



Environment
Agency



A review of skills and guidance in flood and coastal risk management benefit cost assessment

Appendix B: user guide for early calculations of potential scheme benefits

Date: April 2021

Version: FRS18201 Appendix B

We are the Environment Agency. We protect and improve the environment.

We help people and wildlife adapt to climate change and reduce its impacts, including flooding, drought, sea level rise and coastal erosion.

We improve the quality of our water, land and air by tackling pollution. We work with businesses to help them comply with environmental regulations. A healthy and diverse environment enhances people's lives and contributes to economic growth.

We can't do this alone. We work as part of the Defra group (Department for Environment, Food & Rural Affairs), with the rest of government, local councils, businesses, civil society groups and local communities to create a better place for people and wildlife.

Published by:

Environment Agency
Horizon House, Deanery Road,
Bristol BS1 5AH

www.gov.uk/environment-agency

© Environment Agency 2021

All rights reserved. This document may be reproduced with prior permission of the Environment Agency.

Further copies of this report are available from our publications catalogue: www.gov.uk/government/publications or our National Customer Contact Centre: 03708 506 506

Email: enquiries@environment-agency.gov.uk

Contents

Benefits tool decision tree.....	4
The Weighted Annual Average Damage (WAAD) Estimation tool.....	5
User guide	5
What is WAAD and when should I use it?	5
Step 1: Gather and edit input data.....	6
Step 2: Estimate properties currently at risk	6
Step 3: Estimate properties remaining at risk	8
Step 4: Interpret the results	8
Simplified benefit:cost appraisal tool (BCA).....	11
User guide	11
What is BCA and when should I use it?.....	11
Step 1a: Gather and edit input data.....	12
Step 1b: Estimate property numbers and depth of flooding.....	13
Step 2: Assign depth-damage values	14
Step 3: Calculate discounted annual averages	15
Step 4: Add scheme costs.....	16
Step 5: Interpret the results	17
Glossary.....	19
Step 1 key terms.....	19
Step 3 key terms.....	19
Step 4 key terms.....	19
Would you like to find out more about us or your environment?	20
incident hotline.....	20
floodline	20
Environment first.....	20

Benefits tool decision tree

The decision tree shown in Figure 1 can be used to decide which tool is appropriate for your situation, based on the level and detail of data available. The user guides that follow will help users estimate the benefits from flood and coastal erosion risk management (FCERM) schemes as damages avoided, using either the Weighted Annual Average Damages tool or the Benefits:Cost Assessment tool.

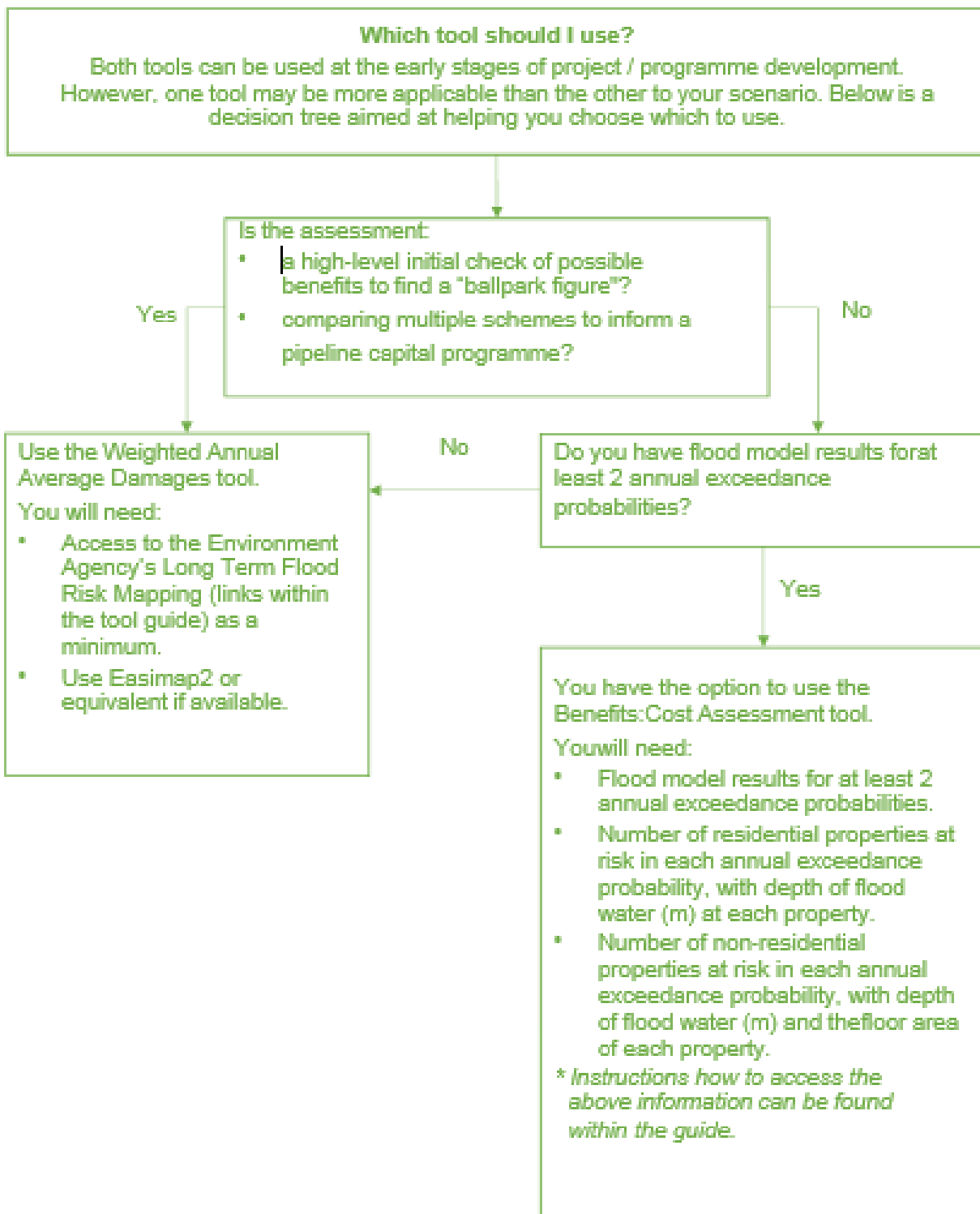


Figure 1 Benefits tool decision tree

The Weighted Annual Average Damage (WAAD) Estimation tool

User guide

This user guide provides step by step instructions for using the Weighted Annual Average Damage (WAAD) Estimation Tool. This tool is provided in the Multi-Coloured Manual (MCM) for calculating benefits from FCERM schemes. The user guide is for beginners in benefits appraisal or those who have not used the WAAD tool before.

The tool can be used to understand the overall viability of FCERM investments and to gain a high level estimate of potential benefits. Due to the high level nature of the tool, its use is less about identifying what schemes can be delivered, and more about minimizing the risk of promoting schemes which are very unlikely to be delivered.

What is WAAD and when should I use it?

The WAAD tool uses the [WAAD method](#) from the Multi-coloured manual to estimate the potential benefits from reducing flooding to properties. These are quantified as economic damages that could be avoided.

Benefits are given in large ranges (e.g. £5-10million). The tool is more useful for larger schemes (>10 properties). The results will be less sensitive to error with a greater number of properties benefiting.

The tool provides potential benefits over a 50-year appraisal period. This can't be edited. Longer appraisal periods may result in more benefits, however, due to the effects of discounting, most of the benefits are gained in the first 50 years. This is therefore sufficient for an assessment of this detail.

To use this tool you will need one of the following:

- Access to the Environment Agency's Long Term Flood Risk Mapping
- A GIS application to analyse spatial data (e.g. Easimap2)
- Historical flood maps

Follow the steps in this user guide to prepare data and use the WAAD tool to complete a benefits assessment for a potential floodscheme.

Step 1: Gather and edit input data

1. Access the [Environment Agency Long Term Flood Risk Information](#).
2. Download the [Flood Map for Planning Rivers and Sea, flood zones 2](#) and 3 to use in a GIS application
3. Open the data in a GIS system (e.g. Easimap 2 if you are Environment Agency staff)
4. Download and open the [WAAD tool online](#) (see Figure 2).

The screenshot shows the 'The Weighted Annual Average Damage (WAAD) Estimation Tool' interface. It is divided into three main sections:

- Top Section (Instructions):** Contains introductory text, a warning, and a three-step process for using the tool. A callout box labeled 'Tool instructions' points to this section.
- Middle Section (Map):** Features a map legend for 'Risk of Flooding from Rivers and Sea' with categories: High (dark blue), Medium (medium blue), Low (light blue), and Very Low (white). A map of Oxford is shown with these risk zones. A callout box labeled 'Input data links and criteria' points to this section.
- Bottom Section (Assessment Tool):** Contains three numbered input tables and a results box. A callout box labeled 'Assessment Tool' points to this section.

Category	Residential	Non-Residential
High Risk Area	100	100
Medium Risk Area	50	50
Low Risk Area	20	20

66		
Category	Residential	Non-Residential
High Risk Area	60	60
Medium Risk Area	20	20
Low Risk Area	20	2

*The average floorsize for all NRP's at flood risk in England and Wales is 66m²

Total Benefits provided by the new scheme (£)	5 - 10	Millions
---	--------	----------

Figure 2 Overview of the tool © Flood Hazard Research Centre, 2019.

Step 2: Estimate properties currently at risk

The next step is to enter data into the WAAD Table 1. This sets the current situation of flood risk in the area (see Figure 3).

1

Enter the number of properties under the <u>current</u> situation		
Category	Residential	Non-Residential
High Risk Area	100	100
Medium Risk Area	50	50
Low Risk Area	20	20

↑
Editable

Figure 3 Table 1 in the WAAD tool © Flood Hazard Research Centre, 2019.

- 5. Open the tool in Excel.
- 6. Delete all example figures currently in the table.
- 7. Use the Environment Agency's Long Term Flood Risk Information to estimate the number of properties currently atrisk in the area of your potential flood risk management scheme.
- 8. Add the number of properties within each risk band (high. medium, low) to the table. Where possible, estimate the number which are residential and non-residential (businesses).When finished, press Enter to update the table.

Additional information

If you wish to input your results into a Partnership Funding calculator, please note that the property risk categories used within this method donot correspond to those used in the calculator. See ‘Step 4 – Interpreting the results’ for a method to convert property numbers to the Partnership Funding Calculator risk bands.

Table 1 Property risk categories in the partnership funding calculator

Risk area	Probability
High risk area	>1 (flood) in 30 (years) (3.3%)
Medium risk area	1 in 100 (1%) > 1 in 30
Low risk area	1 in 1000 (0.1%) > 1 in 100

Step 3: Estimate properties remaining at risk

The next step is to enter data into the WAAD Table 2 (see Figure 4). This sets the new situation of flood risk after the potential flood risk management scheme is implemented.

Average for England and Wales provided. If a more accurate figure is available this can be edited.

2

Enter the average ground floor size for all of the NRPs in sq metres (m ²):			66
Enter the number of properties after protection measures have been implemented			
Category	Residential	Non-Residential	
High Risk Area	80	80	
Medium Risk Area	20	20	
Low Risk Area	20	3	
*The average floorsize for all NRPs at flood risk in England and Wales is 66m ²			

Editable

Figure 4 Table 2 in the WAAD tool © Flood Hazard Research Centre, 2019.

9. Delete all example figures currently in the table.
10. Add the number of properties that would remain in each risk category if a potential flood risk management scheme was in place. Where possible, estimate the number which are residential and non-residential (businesses).

Additional information

The average ground floor size for all non-residential properties in England and Wales is given, which will be suitable for all assessments with this level of detail. Unless there is a specific project requirement, it is recommended to use the default value.

Step 4: Interpret the results

The WAAD tool Table 3 is automatically updated when the figures in Table 1 and Table 2 has been added. These are the calculated potential benefits of the scheme (see Figure 5).

3

Total Benefits provided by the new scheme (£)	5 - 10	Millions
<small>This is for the 50-year lifetime of the scheme with a 3.5% discount rate</small>		

Calculated Potential Benefits

Additional information

- The high level output is the total possible present value benefits (damages avoided)
- The possible ranges of benefits are shown in Table 2 below.
- No part of the table is editable.
- This is based on applying the Weighted Annual Average Damages over an assumed 50-year appraisal period.
- The potential benefits show the value of avoiding this flooding to the UK economy. For a scheme to be considered cost beneficial, the cost of the scheme must be lower than the potential benefits, but schemes with a chance of being delivered in the medium term typically require benefits to be at least 5 times greater than the cost.

Table 2 Potential benefits in the results table

Potential range of benefits results
£0
£1 – 5 million
£5 – 10 million
£10 – 50 million
£50 – 100 million
£100 – 500 million
<£500 million

The results give a high level indication of the potential economic damages that could be avoided (in millions of pounds) from a FCERM scheme that will reduce the risk of flooding to the properties selected. These are described as “potential benefits”.

The results can be used to understand the potential of a FCERM scheme in a given location and can aid any prioritisation of schemes added to the capital programme pipeline.

If the ballpark cost of a scheme is known, the results can be used to see if a scheme is likely to need partnership funding or if it could be funded using Flood Defence Grant-in-Aid (FDGiA).

Sensitivity Testing

You should carry out sensitivity tests on your results. To do this, alter the number of properties in the WAAD Table 1 and Table 2.

Sensitivity tests will demonstrate how the benefits would change if either the number of properties at risk changes, or the depth of flooding is higher or lower than initially thought. To carry out sensitivity tests, choose values at the extremes of the results range obtained and see how this affects the Partnership Funding score.

As the range of outputs are large, the overall benefits may not change.

Partnership Funding Calculator

The results obtained are a range of values and not a single figure, therefore cannot be put directly into the [Partnership Funding Calculator](#).

You can take a benefit value within the range obtained and input this into the Partnership Funding Calculator.

Simple calculations to convert the WAAD property number into the Partnership Funding Calculator (PFC) risk bands are shown in Table 3 below.

Table 3 – converting WAAD property numbers into PFC risk bands

Partnership funding risk band	Conversion calculation
Very significant (>1 in 20)	0.7 x High risk areas
Significant (1 in 20 >1 in 75)	(0.3 x High risk areas) + (0.6 x Medium risk areas)
Moderate (1 in 75 > 1 in 200)	(0.4 x Medium risk areas) + (0.1 x Low risk areas)

Simplified benefit:cost appraisal tool (BCA)

User guide

This user guide provides step by step instructions for using a Simplified Benefit:Cost Appraisal (BCA) Tool for Flood Risk Management. This tool is provided in the Multi-Coloured Manual (MCM) for calculating benefits from flood risk schemes. The user guide is for beginners in benefit:cost appraisal or those who have not used the BCA tool before.

The tool can be used to understand the overall viability of FCERM investments and to gain a high level estimate of potential benefits. These benefits can then be compared against cost estimates to assess the benefit:cost ratio and benefits minus costs of a potential scheme.

What is BCA and when should I use it?

The Simplified Benefit:Cost Appraisal (BCA) Tool for Flood Risk Management provides a mechanism to calculate an initial benefit:cost analysis of potential schemes. It is also a tool for informed analysis of further investment priorities. It should be used for estimating the benefits of schemes, but will need flood depth data for at least two annual flood probabilities. Some work is required prior to using the BCA tool to obtain the necessary input data in the correct format. This user guide explains the data and formats needed and how to use the BCA tool. The tool can be accessed from the [Multi-coloured manual website](#).

The BCA tool carries out a more detailed analysis than the Weighted Annual Average Damages (WAAD) tool.

Follow the steps in this user guide to prepare data and use the BCA tool to complete a benefits assessment for a potential flood scheme.

To use this tool you will need the following:

- Minimum two modelled return periods with water levels and flood extents.
- Number of residential properties at risk in each return period, with depth of flood water (m) at each property.
- Number of non-residential properties (NRPs) at risk in each return period, with depth of flood water (m) and the floor area of each property.
- If you wish to calculate the Benefit:Cost Ratio (BCR) and Net Present Value, you will need the whole-life costs of a scheme that would protect against each tested return period.

If accuracy is not critical, estimates can be made for any of the above criteria. The data we have used in the images of the tool are based on fictional estimated figures.

A summary of the key terms and abbreviations used within the tool are provided in the glossary at the end of the guide.

Step 1a: Gather and edit input data

There is more than one way to gather the information required to use the BCA tool. Below are suggested sources. If you cannot access any of these sources or wish to make a higher level assessment, any of the figures can be estimated based on your own experiences.

1. Gather the input data required (see steps below)
2. Download the [Benefit:Cost Appraisal tool](#) from the MCM webpage
3. Open the tool in Excel.

Property numbers and type (residential or non-residential)

The most accurate way to obtain the property numbers is by downloading [the National Receptor Dataset](#) (NRD) for the area covered by the scheme. This download is in the form of a shapefile and must be viewed in a GIS viewer. From here it can be extracted to a spreadsheet format.

The key data required from this will be Floor Area and MCM-Code.

Residential and non-residential properties can be counted by filtering the dataset by MCM-Code:

- Residential properties have the MCM-code 1.
- Some property types may not be relevant for the scope e.g. 999 – unspecified.
- A full break down of non-residential MCM-Codes can be found on the MCM website.

There are no damages attributed to upper level flats at this stage. In the NRD the floor area for these properties is zero for this reason.

Hydraulic modelling

This can either come from specific modelling carried out for the project, or from historical modelling carried out in the area and is needed to determine the modelled flood depths for at least two return periods.

Flood depths at each property

These are obtained from hydraulic modelling. Flood depths is can be extracted at each NRD point using a GIS viewer. If the modelling only provides flood levels the flood depths can be calculated by subtracting the property threshold levels (if available) or ground levels from the water levels.

Only flood depths of -0.3m and greater for residential properties or greater than -1m for non-residential properties should be included in the assessment. These negative flood depths may arise due to the threshold level used, and are included to account for damage to roads and disruption to emergency services.

Property threshold levels

These can be obtained from a threshold survey. If this is not available a standard threshold (150mm is typical) or no threshold (ground level) will need to be assumed at each property.

Ground levels

Ground levels can be obtained from [LIDAR data](#) which can be found online.

Scheme present-value costs (£k)

These need to be calculated separately. A potential source of scheme costs can be found on the [government website](#).

Step 1b: Estimate property numbers and depth of flooding

In the BCA spreadsheet labelled “Step 1” (figure 6) fill in the Return Periods, No. of Properties, Depths of Flooding and NRP Average Floor Area columns from the data you have previously gathered using the steps below.

Table 1 - The return period of each flood that is analysed, and the land use data for the benefit area

Return Period of the flood (years)	Residential properties at risk (No.)	Mean depth of flooding	Damage per residential property	Total damage	Non-Residential properties at risk	Mean depth of flooding	Average m ²	Damage/m ²	Total damage	Total
2	0	0.10			1	0.10	400			
5	15	0.15			2	0.10	1500			
10	30	0.20			2	0.10	1500			
25	40	0.25			2	0.25	1500			
50	50	0.60			2	0.25	1500			
100	55	0.90			2	0.5	1500			
200	100	0.60			5	0.25	900			
300	125	0.30			7	0.15	850			

Key	
Inputs	
Outputs	
Intermediate workings	
Read me/info	
Step overview	

Figure 6 Image of Step 1 spreadsheet in the BCA © Flood Hazard Research Centre, 2019.

4. Click on the tab called “Step 1”
5. Follow the on-screen “key” (shown the Figure 6) for editable cells.
6. Delete all figures currently in the table.
7. Fill the “Return Period of the flood (years)” column to show the modelled return periods in ascending order.
8. Fill in the “Residential properties at risk (No.)” and “Non-Residential Properties at risk” columns to show the number of properties at risk in each return period.
9. Fill in the “Mean depth of flooding” columns.
10. Fill in the “Average m²” column to show the average floor area in m² of all non-residential properties at risk.

Additional information

- The property numbers here are cumulative.
- The most accurate way to count residential and non-residential properties is by downloading the National Receptor Dataset (NRD) for the area.
- Only flood depths of -0.3m and greater for residential properties and -1m and greater for NRPs should be included in the assessment. These negative flood depths may arise due to the threshold level used, and are included to account for damage to roads and disruption to emergency services.

Step 2: Assign depth-damage values

The next stage is to complete Step 2 in the BCA spreadsheet (see Figure 7). Fill in the appropriate residential and non-residential depth-damage curve data for your scenario.

Residential property average depth-damage curve (Example data are from 2019 MCH, Fluvial, short duration, no warning)										
Depth (m)	-0.30	0.00	0.05	0.10	0.20	0.30	0.60	0.90	1.20	1.50
Damage (£)	£1,128	£1,128	£7,196	£11,474	£19,362	£23,630	£29,177	£31,793	£35,126	£37,887

Non-residential property (NRP) average depth-damage curve (Example data are from 2019 MCH, Fluvial, Short duration, with Cellars, no warning)										
Depth (m)	-1	-0.75	-0.5	-0.25	0	0.25	0.5	0.75	1	1.25
Damage (£/m ²)	£5	£6	£8	£9	£42	£302	£445	£587	£798	£943

Steps:
 Data presented in the yellow (input) cells above provide indicative sector average data for specific scenarios. These can be altered by selecting other scenarios from the MCH online (i.e. you could select floods of short, long, extra long duration, with or without warning, for floods with or without salt and waves). Alternatively, you could choose to keep the data presented.

Table 2 - The return period of each flood that is analysed, and the land use data for the benefit area										
Return Period of the flood (years)	Residential properties at risk (No.)	Mean depth of flooding	Damage per residential property	Total Residential damages	NRPs at risk	Mean depth of flooding	Average m ²	Damage/m ²	Total Non-residential damages	Total damages (per return period)
2	0	0.1	£11,474	£0	1	0.1	400	£42	£16,704	£16,704
5	15	0.15	£11,474	£172,110	2	0.1	1500	£42	£125,280	£297,390
10	30	0.2	£19,362	£580,860	2	0.1	1500	£42	£125,280	£706,140
25	40	0.25	£19,362	£774,480	2	0.25	1500	£302	£905,910	£1,680,390
50	50	0.6	£29,177	£1,458,850	2	0.25	1500	£302	£905,910	£2,364,760
100	55	0.9	£31,793	£1,748,615	2	0.5	1500	£445	£1,336,380	£3,084,995
200	100	0.6	£29,177	£2,917,700	5	0.25	900	£302	£1,358,865	£4,276,565
300	125	0.3	£23,630	£2,953,750	7	0.15	850	£42	£248,472	£3,202,222

Figure 7 Image of BCA spreadsheet Step 2 © Flood Hazard Research Centre, 2019.

11.If using the sector average depth-damage data (which is recommended for any high level or early stage assessment), no further action is required at this Step.

12.If you wish to carry out a more project specific analysis, you can input the appropriate depth-damage curve information that is applicable to your scenario. This can be accessed from the MCM handbook online with payment.

Additional information

- The “Residential property average depth-damage curve” and “Non-residential property (NRP) average depth-damage curve” figures provided in the tool have been taken from the MCM-Online and are average values that will be suitable for a basic assessment.
- Table 2 in this step is automatically generated using the values from Step 1 and the residential and non-residential depth-damage curves.

Step 3: Calculate discounted annual averages

Step 3 Table is used to confirm the Discount Factor and automatically calculate Discounted annual average damages (AAD) (£k) (see Figure 8). It will use information from Steps 1 and 2.

Table 3 - Loss-probability calculation							
Data from steps 1 and 2			Intermediate calculations				Lifetime damages (i.e. Discounted) (£)
Return Period (years)	Exceedance probability	Damages	Probability Interval	Mean damage (£)	Interval damages (£)	Cumulative damages (£)	
2	0.500	£16,704					
			0.300	£157,047	£47,114	£47,114	£1,406,985
5	0.200	£297,390					
			0.100	£501,765	£50,177	£97,291	£2,905,425
10	0.100	£706,140					
			0.060	£1,193,265	£71,596	£168,887	£5,043,519
25	0.040	£1,680,390					
			0.020	£2,022,575	£40,452	£209,338	£6,251,537
50	0.020	£2,364,760					
			0.010	£2,724,878	£27,249	£236,587	£7,065,277
100	0.010	£3,084,995					
			0.005	£3,680,780	£18,404	£254,991	£7,614,879
200	0.005	£4,276,565					
			0.002	£3,739,394	£6,232	£261,223	£7,800,997
300	0.003	£3,202,222					
TOTAL ANNUAL DAMAGES						£261,223	
DISCOUNTED FUTURE ANNUAL AVERAGE DAMAGES						£7,800,997	

Scheme life	100
Discount rate	3.5%; 3%; 2.5%
Discount factor =	29.86

©Flood Hazard Research Centre, 2019; v1

Figure 8 Image of Step 3 table in BCA spreadsheet © Flood Hazard Research Centre, 2019.

13.If you are assessing the scheme over an appraisal period of 100 years there is no action here.

14.If you wish to assess the scheme over a different length appraisal period, edit the “Scheme Life” cell to match your chosen appraisal period. This will automatically change the “Discount Factor” to fit your scheme.

Additional information

The discount rate is applied to the average damages to calculate the total damages over the appraisal period.

Step 4: Add scheme costs

Step 4 Table in the BCA spreadsheet is used to fill in the costs to produce the final summary table of results (see Figure 9).

Return period	Exceedance probability	Costs of Scheme Implementation (£)	Benefits £(k)	Benefit-cost Ratio	Benefits minus Costs (£)
2	0.5	£0	£0		
5	0.200	£1,500,000	£1,406,985	0.937990325	-£93,015
10	0.100	£2,600,000	£2,905,425	1.117470976	£305,425
25	0.040	£3,500,000	£5,043,519	1.441005404	£1,543,519
50	0.020	£4,300,000	£6,251,537	1.453845758	£1,951,537
100	0.010	£5,300,000	£7,065,277	1.333071099	£1,765,277
200	0.005	£7,300,000	£7,614,879	1.043134134	£314,879
300	0.003	£8,000,000	£7,800,997	0.975124661	-£199,003

Figure 9 Image showing Table 4 in BCA spreadsheet © Flood Hazard Research Centre, 2019.

15. Complete the “Costs (£k)” column with your scheme costs (these need to have been estimated outside of the tool). Once costs are entered, the table calculates the benefit:cost ratio and benefits minus costs (net present value).

16. Press “Enter” to automatically calculate the benefit:cost ratio, and benefits minus costs.

Additional information

The costs entered should be the whole-life present-value (PV) cost of a scheme that would protect against a flood with the relevant return period. A potential source of scheme costs can be found on the [government website](#).

In the BCA version current at the time of writing (2019) the “Benefits” are labelled as in “£k” (thousands of pounds), but they are actually in £ (pounds). This label is an error and should be updated in future versions.

A graphical representation of the “Benefits vs cost” is shown in Step 4 (see Figure 10 below). Again, this is labelled to be in £k, when in fact it is shown in £.

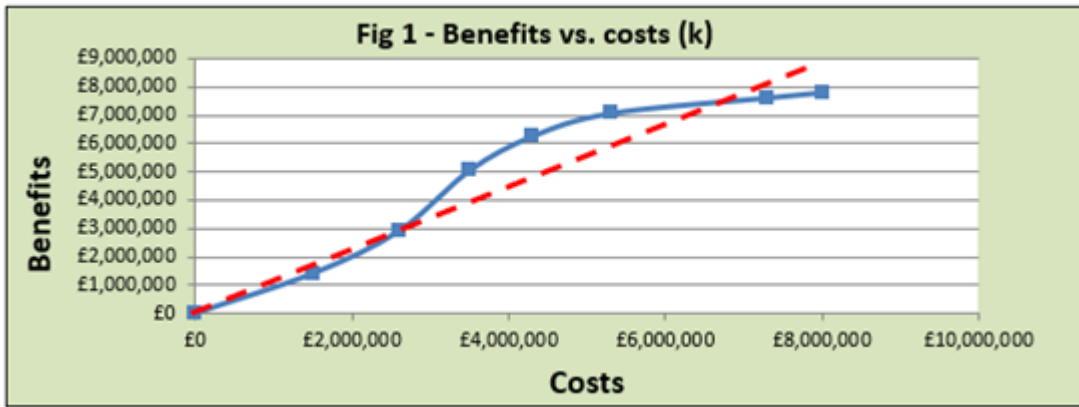


Figure 10 Image showing graph from step 4 in the BCA © Flood Hazard Research Centre, 2019.

Step 5: Interpret the results

Using the graph

A graph is shown on Step 4 will only add extra information if the user has entered data for 8 modelled return periods. Otherwise it will automatically give values of 0 to any unfilled rows in the table. This distorts the graph and can make it misleading.

The calculated benefits

The benefits (£) are the amount of damages avoided if all properties that were originally at risk in that return period are no longer at risk.

For example, the benefits given for a flood with a 0.1 probability (100-year return period) assume that all properties are now protected against a flood of that magnitude. Residual benefits for higher probability floods have not been counted.

Partnership Funding Calculator

The benefits and costs can be transferred into a Partnership Funding Calculator (PFC) to gain an understanding of the potential partnership funding score and external funding required. The [PFC](#) can be accessed online.

If your modelled return periods do not match the bands used within the PFC, you must apply a proportional split to estimate the number of properties in each of the risk bands.

Sensitivity Testing

You should carry out sensitivity tests on your results. To do this, alter the number of properties or depth of flooding figures within Step 1b.

Sensitivity tests will demonstrate how the benefits would change if the either the number of properties at risk changes or the depth of flooding was found to be either higher or lower than initially thought.

Confidence should be highest in the results when the benefits stay fairly consistent when the input data is changed by +/-10%.

Glossary

A glossary of key terms and abbreviations used in the BCA guide and spreadsheet are provided below. A more comprehensive list of definitions can be found from the [MCM online](#) here.

Step 1 key terms

- 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). This should not be taken as a prediction of actual 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.
- NRP's: Non-Residential Properties
- Cumulative: All properties that are counted at a high return period will also be included in all subsequent return periods.

Step 3 key terms

- Exceed Prob.: the Exceedance Probability. The probability that a flood event with a given return period will occur in any year.
- Int. Prob.: Intermediate Probability between the given return periods.
- Mean dam.: the Mean Damages between the given return periods.
- Int. dam.: the Intermediate Damages value between the given return periods. This is calculated as the Int. prob. x Mean dam.
- Cumul.: the Cumulative Damages including that return period and all higher return periods.
- Discounted AAD: Discounted Annual Average Damages, calculated as Cumul. x Discount Factor. This is shown in £k.
- 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.
- Discount Factor: the figure calculated by applying the Discount Rate over the chosen appraisal period.

Step 4 key terms

- Prob.: the exceedance probability.
- BCR: the Benefit:Cost ratio. When $BCR > 1$ then the project is cost-beneficial, i.e. value of benefits gained are greater than project costs.
- B minus C: Benefits minus Costs

Would you like to find out more about us or your environment?

Then call us on

03708 506 506 (Monday to Friday, 8am to 6pm)

Email: enquiries@environment-agency.gov.uk

Or visit our website

www.gov.uk/environment-agency

incident hotline

0800 807060 **(24 hours)**

floodline

0345 988 1188 **(24 hours)**

Find out about call charges (<https://www.gov.uk/call-charges>)

Environment first

Are you viewing this onscreen? Please consider the environment and only print if absolutely necessary. If you are reading a paper copy, please don't forget to reuse and recycle.