Integrating natural capital into flood risk management appraisal

Practical guide

September 2020

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- Heather Forbes – SEPA, NFM policy lead
- Helen Panter – SEPA, Flood appraisal policy lead

Glossary of key terms and anacronyms

The following key terms and anacronyms are used in this document.

Action, or **flood risk management action**	Terminology used within *Options appraisal for flood risk management; Guidance to support SEPA and the responsible authorities* (Scottish Government, 2016). An action may consist of a single intervention (e.g. build a storage reservoir) or could be two or more interventions, where the presence of one is essential to the success of another (e.g. demountable defences and flood warning system). See also "flood risk management measure".
AEP	Annual Exceedance Probability
Appraisal Guidance	Refers to the guidance within *Flood Risk Management (Scotland) Act 2009: Options appraisal for flood risk management: Guidance to support SEPA and the responsible authorities* (Scottish Government, 2016)**.**
B£ST	Benefits Estimation Tool released by CIRIA for the estimation of ecosystem services (CIRIA, 2019). It is a free tool that provides a structured approach to evaluating a wide range of benefits from blue-green infrastructure including SuDS and natural flood management.
BCR, or **benefit cost ratio**	The ratio of the present value of benefits to the present value of costs. If the ratio is greater than one, then the project is deemed to be viable.
Eligible costs	Local Authorities can only claim Capital Grant Funding for costs directly associated with the flood protection works (Scottish Government, June 2020). A local authority may add additional works such as public realm improvements to their scheme, but these additional costs do not attract flood element grant and should not be included when making returns for flood protection scheme grant allocation purposes.
ENCA	*Enabling a Natural Capital Approach* (DEFRA, 2020).
ESS, or **ecosystem service**	The benefits people obtain from ecosystems. These include provisioning services such as food and clean water; regulating services such as flood protection, carbon sequestration and disease control; cultural services such as recreation and wellbeing. Refer also to multiple benefits.

IBCR, or **incremental benefit cost ratio**	The ratio of the additional benefit to the additional cost, when two options with different standards of protection are compared.
Measure, or **flood risk management measure**	Terminology used within the Flood Risk Management Scotland Act 2009, includes formal flood protection schemes, natural flood measures and blended approach. See also “flood risk management action”.
Multiple benefits	Improvements to the environment or community occurring through a specific intervention or process that have more than one benefit. Refer to ecosystem services.
Natural capital	Stocks of the elements of nature that have value to society, such as forests, fisheries, rivers, biodiversity, land and minerals. Natural capital includes both the living and non-living aspects of ecosystems. Stocks of natural capital provide flows of environmental or ‘ecosystem’ services over time.
NFM, or **natural flood management**	Flood risk management techniques that aim to work with natural hydrological and morphological processes, features and characteristics to manage the sources and pathways of flood waters. These techniques include the restoration, enhancement and alteration of natural features and characteristics, but exclude traditional flood defence engineering that works against or disrupts these natural processes.
NPV, or **net present value**	Net Present Value is the value of all future cash flows (positive and negative) over the entire life of an investment discounted to represent the equivalent present value.
PV, or **present value**	The value in the present of a sum of money, in contrast to some future value it will have when it has been invested at compound interest.
SEPA	Scottish Environment Protection Agency.
Six capitals	The six capitals are stocks of value that are affected or transformed by the activities and outputs of an organisation. Categorised as financial, manufactured, intellectual, human, social and relationship, and natural.
SNH	Scottish Natural Heritage. Note that SNH changed its name to NatureScot after the initial drafting of this document.
SOP, or **standard of protection**	The frequency of flooding that a flood risk management measure is designed to protect against flooding.

Contents

1 Introduction

1.1 Background

The aim of this document is the provision of a clear and concise practical guide for Local Authorities and other stakeholders on the incorporation of multiple benefits in the form of natural capital and ecosystem services into Scottish flood risk management appraisals.

The short guide accompanies a larger study report: *Integrating natural capital into flood risk management appraisal – study report* (Mott MacDonald, 2020). The report details the development of the integration approach presented in this guide.

This practical guide and the accompanying report were developed as part of the Eddleston Water Project. The Eddleston Water Project is the Scottish Government's long-term study of the implementation and effectiveness of Natural Flood Management (NFM) measures to reduce flood risk, improve wetland habitats and to deliver multiple benefits in the Eddleston Water catchment. It is led by the Tweed Forum and has been undertaken with the support of the EU Interreg North Sea Region *Building with Nature* programme.

1.2 Applicability of this guidance

This guidance is to support the integration of multiple benefits in the form of natural capital and ecosystem services into the current flood risk management decision-making process. The guidance is not limited to NFM and the methodology should also be suitable for traditional flood risk management measures thereby allowing the holistic appraisal of all flood risk management measures using a single consistent methodology.

The primary guidance detailing the current flood risk management decision-making process is outlined in '*Options appraisal for flood risk management: Guidance to support SEPA and the responsible authorities'* (Scottish Government, 2016). This guide does not supersede the Scottish Government's guidance, it is intended to supplement and expand the Government's guidance. Similarly, this guidance does not supersede or replace the existing B£ST guidance. For information on the use of B£ST please refer to *W047b B£ST Guidance* (CIRIA, 2019).

The application of the recommendations of this guidance on how to integrate multiple benefits in the form of ecosystem services and natural capital into flood risk management appraisals requires input and oversight by practitioners experienced in ecosystem services and flood risk appraisal. It is the responsibility of the practitioners to check that the generated output is sensible and correct. There is no stipulation that the recommendations of this guidance must be used, and appraisals should be conducted using the means deemed most appropriate by the experienced practitioners in consultation with a wide range of stakeholders.

1.3 Estimation of ecosystem services using B£ST

As concluded in the *Integrating natural capital into flood risk management appraisal – study report* (Mott MacDonald, 2020), B£ST (CIRIA, 2019) was deemed the most appropriate method for the assessment and quantification of ecosystem services associated with flood risk management projects. B£ST offers the following advantages:

- It is open access and does not require any specialist software
- It is provided with comprehensive guidance (CIRIA, 2019)

- It includes screening and coarse assessment modules which can be incorporated early within the option appraisal process to help set objectives and to provide initial or high-level results
- It maps value change across all six capitals:
  - Natural
  - Social and relationship
  - Human
  - Intellectual
  - Manufactured
  - Financial
- It is in line with good practice including appraisal guidance (HM Treasury, 2018) and consistent with other approaches in the sector
- It includes a comparison tool that enables the comparison of more than one option within an assessment
- It is easy to use and the most well-known tool within the target user community
- It is not a single release and it should be updated in the future

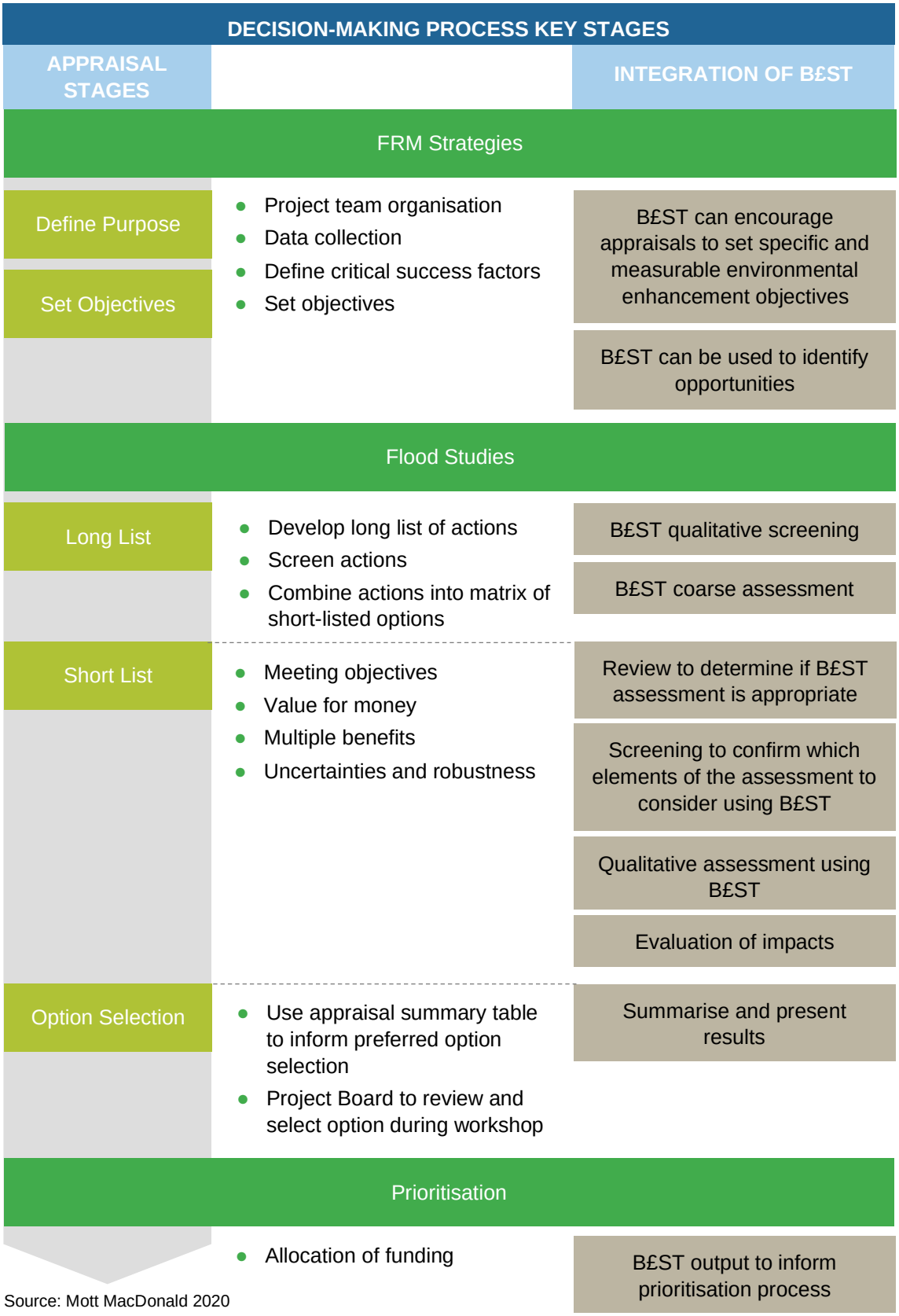
B£ST can be applied at differing stages of the flood risk management design and planning process, from strategic assessment to optioneering and implementation. However, its usefulness and effectiveness will be greater the earlier in the decision-making process it is applied.

The B£ST guidance (CIRIA, 2019) splits the assessment process is split into five stages:

- Review to determine if an assessment is appropriate
- Screening to confirm which elements of the assessment are appropriate
- Qualitative assessment
- Evaluation of impacts
- Summarise and present results

The integration of the five stages into the Scottish flood risk management decision-making process is summarised in Figure 1.1.

Figure 1.1: B£ST integration into the flood risk management decision-making process



Source: Mott MacDonald 2020

1.4 Assessment preparation

Prior to using B£ST to analyse natural capital and ecosystem services, several preassessment steps are suggested to ensure consistency in approach and to prevent delays during the detailed assessments.

- Assessment team – Section 1.4.1
- Familiarisation and competency using B£ST – Section 1.4.2
- Data collection – Section 1.4.3

1.4.1 Assessment team

It is recommended that the appraisal using B£ST is not undertaken in isolation by a single individual and instead an effective assessment requires collaboration across a range of technical disciplines. This should ensure appropriate expert knowledge of all project areas allowing key issues and potential opportunities to be captured within the assessment. Box 1-1 provides suggested team roles for appraisals.

The team may not be in one organisation. It is therefore important that a suitably flexible relationship is in place to allow collaboration and shared ambition between team members.

Box 1-1: Team skills might include

- Project manager with understanding of the project partners, suppliers, funding, programme and risks
- Ecosystem services specialists
- Environmental scientists and ecologists
- Flood risk management specialists including support from hydrologists, hydraulic modellers geomorphologists and engineers
- Quantity surveyors and/or suppliers
- Stakeholder engagement specialists

1.4.2 Familiarisation and competency using B£ST

The team undertaking the assessment should be competent in using B£ST, have suitable appraisal experience, be capable of identifying erroneous results and be sufficiently competent to take corrective action. Familiarisation of the CIRIA B£ST tool, ideally under the supervision of an experienced practitioner, should be undertaken prior to its use within a project to avoid errors. Clear guidance is provided within the tool itself and within *W047b B£ST Guidance* (CIRIA, 2019). As a minimum, users should understand the tool's data requirements, have a grasp of the overall workflow and be able to critically review the tool's outputs. There are various online examples and recorded training videos which may provide useful training resources (Box 1-2).

Box 1-2: Training material

- Online training webinar *https://www.youtube.com/watch?v=Dm5wrmCJoC4&list=PLinYZSz1gzVV8C62jTIloOFn7br8s7Xbw*
- Case studies and examples *https://www.susdrain.org/resources/best.html*

1.4.3 Data collection and baseline assessments

Local Authority flood study checklist (SEPA, 2018) highlights that it is essential that existing relevant data is collated ahead of all flood risk management appraisals. This ensures that the best available information can be included within the assessment to limit the need for large assumptions and uncertainties. Readers are directed to follow Section 3 of the checklist during the preparation phase. Key datasets are listed below.

- Local (catchment) flood history
- Survey and site visit

- Flood defence asset survey
- Community surveys
- Landowner/title searches
- Public utility searches
- Ecological and environmental surveys
- Survey/ground-truth of receptors at risk

To facilitate the use of B£ST it is recommended that the following datasets are collated in addition to the flood study checklist:

- Formally defined appraisal extent – typically the catchment boundary
  - Can be defined using GIS software, based on a pre-existing outline (e.g. Potentially Vulnerable Area) or manually drawn using alternative tools such as Google Earth
- Baseline land cover and land use information
  - *Habitat Map of Scotland* (Scottish Natural Heritage, 2017)
  - Land Cover Map
  - Aerial photography (various sources)
  - Ordnance Survey mapping
  - *Global Heat Map* (Strava, 2020)
  - *Global Land Survey* (Copernicus, 2020)
  - *Land Capability Map* (James Hutton Institute)
  - *Farm Structure Survey* (Eurostat, 2020)
- Existing cultural heritage and environmental designations
- Existing national flood datasets
  - *NFM opportunity maps* (SEPA, 2014)
  - Fluvial, coastal and surface water flood maps (SEPA, 2014)
  - *Baseline receptor data* (SEPA, 2018)
- River Basin Management Plan including breakdown of existing water body status from the *Water Environment Hub* (SEPA, 2020)
- Baseline socioeconomic setting of study area
  - Local Development Plan e.g. *Scottish Borders Approved Local Development Plan* (Scottish Borders Council, 2016)
  - *Official Government Statistics* (Scottish Government, 2020), providing location specific dashboard data on:
    - Access to key services
    - Crime and justice
    - Economic activity, benefits and tax credits
    - Education
    - Health and social care
    - Demographics, births and death
    - Scottish Index of Multiple Deprivation
    - Access to public transport
  - Tourism and recreation data
    - Visitor data (Visit Scotland, 2020)

1.5 Limitations of B£ST

B£ST has a number of limitations which can be addressed as outlined in the text below.

1.5.1 Absence of a spatial element

There is currently no published approach for displaying the output of B£ST spatially, this will limit the ease of understanding of the results. The following approaches could be used if it is deemed desirable by the project team to communicate the results spatially:

1. Using GIS polygon features, representing the location of NFM measures, can be attributed with the appraised B£ST benefit types. Monetised benefits for each category generated by B£ST can then be area weighted over the features and the results displayed using an appropriate GIS display style. The categories could be mapped to the six capitals using the distribution weightings available in B£ST's "Capitals distribution" tab.
2. There is no requirement to use only B£ST. The *Enabling a Natural Capital Approach* (DEFRA, 2020) (ENCA) facilitates the appraisal of natural capital by habitat type. This alternative method can therefore be used to create maps of natural capital. It should be noted that the ENCA method is a more complex approach to apply.

At the time of writing CIRIA has recently announced plans (CIRIA, 2020) for the next release of B£ST to include "an integrated GIS user interface" to account for the spatial variation in benefits. Future users of this guidance interested in the spatial variation of benefits should investigate if the planned release is available and suitable for their needs.

1.5.2 Limited opportunity for supporting opportunity identification

B£ST does not include a specific tool for identifying opportunities as it lacks the capability to assess the total baseline natural capital. Instead, B£ST enables the appraisal of the change in natural capital. The screening tool within B£ST can be used as an effective prompt sheet for identifying opportunities allowing project teams in combination with stakeholders to review whether it would be practical to incorporate additional elements to the options to deliver additional benefits. The ENCA approach reported above could alternatively be used to generate maps of the total natural capital allowing areas of deficit, and hence opportunities, to be identified.

1.5.3 Omission of in-built tools to assess peatland and woodland carbon sequestration

B£ST does not contain a uniform approach for the incorporation of carbon sequestration values from different sources. The sequestration benefits from floodplain creation/restoration (CS3) are calculated within the tool using the Zhetner *et al* methodology (Zehetner, F., Lair, G.J. & Gerzabek, M.H, 2009). However, the current release of B£ST does not include a specific internal methodology for the calculation of carbon sequestration associated with land cover types such as woodland or peatland. These values must be sourced from external calculators and tools and integrated into the assessment. Further guidance is provided in Section 2.3.3 on suitable external tools and how they should be incorporated into the appraisal.

1.5.4 Incorporating more detailed or locally derived information

B£ST makes provision for the incorporation of alternate information where it is available allowing practitioners to utilise more detailed information where it is available. For example, more detailed information could be obtained from existing or new site studies and surveys, past projects information, or organisation studies such as a natural capital asset register for their

region. Relevant local level data can supplement the national datasets already in B£ST to provide a more comprehensive and location-specific assessment.

1.5.5 Non-Scottish data

B£ST was developed for use across the UK and therefore references English and Welsh data in addition to Scottish sources. As a consequence, the B£ST guidance and tool terminology sometimes deviate from that used in Scotland and in some appraisal modules omits to provide users with options to select Scottish locations. It is necessary for users to select appropriate donor locations from those available from England and Wales that match the geographical and socio-economic setting of the project. Further detail on selecting donor locations is provided in Section 2.3.3.3 and more general guidance on applying valuation evidence to a new area can be found within Section 2.4 of the *Enabling a Natural Capital Approach Guidance* (DEFRA, 2020).

2 Methodology

2.1 Project framing stage

2.1.1 Defining the purpose

In accordance with Scottish Government *Options appraisal for flood risk management: Guidance to support SEPA and the responsible authorities* (Scottish Government, 2016), an appraisal should start with a clear description of the problems to be tackled. At this stage in the appraisal, the strategic case for change and scope for the project should be established by the project board. In doing so, the project board should define clear boundaries for the project by defining what constitutes project failure via the use of Critical Success Factors. *Flood and coastal erosion risk management business case guidance* (Welsh Government, 2019) provides guidance on setting Critical Success Factors that are crucial to the successful delivery of the project. In this respect Critical Success Factors differ from Objectives, which identify aspirational outcomes.

Box 2-1: Example Critical Success Factors

Strategic Fit & Business Needs Must fit with the local flood risk management plan.

Economic The benefits must exceed the costs.

Supplier Capacity & Capability Must match the capacity of potential suppliers to deliver.

Potential Affordability Can be funded from available resources.

Achievable Must be possible to deliver and maintain.

2.1.2 Setting the objectives

Scottish Appraisal Guidance highlights the importance of considering objectives and opportunities for delivering multiple outcomes early in the process (Scottish Government, 2016). Objectives should be SMART.

Local scale flood risk management actions should be developed in the context of the wider objectives and actions set out in the Flood Risk Management Strategies as well as other non-flood related strategies.

Box 2-2: Make an objective SMART

- Specific
- Measurable
- Attainable
- Realistic

Box 2-3: Example SMART Objectives

Maximise the Present Value of sum of flood damages avoided and other multiple benefits within the 100-year period 2022 – 2121

Improve the Water Framework Directive status of water body (123456789) by 2027

B£ST could be used to set specific and measurable objectives for the delivery of multiple benefits alongside more traditional flood risk management objectives. The screening tool can be used as a prompt list to explore opportunities for delivering multiple benefits in addition to flood damages avoided. Appraisal teams should work through the B£ST screening questions to identify specific opportunities and the quantitative B£ST tools can be used to define performance measures.

2.2 Long list appraisal

The Scottish Government Appraisal Guidance details how long list screening of actions should be undertaken. The long list phase comprises of three sub-steps:

1. Generation of a list of all potential flood risk management actions

Annex 2 of the *Local Authority flood study checklist* (SEPA, 2018) provides a suggested list of structural and non-structural flood risk management actions. This list represents a basis for the identification of flood risk management actions.

2. Screening the list of actions

Following the principles outlined in Section 5.2 of the *Local Authority flood study checklist* (SEPA, 2018) the long list of actions should be screened to create a more manageable list of actions by considering the objectives, technical, economic and legal feasibility. The screening process should consider wider impacts and should not be limited to benefits local to the interventions. B£ST incorporates a number of levels of assessments each targeted at different project scales and needs. The most basic rapid qualitative screening approach is suitable for screening the long list of actions. The screening tool criteria can be incorporated into the screening criteria to efficiently test the long list of actions allowing the decision process to be robust, repeatable and documented.

A long list screening summary table should be used to record the screening outcome including reasons for rejection. Actions should be appraised on how they might contribute to a currently undefined collection of actions grouped together to form an option and not in isolation. A weighted scoring system can be developed based on the critical success factors and objectives to help rank and eliminate actions.

In some appraisals it may be appropriate to use the B£ST quantitative “coarse assessment” to help objectively score the range of potential benefits at long list stage. It is based on concise questions, responses to which are linked to quantified variables and monetary estimates that are combined to produce an overall value using ten benefit categories.

3. Combining actions to form options

The various flood risk management actions should be brought together into a matrix to formulate the short list options. The actions should be grouped to form options that deliver all critical success factors and maximise the delivery of objectives. Table 2.1 presents an example matrix of options arising from a long list appraisal. The matrix considers ‘in town’ actions in combination with a range of catchment actions. It is acknowledged that the grouping of actions is a complex process, for example adding an uneconomic action to economic may or may not result in an economic option. It will be necessary to undertake the grouping of actions using the best available information, this will include experienced based assumptions. Projects should make provision for the iterative nature of screening actions, the formulation of options and the short list appraisal. The short list should include the Do Nothing and the Do Minimum baseline comparator options. Table 2.1 presents the formulation of a short list of six options, once an adequate range of options encompassing a range of protection strategies, project objectives and defence standards are considered it may be appropriate to consider more than six options.

Table 2.1: Matrix of action combinations to form options based on the critical success factors and objectives

	Maintain the legal minimum	Maintain existing assets	In Town action 1	In Town action 2	In Town action 3	Engineered storage action 4	NFM action 5	NFM action 6
CSF1	X	X	✓	✓	✓	X	X	X
CSF2	X	✓	X	✓	X	✓	✓	✓
CSF3	✓	✓	X	✓	✓	✓	X	X
Objective1	X	X	✓	✓	✓	✓	X	✓
Objective2	X	X	X	✓	X	X	✓	✓
Option 1 Do Nothing	✓	X	X	X	X	X	X	X
Option 2 Do Minimum	X	✓	X	X	X	X	X	X
Option 3	X	✓	✓	X	X	X	✓	X
Option 4	X	X	X	✓	X	X	X	✓
Option 5	X	✓	✓	X	✓	X	✓	✓
Option 6	X	✓	✓	X	✓	✓	✓	X

Source: Mott MacDonald

2.3 Short list appraisal

The Appraisal Guidance (Scottish Government, 2016) outlines how short list appraisal is used to identify the most sustainable option via the subjective consideration of four criteria as defined below.

- Meeting objectives – Section 2.3.1
- Best value for money– Section 2.3.2
- Delivery of multiple benefits– Section 2.3.3
- Uncertainty and robustness– Section 2.3.4

Appraisal summary tables, as described in Section 2.3.5, should be used to support the consideration of the four criteria and to record the justification for the preferred option selection.

2.3.1 Meeting objectives

Throughout the short list process the options will be progressively developed to “concept deign” level. As the phase progresses the short list options should be reviewed against the project critical success factors and objectives to confirm that the project is on track to deliver success and where necessary allowing corrective action to be taken. Corrective action could be formally dropping an option that will no-longer meet all critical success factors or by supplementing an option with an additional action to address a potential shortcoming.

Where appropriate, the B£ST methods presented in Section 2.2 and Section 2.3.3 can be used to review alignment with the critical success factors and objectives.

2.3.2 Best value for money

The benefits used in an assessment of best value for money should be limited to flood damages avoided. Similarly, the costs used should be limited to "eligible costs" (Scottish Government, June 2020). The maximisation of all benefits relative to all costs is considered separately via multiple benefits in Section 2.3.3.

Economic analysis should be undertaken following the Appraisal Guidance (Scottish Government, 2016) using the Benefit-Cost Ratio, Net Present Value and Incremental Benefit Cost Ratio. The whole life costs and benefits should be discounted to create Present Values in compliance with current guidance (HM Treasury, 2018). A consistent appraisal extent, appraisal baseline and appraisal period should be used so that like is compared with like.

B£ST incorporates rapid approaches to facilitate the estimate of benefits relating to flood damages avoided however it is anticipated that these would rarely be used, with the industry standard Multi Coloured Handbook (Flood Hazard Research Centre, 2020) remaining the recommended approach.

As such B£ST is not expected to play a role in this part of the appraisal.

2.3.3 Delivery of multiple benefits

Multiple benefits should be considered within a supplementary cost benefit analysis considering all option benefits (sum of "multiple benefits" and flood damages avoided benefits) relative to all costs. In most cases the use of B£ST would permit all significant benefits to be monetised in line with the 10% significance threshold provided within the Appraisal Guidance allowing the Benefit-Cost Ratio, Net Present Value and Incremental Benefit Cost Ratio to be considered when selecting the preferred option. Where project teams determine that all significant benefits cannot be monetised, a scoring and weighting approach (Department of Communities and Local Government, 2009) should be used.

Box 2-4: Suggested filing structure

- Appraisal summary table
- Costs
- Flood damages avoided
- Multiple benefits
- V1
  - V1_Option 1.xlsm
  - V1_Option 2.xlsm
  - V1_Comparison.xlsx
  - Sensitivity testing
- V2
  - V2_Option 1.xlsm
  - V2_Option 2.xlsm
  - V2_Comparison.xlsx
  - Sensitivity testing

The B£ST guidance (CIRIA, 2019) provides comprehensive instruction on how to analyse ecosystem services using B£ST and it is recommended that it is referenced throughout the assessment. It is recommended that the analysis is undertaken by a team of practitioners following the collation of data and baseline assessments as suggested in Section 2.1. In most cases the analysis will be an iterative process as the concept designs are developed and better quality information becomes available.

Each option will require its own B£ST excel file with additional copies made for sensitivity testing. A suggested filing structure is presented in Box 2-4.

It is recommended that a benefits report is prepared to facilitate the communication of key assumptions and findings. The B£ST analysis files should form appendices to the report.

When appraising multiple benefits using B£ST alongside flood damages avoided, it is essential that consistent appraisal options, appraisal periods, discount rates and appraisal extents are used to enable a fair test. The

appraisal period and appraisal date for estimating multiple benefits should match that used to estimate flood damages avoided and for costs. The current version of B£ST prevents some categories being appraised over a 100 year period forcing a misalignment of appraisal periods. It is hoped that this will be addressed in later revisions of the tool however it is anticipated that in a majority of cases the effect of discounting on distant future benefits would mean that the omitted benefits would not have a significant impact on the appraisal. The values reported in B£ST are in 2017 prices, the GDP Deflator (HM Treasury, 2020) should be used to convert to a consistent time period.

To support good decision-making it is important that all costs associated with achieving the benefits are considered. When assessing multiple benefits these costs may be different to costs that are eligible for capital grant funding, for example the cost of constructing or maintaining a footpath network which is necessary to deliver amenity and health benefits.

2.3.3.1 Additional guidance on assessing carbon benefits

The assessment of carbon sequestration by woodland is undertaken using a separate tool (Woodland Carbon Code, 2020) with the estimated sequestered carbon entered into B£ST. It is anticipated that in most cases the Woodland Carbon Code's "*Small Project Carbon Calculator*" will provide adequate data. It should be assumed that 1 PIU (Pending Insurance Unit) equals 1 tonne carbon dioxide equivalent.

Alternative sources for evidence of carbon sequestration rates include the *UK Peatland Code* (ICUN, 2017), *Calculating potential carbon losses and savings from wind farms on Scottish peatlands* (SEPA, 2020) and the *Natural England Research Report NERR043: Carbon storage by habitat* (Natural England, 2012), these sources should be reviewed to find the most appropriate evidence source.

Manually calculated sequestered carbon should be manually added to the B£ST workbook within CS04. The 5-yearly cumulative carbon sequestered table should be populated to estimate the ESS benefit across the appraisal period.

2.3.3.2 Additional guidance on assessing water environment benefits

The water quality and quantity of water assessments provide support to estimate the impact on the water environment. It is based on the expected change in water quality for the principal water body. This should be aligned with the Water Framework Directive (WFD) classification (e.g. poor to moderate, moderate to good) and based on the descriptions of status shown in Appendix E of the B£ST guidance (CIRIA, 2019) (from Environment Agency (2013)).

Note, B£ST considers the improvement in six separate components. The components include:

- Fish – assessed within water quality
- Other animals such as invertebrates – assessed within water quality
- Plant communities – assessed within water quality
- The clarity of water – assessed within water quality
- The condition of the river channel and flow of water – assessed within quantity of water
- The safety of the water for recreational contact – assessed within water quality

The assessment of the components can be informed by the relevant WFD parameters reported in the *Water Classification Hub* (SEPA, 2020). The full water body length (or area) should be considered when assessing changes and not just the physical length of the works.

Where a partial improvement of a water body is expected, the quantity confidence score within B£ST can be used to claim a proportion of the benefit, or alternatively a fraction of the water body length can be used. Where a water body is expected to increase from Poor to Good it is necessary to enter two improvements, one from Poor to Moderate and a second from Moderate to Good.

2.3.3.3 Guidance on incorporating local data and selecting appropriate English donor sites

It is acknowledged that B£ST contains a finite number of valuation sources for ecosystem services and this is predominately focused within the urban environment. B£ST enables users to supplement or replace the standard monetisation values from within the library with user defined values if required. It is advised that the list of sources is reviewed and assessed for its suitability to the project study area. Where more accurate or applicable data sources are available it is suggested that these are used within the benefit monetisation assessment.

Whilst the tool can, with appropriate input information, provide indicative values of the benefits of blue green infrastructure, it allows the use of site-specific, locally derived values, for example, from visitor surveys, local charges or water company willingness to pay (WTP) surveys. It is possible to add in these values in the 'values library' that accompanies the tool, and which includes full details of all the valuation evidence used. In general, locally derived and site-specific quantities and values will provide a more accurate and robust assessment.

Further guidance on transfer values in ecosystem services assessment is provided in within section 2.4 of the *Enabling a Natural Capital Approach Guidance* (DEFRA, 2020).

When appraising benefits relating to the water related environment (water quality "WQ" and water quantity "QW1") it is necessary to select an appropriate WFD river basin from a pre-defined list. Unfortunately, in the current release of B£ST the list only contains English and Welsh catchments. For projects in the Solway-Tweed, the Solway-Tweed can be selected. For all other areas it is necessary to select an appropriate donor site. For projects in the central belt the Humber or North West basins could be appropriate donors. Projects in the highlands and islands could adopt the West of Wales or the Solway-Tweed basins as donors.

2.3.4 Uncertainty and robustness

Sensitivity testing should be conducted to test the uncertainty and robustness in the appraisal of options. Sensitivity testing should be applied to both the estimation of costs and benefits (including flood damages avoided and multiple benefits). The uncertainty and robustness testing principles outlined within the Appraisal Guidance (Scottish Government, 2016) should be followed when incorporating output from B£ST into an appraisal.

Section 6 of the B£ST guidance (CIRIA, 2019) details how uncertainty can be considered and the tool's in-built functionality for undertaking sensitivity tests. The tool considers uncertainty in two ways for monetised benefits:

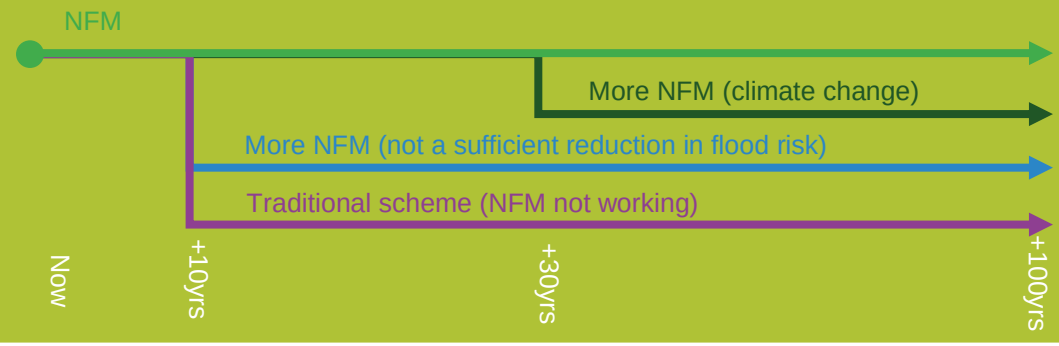
- Ranges of quantitative estimates and monetary values are permitted
- User-defined confidence scores relating to both quantified estimates and monetary values

The use of ranges and confidence scores helps to ensure outputs are repeatable, reliable and consistent with expectations. Where appraisal outcomes are sensitive to key assumptions, particularly for greater investments, it may be appropriate to adopt more complex techniques to assess the uncertainty and manage its consequences on the decision process. Section 1.4 details how better local data can be incorporated into assessments using B£ST. The 10% principle is a useful guide for supporting where more accurate data is appropriate. Should an

improved analysis not be expected to change the estimated total benefits by more than 10% (informed by sensitivity testing) and not change the preferred option, then it is not normally justified to undertake further analysis.

Although not part of B£ST, tools such as Monte Carlo Analysis and Adaptive Pathways can be used to manage uncertainty. The probabilistic Monte Carlo Analysis approaches commonly used for managing cost uncertainty can also be used to manage benefit uncertainty allowing the 25th, 50th and 75th percentile whole life benefits to be reported for example. Adaptive Pathways (ClimateXChange, 2020) are commonly used to manage climate change uncertainty, the approach can also be used to define a range of "what-if" scenarios for flood risk management schemes that incorporate NFM.

Box 2-5: Using Adaptive Pathways with NFM



2.3.5 Appraisal summary table

An appraisal summary table should be used as a framework for systematically describing, valuing and, where possible, monetising the positive and negative impacts of options. The table should transparently identify which impacts have been monetised and which have not. Table 2.2 presents an example summary appraisal table.

Table 2.2: Example appraisal summary table summarising the leading options

Benefit category	Option 1	Option 2	Option n
CRITERIA 1 – Meeting the objectives			
Critical success factor 1	X/✓	X/✓	X/✓
Critical success factor 2	X/✓	X/✓	X/✓
Meets objective 1	X/✓	X/✓	X/✓
Meets objective 2	X/✓	X/✓	X/✓
Meets objective 3	X/✓	X/✓	X/✓
Objectives and critical success factor comment	Meets all/most/none of the objectives	Meets all/most/none of the objectives	Meets all/most/none of the objectives
CRITERIA 2 – Assessing best value for money			
Whole life cost (£k)	£	££	£££
Flood damages avoided (£k)	£	££	£££
Value for money BCR	#.##	#.##	#.##
Value for money NPV (£k)	£	££	£££
Value for money rank	n^{th}	n^{th}	n^{th}
CRITERIA 3 – Assessing multiple benefits			
Air quality (£k)	£	£	£
Amenity (£k)	£	£	£
Biodiversity and ecology (£k)	£	£	£
Carbon reduction and sequestration (£k)	£	£	£
Education (£k)	£	£	£
Flows in watercourse (£k)	£	£	£
Health (£k)	£	£	£
Recreation (£k)	£	£	£
Total multiple benefits (£k)	£££	£	£££
Total benefit (£k)	~~££££~~	~~£££~~	~~£££££~~
Total benefits BCR	#.##	#.##	#.##
Total benefits NPV (£k)	~~££££~~	~~£££~~	~~£££££~~
Commentary or rank of non-monetised benefits	n^{th}	n^{th}	n^{th}
CRITERIA 4 – Managing risk and uncertainty			
Commentary on risk and uncertainty	Comment on risk and uncertainty	Comment on risk and uncertainty	Comment on risk and uncertainty
Preferred option selected by the Project Board	**This table should be presented to the Project Board at the Preferred Option Selection Workshop where the Board will review and select the Preferred Option based on their consideration of the four criteria. The justification for their selection should be recorded here.**		

Source: Mott MacDonald 2020

2.4 Prioritisation

Outputs from the B£ST assessment may be used to support funding bids, e.g. Capital Grant Funding from the Scottish Government.

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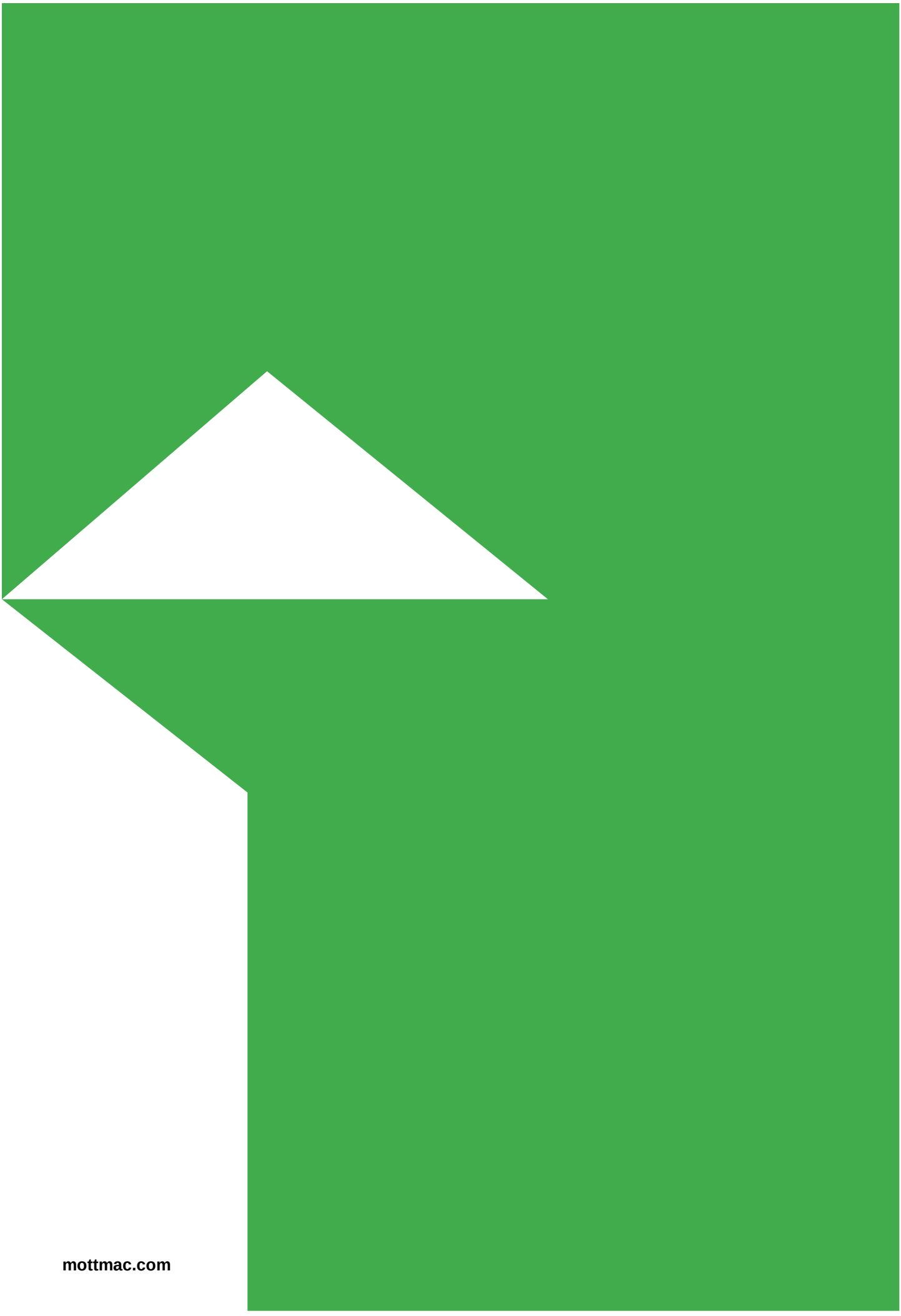

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