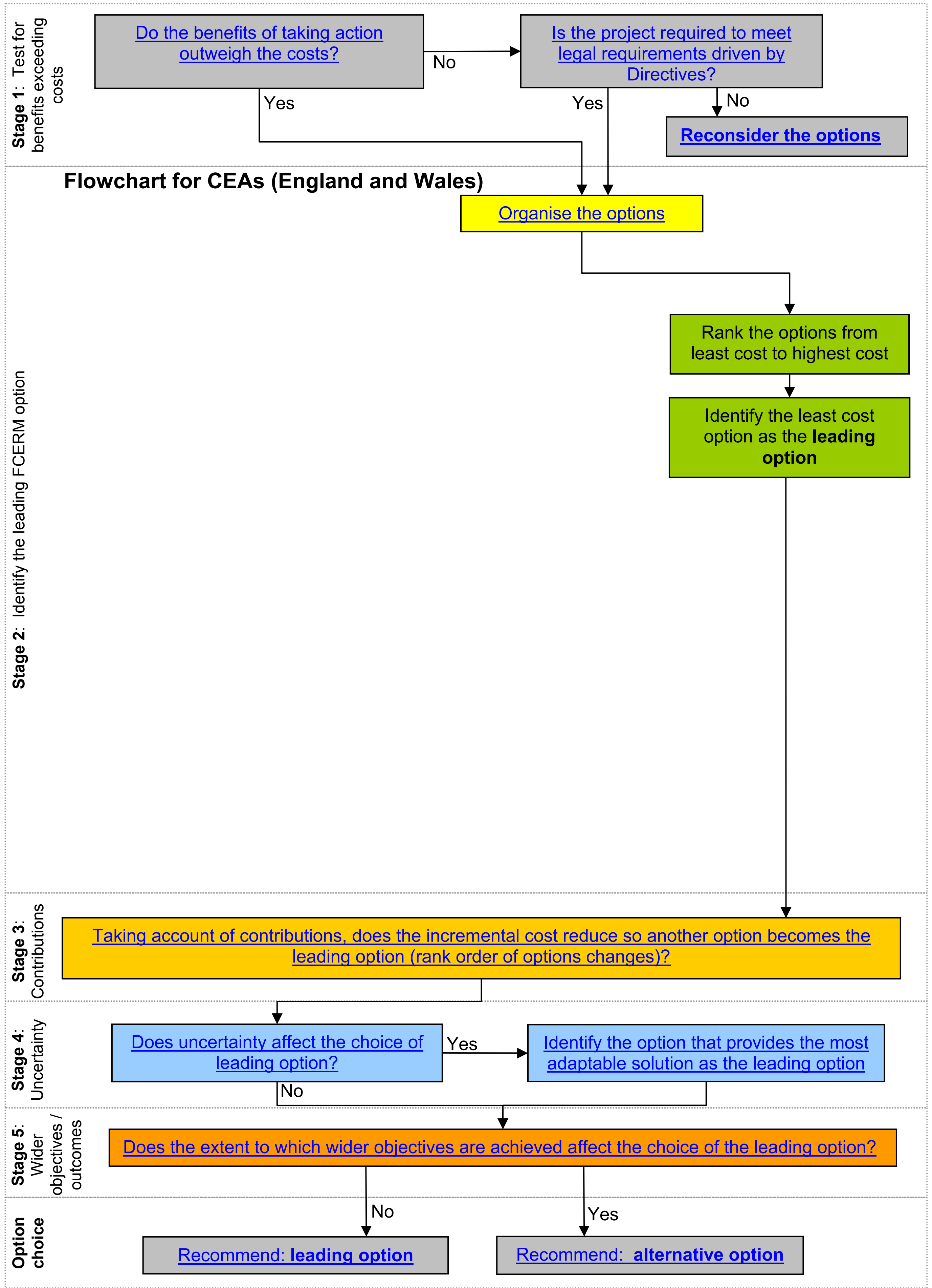
- ***(average) benefit-cost ratio***: divide the total PV benefits by the total PV costs (ensure that the total costs include optimism bias). The same approach is used for the implied benefit-cost ratio where scoring and weighting has been undertaken (in this case, the implied benefit-cost ratio should be used in addition to the average benefit-cost ratio)

  Stage 1: $\dfrac{\text{PV benefits Option 1}}{\text{PV costs Option 1}}$

  Stage 3: $\dfrac{\text{PV benefits Option 1}}{\text{PV costs}_{FCERM}\text{ Option 1}}$

  Where costs_{FCERM} = whole life costs minus contribution from non-FCERM funding sources

  The average benefit-cost ratios of solutions taken further in the decision-making process must be greater than one (or the non-monetised benefits must outweigh the costs) for the option to be implemented.



Calculation of economic decision-making criteria (England)

- ***(average) benefit-cost ratio***: divide the total PV benefits by the total PV costs (ensure that the total costs include optimism bias). The same approach is used for the implied benefit-cost ratio where scoring and weighting has been undertaken (in this case, the implied benefit-cost ratio should be used in addition to the average benefit-cost ratio)

  Stage 1: $\dfrac{\text{PV benefits Option 1}}{\text{PV costs Option 1}}$

  Stage 3: $\dfrac{\text{PV benefits Option 1}}{\text{PV costs}_{\text{FCERM}}\text{ Option 1}}$

  Where $\text{costs}_{\text{FCERM}}$ = whole life costs minus contribution from non-FCERM funding sources

  The average benefit-cost ratios of solutions taken further in the decision-making process must be greater than one (or the non-monetised benefits must outweigh the costs) for the option to be implemented.

- ***incremental benefit-cost ratio***: For the do-nothing option and those options with average benefit-cost ratios greater than one (see above), arrange the options in either increasing order of benefit or increasing order of cost. For each pair of neighbouring options in this "chain", subtract the PV benefits of Option "1" from those of Option "2" and divide these by the difference in PV costs of Options 1 and 2 (subtracting any contributions from non-FCERM funding sources in Stage 3). (As with the average benefit-cost ratio, the approach to calculation of the implied incremental benefit-cost ratio is the same as that for the incremental benefit-cost ratio):

  Stage 2: $\dfrac{\text{PV benefits Option 2} - \text{PV benefits Option 1}}{\text{PV costs Option 2} - \text{PV costs Option 1}}$

  Stage 3: $\dfrac{\text{PV benefits Option 2} - \text{PV benefits Option 1}}{\text{PV costs}_{\text{FCERM}}\text{ Option 2} - \text{PV costs}_{\text{FCERM}}\text{ Option 1}}$

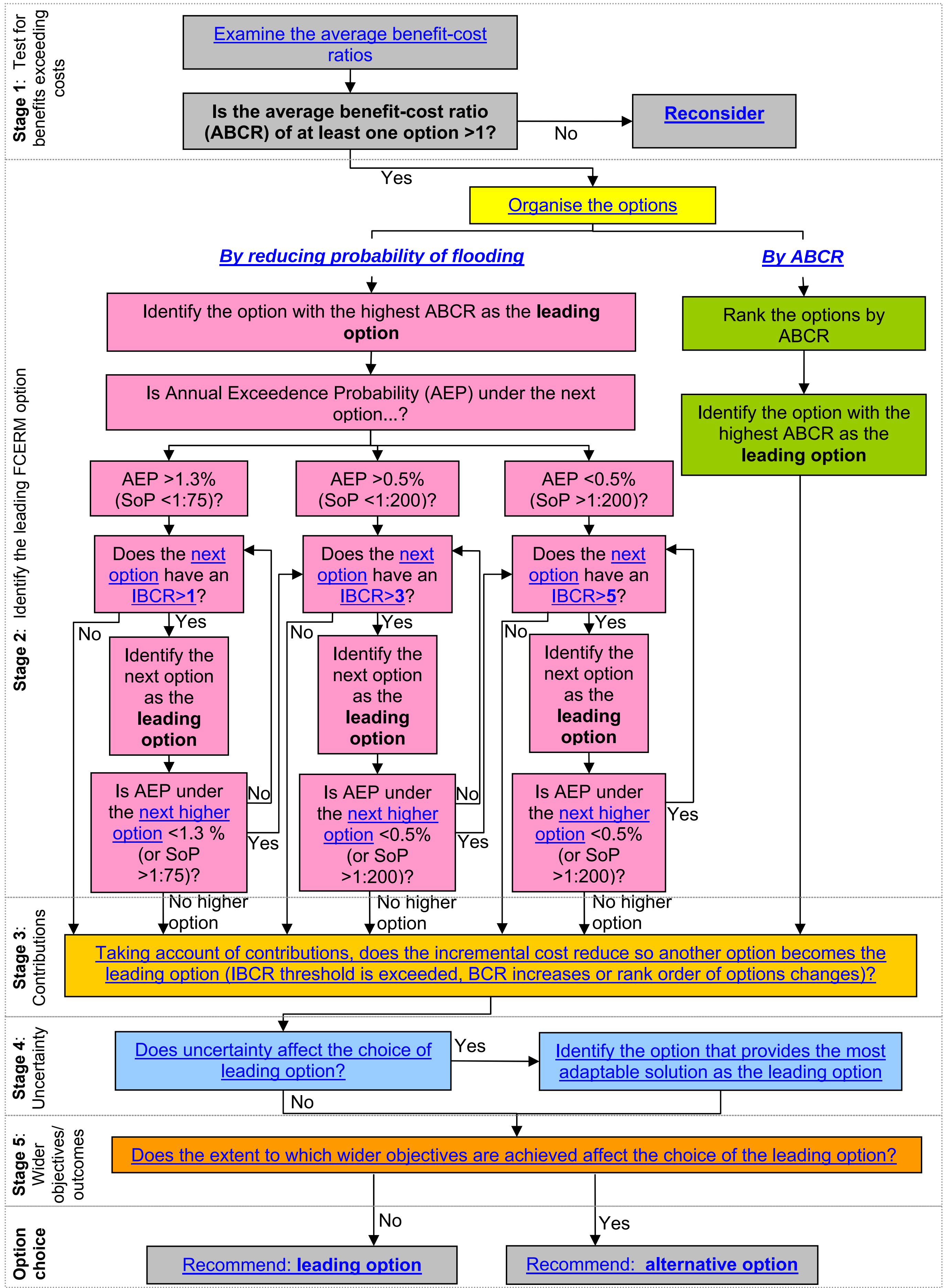
  Where $\text{costs}_{\text{FCERM}}$ = whole life costs minus contribution from non-FCERM funding sources

  The incremental benefit-cost ratio is used to identify how 'much' can be delivered. Any option Different thresholds for the required IBCR are used when deciding which option should form the preferred solution (see the need for IBCR thresholds).

- ***net present value***: total benefits minus total costs

  PV benefits Option 1 – PV $\text{costs}_{\text{FCERM}}$ Option 1

  Where $\text{costs}_{\text{FCERM}}$ = whole life costs – contribution from non-FCERM funding sources



Calculation of economic decision-making criteria (Wales)

- ***(average) benefit-cost ratio***: divide the total PV benefits by the total PV costs (ensure that the total costs include optimism bias). The same approach is used for the implied benefit-cost ratio where scoring and weighting has been undertaken (in this case, the implied benefit-cost ratio should be used in addition to the average benefit-cost ratio)

  Stage 1: $$\frac{\text{PV benefits Option 1}}{\text{PV costs Option 1}}$$

  Stage 3: $$\frac{\text{PV benefits Option 1}}{\text{PV costs}_{\text{FCERM}}\text{ Option 1}}$$

  Where $\text{costs}_{\text{FCERM}}$ = whole life costs minus contribution from non-FCERM funding sources

  The average benefit-cost ratios of solutions taken further in the decision-making process must be greater than one (or the non-monetised benefits must outweigh the costs) for the option to be implemented.

- ***incremental benefit-cost ratio***: For the do-nothing option and those options with average benefit-cost ratios greater than one (see above), arrange the options in either increasing order of benefit or increasing order of cost. For each pair of neighbouring options in this "chain", subtract the PV benefits of Option "1" from those of Option "2" and divide these by the difference in PV costs of Options 1 and 2 (subtracting any contributions from non-FCERM funding sources in Stage 3). (As with the average benefit-cost ratio, the approach to calculation of the implied incremental benefit-cost ratio is the same as that for the incremental benefit-cost ratio):

  Stage 2: $$\frac{\text{PV benefits Option} - \text{PV benefits Option with the highest bcr}}{\text{PV costs Option} - \text{PV costs Option with the highest bcr}}$$

  Stage 3: $$\frac{\text{PV benefits Option} - \text{PV benefits Option with the highest bcr}}{\text{PV costs}_{\text{FCERM}}\text{ Option} - \text{PV costs}_{\text{FCERM}}\text{ Option with the highest bcr}}$$

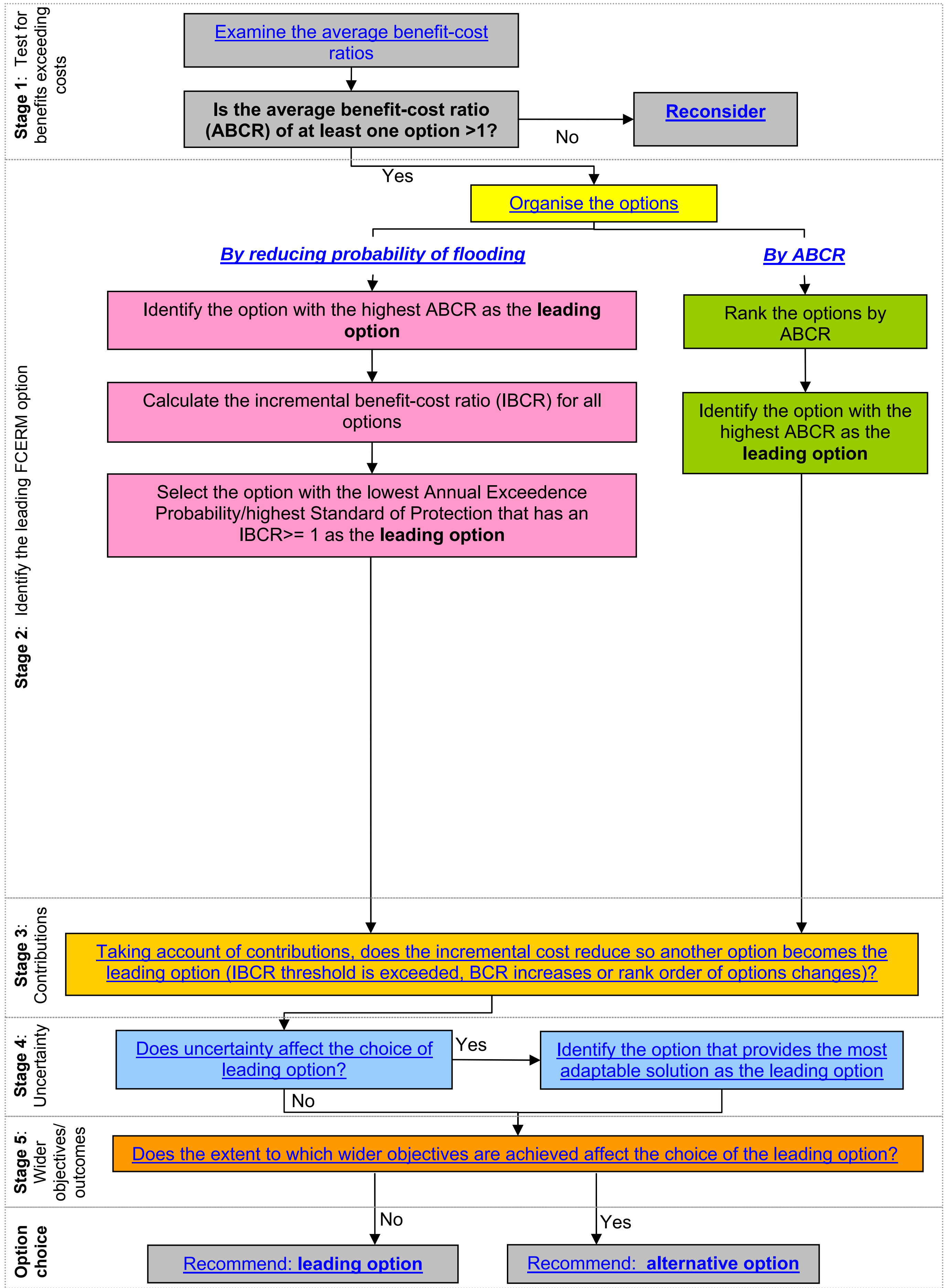
  Where $\text{costs}_{\text{FCERM}}$ = whole life costs minus contribution from non-FCERM funding sources

  The incremental benefit-cost ratio is used to identify how 'much' can be delivered.

- ***net present value***: total benefits minus total costs

  PV benefits Option 1 – PV $\text{costs}_{\text{FCERM}}$ Option 1

  Where $\text{costs}_{\text{FCERM}}$ = whole life costs – contribution from non-FCERM funding sources



8.4 Checkpoints and outputs from compare and select the preferred option

Checkpoints

Assess whether it is worthwhile continuing with the appraisal in its current form by answering the following questions:

1. **For CBAs, is there at least one option that has an average benefit-cost ratio greater than one?** If not, you should consider the need for an exit strategy (based on providing information and assistance to local communities to help them adapt to future changes). This should be considered in advance of finalising the appraisal and preparing the appraisal report. It will also be essential to engage with stakeholders to inform them of the changes and to discuss what is needed to help the community to adapt.

2. **Has sufficient data and information been collected and recorded during the appraisal to allow a justifiable choice of preferred solution to be made?** If no, you may need to return to some steps of the appraisal to add to the data and information to ensure that choice of preferred solution can be clearly justified. Again informing stakeholders of the changes and what will happen next is critical.

Outputs

Typically, to complete the comparison and selection of the preferred option you should have:

- identified a preferred option using the decision-making process and justified your choice of option with robust reasons that support the choice of the preferred option over all other options (see: 8.3: Decision criteria and decision process); and
- discussed the preferred option with stakeholders explaining the choice and the reasons for the choice; and
- update the SEP to clearly show what you have done, why, with whom, how and when.

All outputs complete: the preferred solution and approaches to managing residual risk have been identified

Move to Chapter 9: Complete appraisal report

9. Complete appraisal report

9.1 Key Principles: Complete appraisal report

The purpose of the Strategy or Project Appraisal Report (StAR or PAR) is to provide a clear and comprehensive record of the appraisal process and a well argued business case for the selection of the preferred option for any project. A good Appraisal Report will provide sufficient information to meet the needs of the approving organisation.

An Appraisal Report can also provide information for other interested parties in the particular project including:

- external funding organisations;
- stakeholders affected by the decision; and
- other organisations or individuals interested in the project.

Figure 9.1 shows where you are in the appraisal process (orange coloured box). Follow the hyperlinks to move back to previous chapters of the guidance if you need to iterate. Clicking on a hyperlink to another chapter takes you directly to the start of that chapter (to the key principles). Clicking on a hyperlink to a section within Chapter 9 takes you to the main guidance.

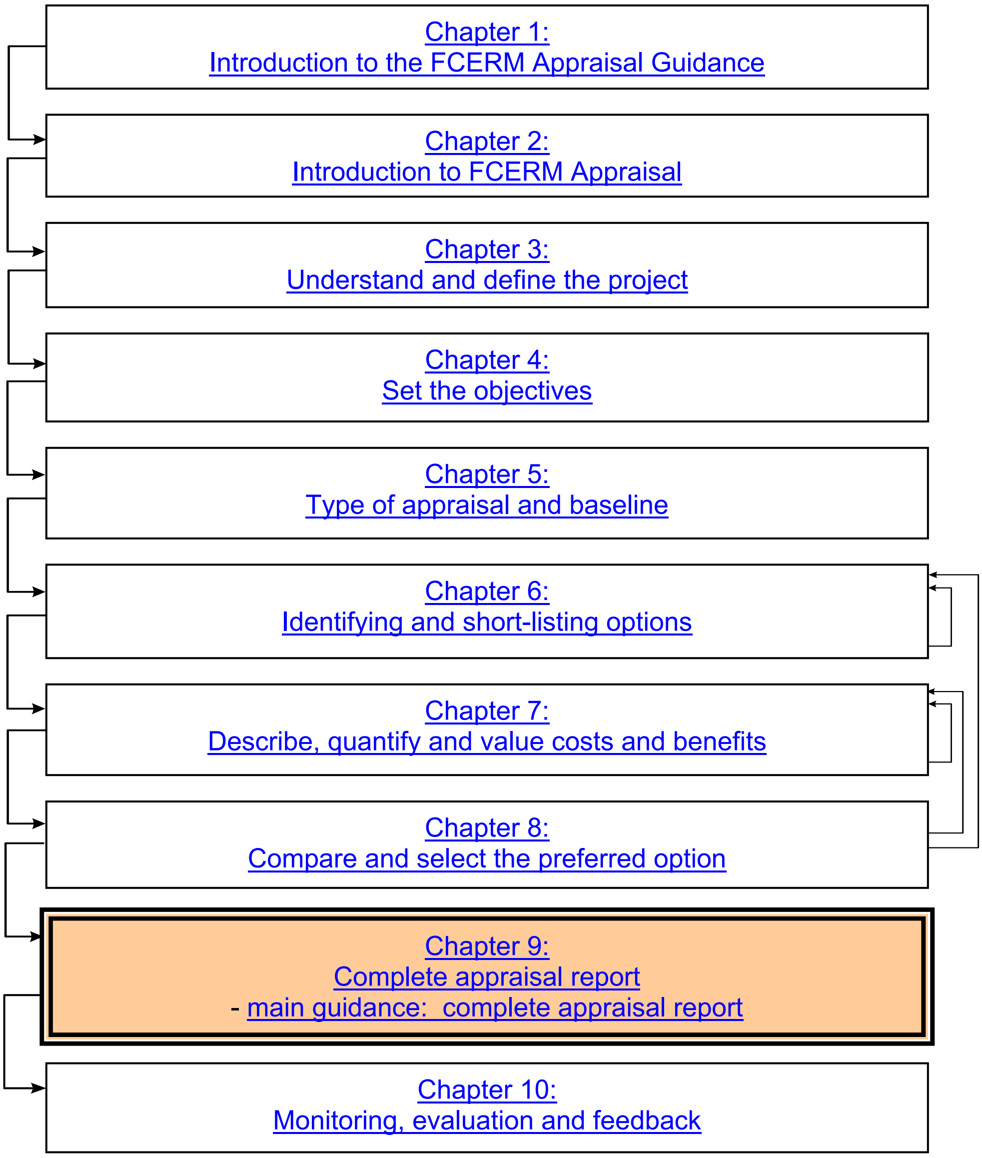


Figure 9.1 Navigation flowchart

9.2 Inputs to complete appraisal report

The appraisal report forms a record of the appraisal process following the approaches set out in Chapter 3 to 8. It is expected that the report, once finalised, will be placed in the public domain.

There are templates (produced by the Environment Agency) for both the StAR and PAR business cases. Use of these templates provides a logical structure to the report, can act as a checklist and aid reviewers (as information can be more easily found) but the report author should exercise some discretion in their use to ensure the needs of their project are adequately presented. The latest templates are provided in a supporting document.

The business case should detail a record of stakeholder engagement. In particular it should highlight the concerns, needs and expectations of those affected by the decision and how they have been taken into account in the final decision. It should also state what the current support and opposition are for the proposal and whether this will affect delivery of the solution, in particular, the ability to gain planning approval if required.

Environmental assessment should be reported where indicated in the template but in addition should be embedded throughout the report as part of the appraisal process.

9.3 Complete appraisal report

9.3.1 Expert summary: Complete appraisal report	
Complete appraisal report Read more	Follow the appropriate report template (see templates) to summarise the findings of the appraisal and set out the business case for obtaining funding.
	Check you have completed all the expected outputs

9.3.2 Main guidance: Complete appraisal report	
Appraisal report templates Read more	The appraisal report templates are a supporting document to this guidance. They provide a structure for the report and prompts on items and issues that may need to be discussed. Required supplementary reporting to meet legislative requirements (such as for Appropriate Assessment) should follow best practice.
Adequacy of the business case Read more	It is important to remember that the appraisal report sets out the business case for obtaining funding. Your project may fail to attract funding (or the decision to provide funding may be delayed) if you do not provide a report that sets out clear reasoning behind the choice of preferred option. Take care to spend the time to adequately report your findings. Remember, you are writing a story to present the business case to support a course of action. This need to have: • a beginning (why? - covering problem definition and objectives); • a main body (what? - covering assessments, options development and outcomes); and • an end (what next? - the recommendation). The appraisal template will help structure the business case, but it is for you to decide how to best present the business case. The report can be supported as necessary with appendices which could be referenced for further information. This may include: • letters of support from stakeholders; • information from higher level studies, such as SMPs, CFMPs or strategies, which the appraisal report drew strongly on for justification of approach; • supporting information showing the existing CBA used to justify following the CEA route; and • information from an impact assessment or other supporting information describing benefits associated with meeting a legal requirement.

9.3.2 Main guidance: Complete appraisal report	
Engagement	Relevant information from the engagement process and Stakeholder Engagement Plan should be clearly documented in the appraisal report. The Stakeholder Engagement Plan should be complied with including delivery of EIA/SEA statutory consultation requirements.
Environmental Assessment	Relevant information from the environmental assessment should be clearly documented in the appraisal report following guidance in the template. The appropriate stages should be completed including statutory consultation requirements.
	Check you have completed all the expected outputs

9.3.3 Explanations and further guidance: Complete appraisal report	
Appraisal report templates Return to main guidance	The appraisal report templates are designed to include the latest developments in appraisal (reflected in this guidance document) and, thus, help prompt you to record the activities you should have undertaken during appraisal. Best practice guidance is available detailing reporting requirements necessary to show that the appraisal is compliant with legislation, for example Appropriate Assessment under Habitats Regulations and reporting under the Water Framework Directive.
Reasons for using templates Return to main guidance	Templates are used to help encourage consistency in reporting (both in terms of the subject areas covered and the structure). This is invaluable to reviewers who then know where to find specific information, avoiding the need to search through the documents. As a result, a well structured and clearly presented appraisal report can help reviewers understand how you have undertaken the appraisal and how you have decided upon the preferred option. You should avoid the use of technical language, wherever possible, to enable non-specialists to understand the whole report and the significance of the results. Again, this will help reviewers who may be expert in one of the appraisal areas but not necessarily all.
	Check you have completed all the expected outputs

9.4 Checkpoints and outputs for complete appraisal report

Checkpoints Assess whether the appraisal is fully complete by answering the following questions:

1. **Has sufficient data and information be collected and recorded during the appraisal to prepare a transparent record in the appraisal report?** If no, you may need to return to some steps of the appraisal to add to the data and information to ensure that the appraisal report provides a full summary of the appraisal process.

Outputs Typically, to complete this section you should have:

- identified the appropriate template;
- completed the appraisal report following the appropriate template;
- completed the appropriate environmental assessment documentation; and
- completed and documented the required engagement in accordance with the SEP.

Your SEP should also clearly identify what will happen in terms of engagement in the detailed design and construction phases and who will be responsible for this and informing stakeholders of next steps.

All outputs complete: appraisal report done

Move to Chapter 10: Monitoring, evaluation and feedback

10. Monitoring, evaluation and feedback

10.1 Overview

This chapter of the guidance only covers evaluation activities, specifically the MEF part of the ROAMEF cycle: Monitoring, Evaluation and Feedback. Other post-appraisal activities (such as detailed design, construction or obtaining approvals) are outside the scope of the guidance.

The points at which project evaluation are desirable include:

- **post-appraisal evaluation** to verify that the appraisal meets pre-set quality criteria;
- **post-implementation evaluation** to assess the accuracy and robustness of the risks, costs and benefits predicted in the appraisal;
- **monitoring** associated with consents and licences and to inform future risk management activities through managed adaptive processes; and
- **feedback of information** to other processes, policies and strategies so they can be updated or maintained.

10.2 Post-appraisal evaluation

A post-appraisal evaluation is an important part of assessing the appraisal phase. Its role is two fold:

1. to assess how well the appraisal objectives have been achieved, identify positive and negative lessons that have affected the achievement; and
2. to provide information to inform business management processes such as CFMPs, SMPs and strategic plans or set the stage for future evaluations.

Post-appraisal evaluation involves:

1. assessing whether the preferred solution satisfies the quality criteria set at the beginning of the project and during development of the environmental assessment and Stakeholder Engagement Plan (SEP). This includes consideration of why this appraisal was undertaken in the first place and whether it achieves what it set out to do, identifying any barriers that may have limited the process and particular actions which were critical to achieving the objectives;
2. assessing the quality of the appraisal process? including proportionality of effort, costs of appraisal and effectiveness of engagement;
3. developing future monitoring and evaluation requirements, based on assumptions and decisions made in the appraisal, to see if they turn out to be correct and if the expected benefits are realised. These assumptions and decisions will need to be used to decide how and when to act for managed adaptive solutions;
4. identification of lessons learnt; and
5. preparation of an evaluation report identifying how the appraisal performs against the quality criteria and project objectives summarising which

criteria have and have not been met. This report can be used to inform and improve future appraisal processes, guidance and decisions so it needs to be fully transparent and widely disseminated.

The remaining three evaluation stages would be undertaken at some time in the future. However, it is important to understand what action needs to be undertaken now to enable future evaluation to take place.

10.3 Post-implementation evaluation

The requirements for post-implementation evaluation will need to be set up as part of post-appraisal evaluation. Evaluation following implementation of the project is about learning lessons for the future rather than about making decisions to commit expenditure on particular projects. Evaluating the extent to which a solution for flood and coastal erosion risk management provides the benefits predicted in the options appraisal can be difficult. However, it can include consideration of:

- predicted versus actual costs to assess how far the cost and benefit calculations carried out for the appraisal have, following the decision to implement, been borne out in reality. It can be difficult to predict costs and benefits over 100 years, and because of the nature of the benefits from FCERM investment, it is very difficult to know whether the flood or erosion benefits from an investment are being fully realised. Only with hindsight stretching back 100 years can we know the answer to that question. However, it should be possible to evaluate benefits that would be delivered early on in the project, especially whether wider objectives have been delivered;
- time taken to implement the scheme;
- positive or negative impacts that actually occurred and the distribution of these impacts; or
- any innovative approaches used that could provide benefits to other projects, elsewhere.

It is essential that all outputs from the appraisal are fully transparent and auditable so evaluation of the project post-implementation and its outcomes can be undertaken.

10.4 Monitoring

Monitoring of the risks, existing defence and coast protection assets and how they are changing will also be important for strategies that take an adaptive or precautionary approach to climate change. See also Section 6.2 of Defra's policy statement (Defra, 2009). It is important to recognise monitoring needs once appraisal is complete so action can be taken to put the monitoring requirements into place.

The Operating Authority does not want to carry out monitoring exercises that are unlikely ever to be justified in appraisal/evaluation terms. It is important to identify ways to monitor that (a) enable the Operating Authority to meet its legal obligations cost-effectively and, also, (b) contribute in a cost-effective way towards post project evaluation needs.

Environmental monitoring involves continuous or regular periodic measurement and/or observation to determine the impacts of the implemented option. It may be required as consent and licence conditions associated with key legislation such as the Water Environment or Habitats Regulations. For example, there may be monitoring requirements associated with legislation or the consenting process or set out as part of the Environmental Management Plan. Any monitoring requirements should be identified through the environmental assessment process and may be stipulated as part of planning consent. The cost of monitoring should be built into the scheme costs where necessary. Any such obligations should be discharged as cost-effectively as possible.

10.5 Feeding information into future appraisals

FCERM plans (such as shoreline management plans (SMPs) and catchment flood management plans (CFMPs)) and strategies (like the Humber Estuary and the Thames Estuary 2100 Project) are intended as phased investment plans typically stretching out over 100 years. Generally, the expectation is that such plans and strategies will be revisited at regular intervals to take advantage of new information. Future information gained from post-implementation evaluation and from monitoring can be used to feed into policies, plans and strategies. This information can be used to provide updated data, an improved knowledge base on which decisions have been made and will assist with future reviews and revisions of the policies, plans and strategies. Such new information might consist of many different things including more/less rapid rates of sea level rise or better information about the consequences of climate change on fluvial flooding problems.

Glossary

[return to contents]

Above design standard damages
The damages from floods which exceed the design standard of protection (see also average annual damage).

Adaptation approach
An approach taken to deal with the effects of future change (such as climate change). The principle is to assess the potential impacts from different climate change scenarios and then develop strategies, where appropriate, which enable society to adapt in a planned and appropriate manner and rate. Particular consideration is given to land use and planning and to implementation of FCERM options that can be adapted in the future.

Average annual damage
Depending on its size (or severity), each flood will cause a different amount of flood damage. The average annual damage is the average damage in pounds (£) per year that would occur in a designated area from flooding over a very long period of time. In many years there may be no flood damage, in some years there will be minor damage (caused by small, relatively frequent floods) and, in a few years, there will be major flood damage (caused by large, rare floods). Average annual damage is calculated by estimating the probability of different damage values being experienced (in practice by determining the area under the damage-probability curve).

Annual exceedence probability (AEP)
The chance of a flood of a given size (or larger) occurring in any one year. It can be expressed as a percentage (such as 1%) or a chance of occurrence (for example, 1 in 100).

Appraisal
The process of defining the problem, setting objectives, examining options and weighing up costs, impacts (positive and negative), risks and uncertainties in order to make to a decision.

Appraisal Summary Table
A table that can be used to document the costs and impacts (positive and negative) of the options being appraised, including all assumptions and uncertainties, in such a way that it forms an auditable and transparent record.

Asset
Any property or object of value.

Glossary

Asset Management Plan	A tactical plan for managing an organisation's infrastructure and other assets to deliver an agreed standard of service. It is a living document that describes the future programme of assets activity and focuses on whole life management of assets. The asset activities should include planning, implementing, maintaining, operating, replacing or disposing of assets. Typically, it will cover more than a single asset, taking a system approach - especially where a number of assets are co-dependent and are required to work together to deliver an agreed standard of service. It provides a framework and support tools for systematic, consistent and evidence-based decision-making for the management, operation, preservation and enhancement of physical asset systems. BSi guidance [PAS 55-1:2008: Asset management. Specification for the optimized management of physical assets] sets the standard for AMPs.
Baseline	The set of current and future risk projections used as a benchmark for the analysis of the impact of different flood risk management options.
Beach nourishment	The process of artificially adding sediment to a beach.
Benefits	The positive quantifiable and unquantifiable changes that a project is expected to produce. It includes damages avoided.
Benefit-cost ratio	The total present value benefits divided by the total present value costs.
Climate change	A change in the state of the climate that persists for an extended period, typically decades or longer. Climate change may be due to natural processes or (directly or indirectly) to human activities that alter the composition of the atmosphere.
Coastal erosion	A process where material is worn away from the coast due to an imbalance in the supply and removal of matter. This covers the loss of natural or constructed coastal defences such as sand dunes and sea walls, as well as cliffs, land and intertidal areas.
Coastal squeeze	The process by which coastal habitats and natural features are progressively lost because they are prevented from migrating landwards in response to sea level rise.

Complex change project	A project that requires a strategic approach to address the extent, integration or interconnection of different areas. It includes projects that are required to implement strategic solutions, but where a strategy does not currently exist.
Contingent valuation method	Refers to the method of valuation used in cost-benefit analysis. It is conditional (contingent) on the construction of hypothetical markets, reflected in expressions of the willingness to pay for potential environmental benefits or for the avoidance of their loss.
Contributions	Funding from sources outside flood and coastal erosion risk management budgets.
Cost	The costs of a project including any capital and recurrent expenditure, administrative costs, monitoring and enforcement costs, and research and development costs. Cost savings (such as materials sales) should be treated as negative costs not as benefits. Similarly contributions should be treated as deductions from the costs.
Cost-benefit analysis	Comparison of present value benefits and costs as part of an economic appraisal.
Cost-effectiveness analysis	A technique which seeks to identify the least cost option for meeting a particular objective. It enables prioritisation between options, but ultimately does not assess whether an option is economically worthwhile.
Critical national infrastructure	The national infrastructure is the underlying framework of facilities, systems, sites and networks necessary for the functioning of the country and the delivery of the essential services which we rely on in every aspect of our daily life. There are nine sectors which deliver essential services: energy, food, water, transport, telecommunications, government and public services, emergency services, health and finance. Within these sectors there are key elements that comprise the critical national infrastructure. These are the components or assets without which the essential services cannot be delivered.
Damages	The value of negative social, economic and environmental impacts caused by flooding or erosion.
Damages avoided	Any damages that would not occur under an option when compared with the baseline (see benefits).

Glossary

Discount rate	An interest rate used to convert future streams of costs and benefits to their present value. It can be thought of as a social “interest rate”. The discount rate is established by HM Treasury for Government funded projects.
Discounting	A method used to convert future costs or benefits to present values using an appropriate discount rate.
Do-minimum option	An option where an operating authority takes the minimum amount of action necessary to maintain an asset.
Do-nothing option	An option used in appraisal to act as a baseline against which all other options are tested. It assumes that no action whatsoever is taken. In the case of existing works, it assumes for the purposes of appraisal that operating authorities cease all maintenance, repairs and other activities immediately. In the case of new works, it assumes that there is no intervention, and natural and other external processes are allowed to take their course.
Do-something option	Any option other than do-nothing.
Economic appraisal	An appraisal technique based on attaching money values to the costs and benefits of actions.
Ecosystem Services Approach	Provides a framework for looking at whole ecosystems in decision-making and for valuing the ecosystem services they provide, to help ensure that a healthy and resilient natural environment can be maintained, now and for future generations.
Emergency planning	The organisation of ways of dealing with large-scale incidents and disasters.
Engagement	Involving people in understanding and solving problems, using their input and insight to help make the right decisions.
Environment	An all encompassing term including a range of receptors which can be impacted such as: biodiversity; population; human health; flora; fauna; soil; water; air; climatic factors; material assets; cultural heritage including architectural and archaeological heritage; and landscape. The inter-relationship between these receptors characterises the environment in which we live.

Environmental assessment	The process whereby the effects of a set of options on the environment are identified, measured and assessed to determine their significance.
Environmental impact assessment (EIA)	A process set out in European and domestic legislation that must be followed when proposing specific types of work, including most forms of flood and coastal erosion risk management, where the environmental effects of the work are systematically considered and suggestions are made to mitigate any negative impacts.
Exit strategy	A plan to enable safe and permanent withdrawal of management intervention, where the on-going maintenance of an existing defence is no longer justifiable (costs significantly outweigh the benefits). It includes informing landowners, occupiers of the land and other interested parties of the operating authority's plan to withdraw maintenance. The information will help affected parties to deal with the change and circumstances in the most appropriate way.
External Funding	Investment from organisations and project partners which complements Grant in Aid (GiA) and income from charges and levies (see contributions).
Failure mechanism	Description of one of any number of ways in which a defence may fail to meet a defined performance threshold.
Flood cell	This refers to the self-contained unit or area which is vulnerable to flooding. The unit may be analysed individually since it is mostly independent of flooding within other cells. (compare with sediment cell).
Floods Directive	The European Directive on the Assessment and Management of Flood Risks (2007/60/EC of 23 October 2007) (the Floods Directive) is designed to help Member States prevent and limit floods and their damaging effects on human health, the environment, infrastructure and property. The Floods Directive came into force on 26 November 2007.
Flood risk	A combination of the probability and consequences of flooding.

Glossary

Flood risk management	The activity of understanding the probability and consequences of flooding, and seeking to modify these factors to reduce flood risk to people, property and the environment. This should take account of other water level management and environmental requirements, and opportunities and constraints. It is not just the application of physical flood defence measures.
Flood risk management measures	Structural and non-structural interventions that modify flooding and flood risk either through changing the frequency of flooding, or by changing the extent and consequences of flooding, or by reducing the vulnerability of those exposed to flood risks. Measures can be in isolation or in combination.
Flood storage areas	Areas that are important for the temporary storage of floodwaters during a flood.
Floodplain	Land adjacent to a river or coast that is periodically flooded or would be flooded in the absence of engineering interventions.
Fragility curve	A graph which gives the relationship between the load on a defence and the probability of the system failing.
Framework for Action	A vehicle for delivering works (typically interim works) before a strategy is implemented.
Freeboard	A factor of safety usually expressed as a height above the adopted flood level thus determining the flood planning level. Freeboard tends to compensate for factors such as wave action, localised hydraulic effects and uncertainties in the design flood levels.

Habitats Regulations Covers both the EC Birds (Council Directive 79/409/EEC) and Habitats Directives (Council Directive 92/43/EEC). The Birds Directive protects all wild birds, their nests, eggs and habitats within the European Community. It gives EU member states the power and responsibility to classify Special Protection Areas (SPAs) to protect birds which are rare or vulnerable in Europe as well as all migratory birds which are regular visitors.

The Habitats Directive builds on the Birds Directive by protecting natural habitats and other species of wild plants and animals. It gives EU member states the power and responsibility to Special Areas of Conservation (SACs). Together with the Birds Directive, it underpins a European network of protected areas known as Natura 2000. This network includes SPAs classified under the Birds Directive (SACs) classified under the Habitats Directive.

Historical flood A flood that has actually occurred.

Incremental benefit-cost ratio The ratio of the additional benefit to the additional cost, when two options are compared.

Indirect loss Losses caused by disruption of physical and economic linkages of the economy and the extra costs of emergency and other actions taken to prevent damages and loss beyond the immediate direct physical impact area.

Intangibles The costs, benefits and risks which are difficult to quantify but which are nevertheless relevant for the decision-making process. The term is usually applied to non-monetary impacts.

Main river Means a watercourse shown as such on a main river map and includes any structure or appliance for controlling or regulating the flow of water into, in or out of the channel which:
(a) is a structure or appliance situated in the channel or in any part of the banks of the channel; and
(b) is not a structure of appliance vested in or controlled by an internal drainage board.

Maintenance Maintenance and repairs do not change the defence or its performance, but simply maintain it in good working order or restore it to its previous condition in the event of a breakdown.

Maintenance costs	The costs of maintaining an asset so it continues to function as intended.
Managed adaptive approaches	Approaches that continually improve flood or erosion risk management by learning from the outcomes of previous actions, monitoring and research.
Managed realignment	The management of a process of establishing a new defence line, often set back from the existing position, with the aim of improving the long-term sustainability of the line, or contributing to other aims such as habitat creation. Managed realignment may be referred to as ‘managed retreat’ or ‘setback’.
Market value	The price at which an asset would change hands if it was sold on the open market.
Monte Carlo simulation	A numerical technique for assessing the probability of different outcomes from two or more variables.
Natural processes	Working with natural processes means taking action to manage flood and coastal erosion risk by protecting, restoring and emulating the natural regulating function of catchments, rivers, floodplains and coasts. This could, for example, involve using farmland to temporarily store flood water, re-instating washlands and wetlands to store flood water away from high risk areas or allowing cliffs to erode to provide sediment downdrift.
Net present value (NPV)	The discounted benefits minus the discounted costs.
No active intervention	Assumes that defences are not maintained (see do-nothing).
No regrets action	Actions taken to respond to perceived future change (such as climate change) impacts whose economic and environmental consequences will be beneficial (usually in the short-term) without imposing any long-term commitments.
Non-main river	Means a watercourse that does not form part of a main river.
Non-monetary impacts	Those impacts that cannot be directly measured in monetary units.

Non-structural option	Those flood management activities which are planned to eliminate or mitigate adverse effects of flooding without involving the construction of flow-modifying structures. For example, flood warning, emergency response plans, development control and floodplain management. It should be recognised that non-structural aspects can in fact involve structural work, in flood proofing, for example. However, such structural work is related directly to modifications to a flood-threatened structure to reduce or eliminate damage to it during a flood, as distinct from constructing structures specifically to modify or redirect flood flows.
Non-use value	The value which people hold for an environmental resource which is not attributable to their direct use of the resource for commercial or recreational purposes.
Operating authority	A body with statutory powers to undertake flood and coastal erosion risk management activities. This is usually the Environment Agency, local authority or internal drainage board.
Optimism bias	The demonstrated systematic tendency for appraisers to be over-optimistic about key project parameters, including capital costs, operating costs, works duration and benefits delivery.
Partner	A person or organisation that shares the decision-making responsibility and/or access to funds for the work. Partners will be key to accessing and using alternative (to GiA) sources of funding.
Post project evaluation	A procedure to review the performance of a project with respect to its original objectives and the manner in which the project was carried out.
Precautionary approaches	Approaches used to manage risk over the whole project life, often involving a one-off intervention at the earliest opportunity. Such approaches are usually adopted where it is not possible to adapt with multiple interventions on a periodic and flexible basis (such as where future adaptation may be technically infeasible or too complex to administer over the long term.
Precautionary principle	An approach which takes avoiding action based on the possibility of significant environmental or other damage, even before there is conclusive evidence that the damage will occur.

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Present value (PV)	The value of a stream of benefits or costs when discounted back to the present time at a prescribed discount rate.
Price index	A measure of the amount by which prices change over time. General price indexes cover a wide range of prices and include the Retail Price Index (RPI).
Probability	A statistical measure of the likely frequency or occurrence of flooding or erosion.
Project	A generic term for a strategy or a scheme.
Real option	An alternative or choice that becomes available through an investment opportunity or action. For example, designing an activity with the flexibility to upgrade in the future provides an option to deal with more (or less) severe climate change.
Real options analysis	A framework used to incorporate the uncertainty of climate change and the value of flexibility into decision making.
Return period	The average interval in years between events of similar or greater magnitude (for example, a flow with a return period of 1 in 100 years will be equalled or exceeded on average once in every 100 years). However, this does not imply regular occurrence, more correctly the 100-year flood should be expressed as the event that has a 1% probability of being met or exceeded in any one year.
Risk	A combination of both the probability of an event occurring and the expected consequences if it does occur.
Risk assessment	The understanding, assessing and interpreting of risk to inform decisions and actions in the risk management process.
Risk management	The complete process of risk assessment, appraisal and implementation of risk management measures.
Risk management measures	Actions taken to reduce the probability or consequences of flooding or erosion.
Robust	A decision is robust if the choice between the options is unaffected by a wide range of possible future scenarios.

Scenario (climate scenario or emissions scenario)	A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios are neither predictions nor forecasts.
Scenario analysis	The use of different scenarios or situations as inputs to a system or model to determine what outcomes may result from particular actions or happenings. Scenario analysis may be used to bring possible changes in variables like sea level rise into decision-making.
Scheme	The implementation of a risk management measure on the ground. It is normally the case that a scheme is identified as a consequence of a broad based investigation and has quite specific objectives.
Scoring and weighting	A technique used to support decision-making when there are a number of non-monetised or other impacts to be included in the cost-benefit analysis.
Sea level rise	The rise in sea level caused by thermal expansion of the oceans and to a lesser extent from melting of the ice caps and glaciers. Relative sea level rise refers to the effective change in sea level relative to the land surface and also takes account of long-term land movement.
Sediment cell	A length of coastline which generally does not import or export significant amounts of sediment, with the result that it can be analysed separately to adjacent cells (compare with flood cell).
Sensitivity analysis	The analysis of how an appraisal will be affected by varying the values of the important variables.
Simple change project	A project that does not require a strategic approach or one which cannot wait for development of a long-term strategy such that a smaller scale focus is appropriate.
Spatial planning	The way in which distribution of development and habitation is controlled through land use planning from the local to the international level.
Special Area of Conservation (SAC)	An internationally important site designated under the EU Habitats Directive.

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Special Protection Area (SPA)	Areas designated for rare or vulnerable birds or migratory birds and their habitats, classified under Article 4 of the EC Directive on the Conservation of Wild Birds.
Stakeholder	A stakeholder is any individual, group of individuals, organisation or political entity, including the public, interested in or affected by a decision to be made. They may be, or perceive that they may be, affected either directly or indirectly by the outcome of the decision.
Storm surge (or tidal surge)	The temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place.
Strategic environmental assessment (SEA)	A process set out in European and domestic legislation that must be followed to ensure that significant environmental effects arising from policies, plans and programmes are identified, assessed, mitigated, communicated to decision-makers, monitored and that opportunities for public involvement are provided.
Strategic framework	A planning structure which has been developed using strategic (high level) principles within which layers of consistent and interrelated plans and strategies can be developed.
Strategy	A combination of long-term goals, aims, objectives, technical measures, policy and processes.
Strategy plan	A documented strategy which is developed from a strategic study into a problem and describes the course of action which has been determined to implement the preferred policy option in a specific area.
Structural option	Flood and coastal erosion risk management interventions that are 'built' solutions. For example, flood storage, improvements to river channels, flood embankments, sea walls, groynes and pumping stations.
Sunk costs	A cost incurred in the past and which cannot be recovered whatever decision is taken now. Consequently, sunk costs are omitted from cost-benefit analysis.
Supported change project	A project which can draw on the data and results presented in a strategy such that the effort and resources required for the appraisal should be reduced.

Sustain standard of protection (SoP)	An option that responds to potential increases in risk from climate change, urban development and land use change into the future.
Sustain standard of service (SoS)	An option that will provide the same defence height, pumping regime or minimum beach level as designed but which does not respond to potential increases in risk from climate change, urban development and land use change into the future.
Sustainability in FCRM	The degree to which flood and coastal erosion risk solutions optimise the social, environmental and economic resilience in a way which is fair, affordable, and avoids tying future generations into inflexible and/or expensive options.
Switching point or switching value	The value that a particular attribute needs to have to switch the decision.
Tangibles	Those costs and benefits, which can be related to specific items of loss or expenditure, that can be quantified in monetary terms and for which there are accepted methods of valuation.
Transfer payment	A payment which has no impact in terms of an economic analysis. Examples are most tax payments and general subsidies.
Treasury Green Book	A publication of HM Treasury providing guidance to other public sector bodies on how proposals should be appraised, before significant funds are committed – and how past and present activities should be evaluated encouraging a thorough, long-term and analytically robust approach to appraisal and evaluation. It is relevant to all appraisals and evaluations.
Uncertainty	Comes from a lack of information, scientific knowledge, or ignorance and is characteristic of all predictive assessments.
Urbanisation	Process where an area, which may previously have been rural, is developed and becomes a built up environment.
Valuation	A method of applying a monetary value to positive and negative impacts.

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Water Framework Directive	The Water Framework Directive (WFD) (2000/60/EC) is designed to improve and integrate the way water bodies are managed throughout Europe. It came into force on 22 December 2000, and was put into UK law (transposed) in 2003. Member States must aim to reach good chemical and ecological status in inland and coastal waters by 2015.
Whole Life Costs	The total costs associated with a project for its full design and potential residual life span, taking proper account of all aspects of design, construction, maintenance and external impacts. It is particularly helpful when determining economic sustainability by comparing the relative costs of long life projects, such as those associated with flood and coastal erosion risk management and where decisions between short-term capital costs and long-term maintenance costs need to be made.
Willingness to pay (WTP)	The amount an individual is prepared to pay in order to obtain a given improvement in utility. For non-market goods and services like ecosystem services, generally determined through methods such as contingent valuation surveys.
Withdrawal	An option to stop maintenance, for example, where it is not economically viable, and where the consequences of stopping maintenance are managed through an exit strategy.

The glossary has been compiled from various sources including: Defra, IPCC, World Commission on Dams, OECD, Environment Agency, Centre for the Protection of National Infrastructure, HM Treasury, Foresight and Water Resources Act.

List of Acronyms [return to contents]

AA	Appropriate Assessment
AAD	Average Annual Damages
ABCR	Average Benefit-Cost Ratio
AEP	Annual Exceedence Probability
AMP	Asset Management Plan
AST	Appraisal Summary Table
BAP	Biodiversity Action Plan
BS	British Standard (see also BSi)
BSi	British Standard
CBA	Cost-benefit analysis
CEA	Cost-effectiveness analysis
CFMP	Catchment flood management plan
CHaMP	Coastal Habitat Management Plan
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EIA	Environmental impact assessment
EH	English Heritage
EMP	Environmental Management Plan
ER	Environmental Report
ES	Environmental Statement
IBCR	Incremental Benefit-Cost Ratio
IDB	Internal Drainage Board
FCDPAG	Flood and Coastal Defence Project Appraisal Guidance
FCERM	Flood and Coastal Erosion Risk Management
FCERM-AG	Flood and Coastal Erosion Risk Management Appraisal Guidance (this document)
FRM	Flood Risk Management
GIS	Geographical Information System
HAP	Habitat Action Plan
LA	Local Authority
LDF	Local Development Framework
MCH	Multi-Coloured Handbook
MCM	Multi-Coloured Manual
MSfW	Making Space for Water
PAG	Project Appraisal Guidance (usually abbreviated form of FCDPAG)
PAR	Project Appraisal Report
PPG15	Planning Policy Guidance (Planning and the Historic Environment)
PPG16	Planning Policy Guidance (Archaeology and Planning)
PPS25	Planning policy statement 25 (Development and Coastal Erosion)
RBMP	River Basin Management Plan
RFDC	Regional Flood Defence Committee
RHCP	Regional Habitat Creation Programme
ROAMEF	Rationale, Objectives, Appraisal, Monitoring, Evaluation, Feedback

List of acronyms

RPI	Retail Price Index
SA	Sustainability Appraisal
SAM	Scheduled Ancient Monument
SAC	Special Area of Conservation
SCI	Sites of Community Importance
SEA	Strategic environmental assessment
SEP	Stakeholder Engagement Plan
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline management plan
SOP	Standard of Protection
SOS	Standard of Service
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
StAR	Strategy Approval Report
STW	Sewage Treatment Works
SUDS	Sustainable Urban Drainage System
SWMP	Surface Water Management Plan
TAN15	Technical Advice Note (Development and Flood Risk (Wales)
TGB	Treasury Green Book
WAG	Welsh Assembly Government
WFD	Water Framework Directive
WLMP	Water Level Management Plan
WTP	Willingness to Pay

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