Annex 5: Guidance on use of the Benefits Assessment Toolkit

1 Introduction

1.1 What is the Benefits Assessment Toolkit?

The Benefits Assessment Toolkit comprises a benefits assessment spreadsheet with the use of other data sources to inform it. It is intended to assist IDBs in identifying the level of benefits they provide to their stakeholders. To help inform this discussion, the toolkit also identifies the beneficiaries and, if the impacts have been estimated in monetary terms, how much they benefit.

We hope that improved data on the benefits provided by IDBs can help inform the communities they serve and potentially also inform discussions on a range of local issues.

It is important to note that the toolkit, and especially the spreadsheet, has been designed to provide an estimate of the benefits provided by *one* IDB. The toolkit has not been designed to provide a cumulative assessment of the benefits provided by all IDBs.

The toolkit is intended to be outcome-focused, not process-focused. Taking a more targeted approach will enable you to get the most out of the toolkit by thinking about what type of information and how much detail you need from it. You should then use the toolkit to provide that type of information and level of detail. You may not need to use all the worksheets or all the suggested data sources to achieve your desired outcomes.

1.2 Aim of this guidance

This guidance provides an overview of how to apply the benefits assessment toolkit. It is not intended to be step-by-step guidance since the toolkit has been designed to draw on the existing expertise and experience within IDBs. As such, the guidance focuses on what types of information are needed, potential sources of information, how to use the information to get reasonably reliable results, and the likely sources of uncertainty.

1.3 The intended audience

The audience for this guidance is those using the toolkit, especially IDBs and their members.

1.4 Level of application of the toolkit

The benefits assessment toolkit is intended to be used at a series of different levels. This means you can input as much detail as you feel is appropriate. This could range from:

- completion of the benefits assessment spreadsheet as part of a meeting, through round table discussion based on information and knowledge within the IDB Board;
- addition of extra detail through use of readily available information, such as from GIS or mapping; or
- collection of further detail through site visits, engagement with stakeholders or investigation and research.

There is no measure of what is the ‘correct’ amount of detail. This will vary from situation to situation and from Board to Board. You are encouraged to use your knowledge and expertise to determine when you feel that you have provided sufficient information. You may also want to discuss this with your stakeholders to determine what level of information they would like.

1.5 Overview of the toolkit

The benefits assessment methodology is based on identifying the difference, measured as benefits delivered or damages avoided, between a baseline and another scenario. The most common set of scenarios is likely to be where an IDB wants to demonstrate the range and magnitude of benefits that it delivers. In this case, the baseline is assumed to be the situation if the IDB stopped all activities. Because this could result in significant land use changes, the spreadsheet has been designed based on the assessment of individual IDBs and, therefore, it is not appropriate to add the benefits of assessments to provide an indication of the cumulative benefits. This is because the impacts of large land use changes across a number of IDBs, especially adjacent ones, are likely to be considerably larger than the sum of the benefits across individual IDBs. The impacts occurring under the baseline are compared against the scenario of the IDB continuing its activities as at present. The benefits assessment spreadsheet can also be used to compare other scenarios, for example:

- adaptation to climate change:
    - baseline: future situation with no adaptation; and
    - scenario: future situation with adaptation (a number of scenarios could be used to test the benefits of different adaptation measures).
- change in IDB priorities:
    - baseline: current situation with current objectives; and
    - scenario: focus on enhancing food production or enhancing biodiversity.

The benefits assessment spreadsheet uses a simplifying assumption when assessing the impacts of future changes: it ignores time. This means you need to think about what the final changes might be. This assumption introduces uncertainty because it does not take account of gradual changes in terms of damages or benefits, but at the same time it means you do not have to make a series of assumptions about what might happen and when. Overall, this means you could overestimate benefits or damages that would not occur immediately, such as some permanent losses. You might also underestimate some damages, such as where the assumption that relocation or rebuild of assets that are permanently affected means that there are no indirect damages. In reality, it is likely to take time to rebuild or relocate the assets, unless there was prior warning or knowledge that the assets were going to be permanently affected so their replacement could be planned.

In addition, it is important to remember that the methodology measures annual benefits or damages. The spreadsheet is set up so that all the impacts are given as ‘per year’ values. This means that they need to be converted to Present Values (PV) through the use of discounting if you want to use them to inform capital Grant-in-Aid appraisals. You will also need to consider the implications that ignoring time has on the PV impacts, as Grant-in-Aid appraisals require damages and benefits to be linked to the year in which they occur.

1.6 Using the toolkit

As described above, the toolkit is designed to be used at a number of different levels. Table 1.1, below, identifies the type of information that you can use when assessing the benefits. The benefits assessment spreadsheet is set up similarly to an Appraisal Summary Table (AST) so you can record the qualitative descriptions and quantitative information needed for the low, moderate and high levels of detail. It also includes default values that will allow you to monetise the impacts at the ‘low’ level of detail. You can modify the calculation sheets within the benefits assessment spreadsheet to enable you to apply the moderate and high levels of detail during monetisation.

Table 1.1: Measuring the difference between the baseline and the current situation				
Quantification	**Detail**	**Low**	**Moderate**	**High**
None	**Baseline**	Qualitative description of impacts	Qualitative description of impacts tailored to specific IDB for most important categories	Qualitative description of impacts tailored to specific IDB for all categories
	Current situation	Qualitative description of benefits of key IDB activities and indication of direction of change	Qualitative description of benefits (tailored to specific IDB for most important categories) and indication of direction of change	Qualitative description of benefits (tailored to specific IDB for all categories), indication of direction of change and likely significance
	Tools	*Based on existing knowledge within the IDB (staff input, published documents, etc.)*	*Additional information from other available sources (including GIS/mapping, reports, plans, etc.) for location of assets*	*New information from site visits, investigations, engagement, etc.*
Some	**Baseline**	Numbers, types, etc. affected	Numbers, types, etc. affected for the most significant/important categories only	Numbers, types, etc. affected for all relevant categories
	Current situation	Numbers, types, etc. benefiting and indication of direction of change	Numbers, types, etc. benefiting for the most significant/important categories only and indication of direction of change	Numbers, types, etc. benefiting for all relevant categories, indication of direction of change and likely significance
	Tools	*Based on existing knowledge within the IDB on number, area, size, etc. of assets*	*Additional information from other available sources (including GIS/mapping, reports, plans, etc.) to measure and quantify number, area, size, etc. of assets*	*New information from site visits, investigations, engagement, etc. used to measure and quantify number, area, size, etc. of assets*
Monetisation	**Baseline**	Monetary value of impacts (e.g. damages) for categories quantified using default numbers	Monetary value of impacts (e.g. damages) quantified using numbers calculated specifically for IDB for most significant categories	Monetary value of impacts (e.g. damages) quantified using numbers calculated specifically for IDB
	Current situation	Monetary value of benefits (e.g. damages avoided) for categories quantified using default numbers	Monetary value of benefits (e.g. damages avoided) quantified using numbers calculated specifically for IDB for most significant categories	Monetary value of benefits (e.g. damages avoided) quantified using numbers calculated specifically for IDB
	Tools	*Default/average values (e.g. weighted average annual damages)*	*Readily available benefit transfer values (e.g. Multi-Coloured Manual, EVEE Handbook[1])*	*Specially developed values (case study specific)*

[1] EVEE (The Economic Valuation of Environmental Effects) Handbook is a supporting document to the Flood and Coastal Erosion Risk Management Appraisal Guidance and can be downloaded from: http://publications.environment-agency.gov.uk/PDF/GEHO0310BSFH-E-E.pdf

1.7 The benefit categories

The spreadsheet includes a number of benefit categories. Dividing the assessment into categories makes it easier to complete as you only need to think about one category at a time and how this might be affected. The categories are divided into two types[2]:

1. core categories: these are ones that are relevant to all (or almost all) IDBs; and
2. optional categories: these are ones that will be relevant to some IDBs (so you only need to complete those that are relevant to you).

The list of benefit categories for use in the benefit assessment is provided in Table 1.2. The categories are divided into three different types:

1. Managing nature and resources (similar to regulating services when using ecosystem services terminology);
2. Production of goods and services (similar to provisioning services); and
3. Social, cultural and employment benefits (similar to cultural services with the addition of a category to capture the number of jobs supported).

Table 1.2: The Benefit Categories

Managing nature and resources		**Production of goods and services**		**Social, cultural and employment benefits**	
Core	**Optional**	**Core**	**Optional**	**Core**	**Optional**
Waterlogging, drought, flooding, erosion		Production of grown food	Collection of natural food	Health and wellbeing of people	Heritage values
Carbon sequestration and storage	Control of invasive species	Biodiversity	Energy (where energy is for use outside IDB)	Health and well-being of community	Knowledge and education
	Water quality		Production of timber, fibre, aggregates, peat, etc.	Level of involvement in decision-making	Recreation and tourism
			Water supply (where water is for use outside IDB)	Landscape character	Jobs directly/ indirectly provided by IDB

1.8 Structure of the remainder of this guidance

Section 2 of this guidance introduces the terms used within the benefits assessment toolkit. Sections 3 to 7 are structured around the worksheets within the benefits assessment spreadsheet.

[2] Responses to a questionnaire sent to all IDBs were used as the basis for identifying which categories are core and which are optional.

2 Introducing key terms

2.1 Overview

The guidance uses a number of terms that need to be explained clearly for you to understand what is required. This section provides additional explanation of those terms and can be used as a reference when you are applying the benefits assessment toolkit.

2.2 Baseline

The baseline is the projected situation that would occur under a particular set of assumptions. When identifying the benefits of IDB activities, it is suggested that the baseline be where the IDB stops all its activities. This is similar to a 'do-nothing' baseline. The baseline can be varied to estimate the benefits of other scenarios.

2.3 Current situation

Where the spreadsheet is to be used to estimate the benefits of IDB activities, the current situation is defined as the IDB continuing as at present; this could also be considered to be a business-as-usual scenario.

2.4 Scenario

A scenario is usually defined as a projection of the future. This means that the baseline can be a scenario where assumptions are made to project what an area might look like if the IDB stopped all its activities. As scenarios are projections of the future, there is no correct answer. All scenarios are based on assumptions and, therefore, include uncertainty in terms of what the benefits might look like and what their magnitude might be.

2.5 Benefits category

The benefit categories are the individual types of impact, usually linked to goods or services that are provided to people. The toolkit is based on an Ecosystem Services Framework, and the benefit categories reflect the range of goods and services that the environment provides to people.

2.6 Core category

Core categories are those benefit categories that are relevant to all, or most, IDBs. The decision as to which categories have been identified as core (rather than optional) is based on responses of IDBs to a questionnaire circulated as part of this study. As the core categories are relevant to all, or most, IDBs, they need to be completed in all assessments.

2.7 Optional category

Like core categories, optional categories have been determined based on responses of IDBs to the questionnaire, and are defined as those categories that are relevant to just some IDBs. Only those IDBs for which these categories are relevant need to assess the impacts for these benefit categories.

2.8 Probability of impacts

Assessment of the magnitude of impacts, especially the monetary estimate of benefits, is based on the change in probability of impacts between the baseline scenario and the current situation. Ten different probability levels are included (100%, 50%, 20%, 10%, 4%, 2%,

1.33%, 1%, 0.5% and 0.1%). The probability levels are intended to capture the probability of impacts occurring in order that they reflect changes in water levels (from above-ground flooding to drought), as well as impacts that are caused by changes in water levels and how these are reflected within the various benefit categories.

2.9 Beneficiary

The toolkit aims to identify the total benefits of IDBs and to then identify how these benefits are distributed across different beneficiaries. To do this, each of the benefit categories has been allocated across one (or more) of six different types of beneficiary:

- local residents (defined as those within the IDB district);
- local businesses (also defined as those within the IDB district);
- farmers/landowners;
- local authority;
- service providers;
- wider society (defined as those outside the IDB district); and
- wider businesses (also defined as those outside the IDB district).

Where benefits are allocated to more than one type of beneficiary, it is assumed that the benefits are distributed equally. For example, if there are two beneficiary types, then 50% of the benefits are allocated to each; where there are three beneficiary types, then 33% of the benefits are allocated to each, and so on. This is a simplification but other allocations would have to be determined on an IDB-by-IDB basis and so would add considerably to the resource requirements of using the toolkit. Hence, it is assumed that this simplification is appropriate within the overall levels of uncertainty associated with the estimation of monetary benefits.

2.10 Direct beneficiary

Direct beneficiaries are people, assets or species who directly benefit from the service or good being provided within the IDB district. Direct beneficiaries include, for example:

- residents who benefit because their houses do not flood;
- walkers who benefit from the provision of recreation;
- farmers who benefit from provisioning services such as food crops, livestock and water supply – and also agri-environment payments for biodiversity and natural resource protection;
- operators of utilities infrastructure which is protected from flooding; and
- operators of transport infrastructure which is protected from flooding.

2.11 Indirect beneficiary

Indirect beneficiaries are people who benefit indirectly from the asset or good being provided within the IDB district, perhaps by visiting an asset or being a consumer of a good. For example:

- people who use the village hall which is protected from flooding;
- people who are supplied with electricity by the generating station/substation which is protected from flooding;
- consumers who purchase food grown in the IDB district; and
- people using roads, railways and air transport assets within the IDB district.

These people may live within the IDB district or, alternatively, they may live outside the district but visit, work or undertake recreation within it. Thus, they use assets and goods provided in the district.

2.12 Induced beneficiary

Induced beneficiaries are people who do not directly use the asset or good provided within the IDB district themselves but who benefit from its existence. For example:

- people using a minor road outside of the IDB district which has less traffic because of the presence of a main road within the district; and
- people using hospitals, schools, care homes, village halls and businesses outside of the IDB district which are less busy because of the services provided within the district.

3 Worksheets within the benefits assessment spreadsheet

3.1 Overview

The benefits assessment spreadsheet comprises 35 worksheets. They are (where further guidance is provided, the title of the worksheet is used to hyperlink to the appropriate section or sub-section of this guidance for easier navigation):

1. *Instructions*: this worksheet introduces the spreadsheet and how it can be used; it gives a brief description of what each worksheet does and suggests using this guidance to find out more.

2. *Summary of area*: this worksheet is used to record the name of the IDB being assessed, who is undertaking the assessment, and a version number and date (so changes and updates can be tracked). It also provides space for recording key statistics and background information, mainly drawn from the policy statement. This worksheet is also used to identify Environment Assets that may be present within or adjacent to the IDB district. There is a high risk of double counting with Environment Agency benefits where there are EA assets, and a simple approach to accounting for this is included. However, the actual overlap between EA and IDB benefits is likely to be very IDB-specific, and to minimise the risk of double counting, it would be worthwhile discussing the overlap with the Environment Agency flood risk managers. This worksheet also includes the approach for dividing benefits between those provided by IDB activities and those resulting from Environment Agency activities. The approach used is simplistic, being based on the percentage of total benefits that are associated with above-ground (i.e. flooding) risks versus those associated with below-ground (i.e. waterlogging) risks. There were very little data on which to base the percentages assumed in the Summary of area worksheet, so this is a key source of uncertainty. However, it is clearly important to divide benefits across IDBs and Environment Agency to avoid double counting. The default percentages can be revised if necessary, for example, where there are no or only limited Environment Agency activities within an IDB district.

3. *Quick estimate*: this worksheet can be used to give a rough estimate of the benefits of the IDB. It is based on extrapolating benefits identified during Grant-in-Aid appraisals to the whole IDB area. For most IDBs, this approach may be highly uncertain but it can be used very quickly.

4. *Describe and quantify assets*: this worksheet is used to describe the current situation for each of the core and, if relevant, optional categories. The worksheet provides space to record information that the IDB knows (from the expertise of its staff) or has at hand (from published documents), additional information that may be collected through use of GIS, mapping, or readily available datasets, and new information that the IDB may decide needs to be collected to inform the assessment. Each category includes space for recording direct, indirect and induced impacts (where relevant, with rows blacked out where such impacts are not relevant). The worksheet can be used to record quantitative information alongside qualitative descriptions and data sources used.

5. *Describe baseline*: this worksheet looks very similar to the 'describe and quantify assets' worksheet in that it is also set out category-by-category and includes space for qualitative and quantitative information to be recorded on the impacts of the baseline. There are then three other columns that are used to summarise the results qualitatively. The results are: direction of change, magnitude of change and

significance of change. Once this worksheet is complete, the qualitative assessment is finished.

6. *OUTPUT-all*: this worksheet presents the results of the assessment. It summarises the qualitative assessment from the 'describe baseline' worksheet and includes monetary impacts (where these have been estimated). The worksheet also identifies who the beneficiaries are and how much they benefit (again, where monetary impacts have been estimated).

7. *OUTPUT-core*: this presents the same information as the 'OUTPUT-all' worksheet but just for the core categories. The smaller number of categories presented may make it easier to present the results, for example, to stakeholders.

8. *OUTPUT-optional*: this presents the same information as the 'OUTPUT-all' worksheet but just for the optional categories. Again, the smaller number of categories may make it easier to present the results.

9. *Summary by significance*: this worksheet presents results tables showing how many and what percentage categories have been assigned to low, medium or high magnitude of impacts, or small, moderate or large significance. These tables could be used to present results to stakeholders.

10. *Map of magnitude-significance*: this worksheet presents a surface chart showing how many categories are assigned to each magnitude and significance. The overall aim is to give an indication of the overall qualitative impacts in visual form.

11. *Summary by beneficiary*: this worksheet presents the monetary impacts by beneficiary (unlike the OUTPUT worksheets that present the results by category). The results are in tabular format that could be used in a report or presentation and give total benefits and damages.

12. *Chart-total beneficiary impacts*: this worksheet presents the monetary impacts in visual form using a bar chart to give an indication of which beneficiaries benefit the most or experience the greatest damages.

13. *Chart-IDB benefits by beneficiary*: this worksheet presents the breakdown of benefits only (excluding damages) by beneficiary. This is given as an alternative method of presenting the results to the bar chart.

14. *Chart-damages by beneficiary*: as above but this time the pie chart shows the breakdown by damages (excluding benefits).

15. *Summary by category*: this worksheet provides the total benefits and damages by category. It shows which categories make up the largest proportion of the total benefits, and so it could be used to identify where it may be worthwhile collecting specific data to improve the robustness of the benefit (and damage) estimates. The worksheet shows total benefits/damages, those to the Environment Agency and those to IDBs.

16. *Chart-total by category*: this worksheet presents the monetary benefits and damages in visual form using a bar chart to give an indication of which categories make up the greatest proportion of benefits and damages. The chart shows just the IDB benefits and damages (i.e. it does not include EA benefits or damages)

17. *Chart-pie by category*: as above but this time the data are presented in a pie chart, showing the proportion of IDB benefits by category.

18. *Calculation Worksheets*: this worksheet introduces the calculation worksheets that are used to estimate the monetary impacts for some of the categories. There are 17 calculation worksheets.

19. *Carbon*: this worksheet sets out a simple method for assessing the change in the amount of carbon that is sequestered in soils.

20. *Water levels-Residential*: this worksheet is used to estimate the impacts on residential properties from changes in water levels. Like most of the calculation worksheets, it uses quick methods and average damage values from the Multi-Coloured Handbook (2010 edition).

21. *Water levels-Business*: this worksheet enables impacts on businesses from changes in water levels to be estimated.

22. *Water levels-Social Infrastructure*: this worksheet enables impacts on assets, such as schools, hospitals, care homes, local authority depots, village halls and post offices from changes in water levels to be estimated.

23. *Water levels-Emergency*: this worksheet enables impacts on police stations, ambulance stations, fire stations, coastguard stations, and lifeboat stations from changes in water levels to be estimated.

24. *Water levels-Utilities*: this worksheet enables impacts on sewage treatment works, water treatment works, phone masts, electricity sub-stations, telephone exchanges, gas works and oil refineries from changes in water levels to be estimated.

25. *Water levels-Transport (road)*: this worksheet enables impacts from disruption to road travel from changes in water levels to be estimated.

26. *Water levels-Transport (rail)*: this worksheet enables impacts from disruption to rail travel from changes in water levels to be estimated. However, the approach to estimating indirect impacts (on rail users) is currently highly uncertain.,

27. *Food production*: this worksheet enables impacts on arable land and grassland from changes in water levels to be estimated.

28. *Energy (direct)*: this worksheet enables impacts on power stations or energy generating areas (such as windfarms) and power lines to be estimated. Again, this is linked to changes in water levels.

29. *Energy (indirect)*: this worksheet enables impacts from loss of power to electricity users due to impacts on power stations or electricity sub-stations to be estimated. This is linked to changes in water levels and the risk that this causes power outages.

30. *Designated biodiversity sites*: this worksheet enables impacts from changes in water levels on designated and non-designated sites to be estimated, taking account of the level of designation.

31. *Biodiversity-non-designated*: this worksheet enables impacts from changes in the biodiversity value of different land uses to be taken into account.

32. *Water supply*: this worksheet enables impacts from changes in water levels on access to abstraction to be estimated.

33. *Heritage*: this worksheet enables impacts on heritage assets from changes in water levels to be estimated. Due to the paucity of available monetary values, the impacts are based on willingness to pay of visitors to give an indication of the potential heritage value. Since many heritage assets may not be open to the public, these benefits may be difficult to explain to stakeholders. They may also be one of the most uncertain estimates across all the calculation worksheets.

34. *Recreation and tourism*: this worksheet enables impacts on recreation and tourism as a whole from changes in water levels to be estimated. As the assessment is for use by IDBs to estimate local impacts, no account is taken of the potential for damages to recreation and tourism in the IDB to result in benefits in other locations. This means these benefits cannot be used for capital Grant-in-Aid appraisals without further consideration of the potential for lost recreational opportunities to be picked up elsewhere.

35. *Jobs*: this worksheet uses current expenditure to estimate the knock-on benefits to other businesses and the number of non-IDB jobs that the IDB activities and expenditure may support.

4 Describe and quantify assets

4.1 What needs to be completed on this worksheet?

There are three columns that can be used to record information. Whether you need to use all three columns will depend on the level of detail you would like to provide. There is also space to record data sources and information in order to help maintain transparency and auditability.

The first column to complete is 'Background knowledge' (column D). You can record information that is readily available from published documents or that is based on the knowledge and expertise of IDB employees and the IDB Board.

If you feel that more information is needed than could be obtained from current knowledge, you can review or interrogate other information sources. GIS and mapping may be particularly useful for quantitative information, while reports and plans produced by others may help with those categories that you do not report on in detail. To maintain transparency within the assessment, you should record the sources of data. Table 4.1 provides an indication of data sources that you could use for each of the categories. The table is based on readily available sources and data that is freely available or should be available through, for example, the Public Sector Management Agreement.

The third column in the worksheet is used for new information that has been generated for the benefits assessment method. In most cases, you will not need to generate specific information unless there is a significant data gap, uncertainty, or a need to demonstrate a particular benefit to stakeholders.

The final column should be used to record sources of information, including references where published information has been used. Expert opinion and local knowledge are valid sources of data and information and should be recorded in this column alongside published sources.

Table 4.1: Source of information		
Category	**Potential sources of information**	**Weblinks (where available) or data owner**
Waterlogging, drought, flooding, erosion: • Residential properties	Local knowledge AddressPoint Web-sites (e.g. Land Registry, Hometrack, Zoopla) Neighbourhood statistics (output area: household spaces, accommodation type, dwellings, housing stock, lowest floor level) National Receptors Dataset (but this may not be free)	http://www.ordnancesurvey.co.uk/business-and-government/products/address-point.html http://www.landregistry.gov.uk/public/house-prices-and-sales; http://www.hometrack.co.uk/our-insight/monthly-national-house-price-survey; http://www.zoopla.co.uk/home-values/ http://www.neighbourhood.statistics.gov.uk/dissemination/ Published by the Environment Agency
Waterlogging, drought, flooding, erosion: • Business properties	Local knowledge AddressPoint Valuation Office Agency (business rates data) CLG (commercial and industrial floorspace rateable value statistics) Neighbourhood statistics (local authority area: local units by broad industry group, VAT Based enterprises, VAT based local units) National Receptors Dataset (but this may not be free)	http://www.ordnancesurvey.co.uk/business-and-government/products/address-point.html http://www.2010.voa.gov.uk/rli/ https://www.gov.uk/government/statistical-data-sets/live-tables-on-commercial-and-industrial-floorspace-and-rateable-value-statistics http://www.neighbourhood.statistics.gov.uk/dissemination/ Published by the Environment Agency
Waterlogging, drought, flooding, erosion: • Social infrastructure	Local knowledge Ordnance Survey maps Neighbourhood statistics	https://www.ordnancesurvey.co.uk/opendatadownload/products.html http://www.neighbourhood.statistics.gov.uk/dissemination/
Waterlogging, drought, flooding, erosion: • Emergency services	Local knowledge Ordnance Survey maps Neighbourhood statistics	https://www.ordnancesurvey.co.uk/opendatadownload/products.html http://www.neighbourhood.statistics.gov.uk/dissemination/
Waterlogging, drought, flooding, erosion: • Utilities infrastructure	Local knowledge Local Authorities Valuation Office Agency Ordnance Survey Utility companies (but may be confidential) National Grid (gas pipes)	http://www.voa.gov.uk/corporate/publications/statisticsCentralLocalRating.html https://www.ordnancesurvey.co.uk/opendatadownload/products.html See websites of specific utility companies http://www2.nationalgrid.com/uk/services/land-and-development/planning-authority/gas-and-electricity-network-routes/
Waterlogging, drought, flooding, erosion: • Transport infrastructure	Local knowledge Ordnance Survey (MasterMap Integrated Transport Network, Vector Map Open Data) Highways Agency/Local Authorities	https://www.ordnancesurvey.co.uk/opendatadownload/products.html Check specific county council websites

Table 4.1: Source of information		
Category	**Potential sources of information**	**Weblinks (where available) or data owner**
	Data.gov.uk (road traffic counts, transport statistics) National Rail Trends portal Neighbourhood statistics (Physical Environment – Land Use Statistics) Associated British Ports/port operators	https://www.gov.uk/government/statistical-data-sets/tra89-traffic-by-local-authority https://dataportal.orr.gov.uk/ http://www.neighbourhood.statistics.gov.uk/dissemination/
Control of invasive species	Local knowledge Biodiversity Action Plan	 IDB specific plan
Water quality	Local knowledge Environment Agency (waterbody status and river bodies and water quality) Biodiversity Action Plan	http://www.geostore.com/environment-agency/WebStore?xml=environment-agency/xml/ogcDataDownload.xml contain links to lots of datasets IDB specific plan
Production of grown food	Local knowledge Land cover maps Savills (land values) Government website MAGIC mapping website	http://www.ceh.ac.uk/accessinglcmdata.html http://www.savills.co.uk/research/uk/rural-research/rural-publications.aspx https://www.gov.uk/government/publications/agriculture-in-the-united-kingdom-2013 www.MAGIC.gov.uk
Collection of natural food	Local knowledge	
Energy	Local knowledge Ordnance Survey maps (including Vector Map Open Data) Power companies (but may be confidential) National Grid (electricity network routes) Regional Power Networks (electricity sub-stations)	https://www.ordnancesurvey.co.uk/opendatadownload/products.html http://www2.nationalgrid.com/uk/services/land-and-development/planning-authority/gas-and-electricity-network-routes/; http://www.westernpower.co.uk/Connections/Generation/Generation-Capacity-Map/Distributed-generation-EHV-constraint-maps.aspx
Production of timber, fibre, aggregates, peat, etc.	Local knowledge Land use classification maps	 https://www.gov.uk/government/publications/national-land-use-database-land-use-and-land-cover-classification
Biodiversity	Local knowledge Biodiversity Action Plan Land cover maps MAGIC (rural and environmental designations) Natural England (nature on the map) Wildlife Trusts Local Biological Records Centre Local Authority National Biodiversity Network (NBN) Gateway Local interest groups (bats, birds, mammals,	IDB specific plan http://www.ceh.ac.uk/accessinglcmdata.html www.MAGIC.gov.uk http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx See websites of specific wildlife trusts http://www.nbn-nfbr.org.uk/nfbr.php (links to Record Centres, these may not have websites) See specific Local Authority websites https://data.nbn.org.uk/ See websites of specific local interest groups

Table 4.1: Source of information		
Category	**Potential sources of information**	**Weblinks (where available) or data owner**
	etc.) RSPB and BTO	http://www.rspb.org.uk/ourwork/gis/library.aspx; http://www.bto.org/research-data-services/data-services
Carbon	Local knowledge Land cover maps Direct measurement of carbon sequestered in soils (such as university research carried out in area)	http://www.ceh.ac.uk/accessinglcmdata.html May only be available for specific locations where research has been carried out
Water supply	Environment Agency CAMS	http://www.geostore.com/environment-agency/WebStore?xml=environment-agency/xml/ogcDataDownload.xml
Health and well-being of people	Local knowledge Neighbourhood statistics (Health and Care – General Health (UV20)) Floodzone 2 data	http://www.neighbourhood.statistics.gov.uk/dissemination/ http://www.geostore.com/environment-agency/WebStore?xml=environment-agency/xml/ogcDataDownload.xml
Health and well-being of communities	Local knowledge Neighbourhood statistics (Health and Care – General Health (UV20)) Floodzone 2 data	http://www.neighbourhood.statistics.gov.uk/dissemination/ http://www.geostore.com/environment-agency/WebStore?xml=environment-agency/xml/ogcDataDownload.xml
Level of involvement in decision-making	Local knowledge	
Landscape character	Local knowledge MAGIC mapping website National Parks AONB website Natural England (National Character Areas)	www.MAGIC.gov.uk See specific National Parks websites www.aonb.org.uk http://www.naturalengland.org.uk/publications/nca/
Heritage values	Local knowledge English Heritage (World Heritage Sites, Listed buildings, Scheduled monuments, parks and gardens, battlefields) Ordnance Survey maps (including Vector Map Open Data)	http://list.english-heritage.org.uk/mapsearch.aspx https://www.ordnancesurvey.co.uk/opendatadownload/products.html
Knowledge and education	Local knowledge Local Authority	See specific Local Authority websites
Recreation and tourism	Local knowledge Ordnance Survey maps (including Vector Map Open Data)	https://www.ordnancesurvey.co.uk/opendatadownload/products.html
Jobs/expenditure	IDB accounts	Specific IDB accounts
Notes: links correct at time of publication (June 2014)		

4.2 What goes into direct, indirect and induced?

To reduce the risk of double counting, it is important to be clear what the direct, indirect and induced benefits are and who experiences them. Table 4.2 provides a summary of each type of benefits for each category. Not all of the categories require direct, indirect and induced beneficiaries to be described (shown as not applicable (N/A) in Table 4.2 and where rows are blacked out in the spreadsheet).

Table 4.2: Linking Benefit Categories to Beneficiaries

Benefit Category	Direct Beneficiaries	Indirect Beneficiaries	Induced Beneficiaries
Managing nature and resources			
Carbon sequestration and storage	Humans and other species (through sequestration of carbon helping to limit climate change)	N/A	N/A
Waterlogging, drought, flooding, erosion	Residential property owners and occupiers at risk of flooding or erosion	N/A	Property renters through reduced pressure on demand for short-term rents due to occasional flooding
	Business property owners and occupiers at risk of flooding or erosion	Businesses who trade with/supply/receive goods from the direct beneficiary businesses	Businesses outside the IDB district who may benefit from activity of businesses within the district (but do not trade directly with those businesses)
	Social infrastructure assets at risk of flooding or erosion	Social infrastructure users	Users of other social infrastructure outside the IDB district
	Police, ambulance and fire stations at risk of flooding or erosion	People who benefit from the emergency services	Users of other emergency services which are not overwhelmed because of the services within the IDB district
	Utilities infrastructure at risk of flooding or erosion	Consumers who are supplied by the utilities infrastructure	Users of other utilities infrastructure which is not overwhelmed because of the assets within the IDB district
	Transport assets at risk	Users of the transport network	Users of the transport network outside of the IDB district
Control of invasive species	Native species (since they are now threatened)	N/A	N/A
	Humans and other species from reduction in disease and pests	Farmers in IDB district (reduction in lost crops, livestock production)	Farmers outside IDB district from prevention of spread of diseases and pests
	Boat owners and users through maintenance of navigation	N/A	Boat users outside the district due to reduced congestion
Water quality	Abstractors Water body users (e.g. anglers, recreational boating, etc.)	N/A	N/A
Production of goods and services			
Production of grown food	Farmers	Consumers	Consumers (where nationally important quantities or types of crops are produced)
	People with bee hives	Consumers	N/A

Table 4.2: Linking Benefit Categories to Beneficiaries			
Benefit Category	**Direct Beneficiaries**	**Indirect Beneficiaries**	**Induced Beneficiaries**
	Anglers Aquaculture/fish farming businesses	Consumers	N/A
Collection of natural food	Hunters, shooting parties People gathering wild food	N/A	N/A
Energy	Energy producers (wind, water, access)	Energy users	N/A
Production of timber, fibre, aggregates, peat, etc.	Woodland/plantation owners and operators	Consumers	N/A
	Peat digging businesses	Consumers	N/A
Biodiversity	Populations of species (through increased genetic diversity increasing resilience and adaptability)	Farmers in the future	N/A
	Species and habitats	Indirect benefits (recreation) picked up under other categories	Wider society (from the knowledge that biodiversity is being protected or enhanced)
Water supply	Abstractors Water traders	Consumers (for PWS)	N/A
Social, cultural and employment benefits			
Health and wellbeing of people	Individuals within the IDB district	N/A	Demand for health services outside IDB district
Health and well-being of community(ies)	Local community within IDB district	N/A	N/A
Level of involvement in decision-making	Local community within IDB district	N/A	N/A
Landscape character	People living and working in the IBD district Visitors	N/A	N/A
Heritage values	People living and working in the IBD district Visitors	N/A	Wider society (from the knowledge that heritage is being protected or enhanced)
Knowledge and education	Adults and children using educational sites/resources	N/A	N/A
Recreation and tourism	Recreational users (e.g. walkers, dog walkers, joggers, bird watchers, etc.)	N/A	Recreational users outside the district through reduced congestion
Jobs supported	Employees of the IDB	Businesses supplying the IDB	Businesses receiving income from IDB employees spending their wages

5 Describe baseline

5.1 What needs to be completed on this worksheet?

The first column to complete is the description of the implications of the baseline. Consider the information entered into the 'describe and quantify assets' worksheet and how these assets might be affected under the baseline. Try to describe the impacts in as much detail as you feel is appropriate. As a guideline, the description included for each category needs to include enough detail to explain why you have chosen the direction of impact, magnitude and significance recorded in the next three columns in the worksheet. Some of the categories include default text that you can use, amend or replace, as you wish.

The next column involved identifying the direction of the impacts. There are five choices available:

- +: for positive impacts (benefits);
- -: for negative impacts (damages);
- Neutral: where there is no impact;
- + and -: where there could be both positive and negative impacts (but remember to focus on the impacts on each category separately); and
- Not relevant: where the category is not relevant.

Here record the direction of change between the current situation and the baseline, as that will fit with the descriptions included. The rest of the spreadsheet focuses on the change from the baseline to the current situation; the spreadsheet will automatically reflect this in the output worksheets.

Next is to identify the magnitude of the impact. Again, it is important to think only about the category for which you are identifying the magnitude. There are three options to choose from on magnitude:

- *Large* (there is a big impact on those assets that are affected): think just about the assets that are affected when identifying the magnitude of the impact. For example, 100 ha of arable land may become unfarmable under the baseline, so that would be a large impact;
- *Moderate* (there is a medium-sized impact on those assets that are affected): for example, the 100 ha of arable land may be affected once every few years due to lack of water management on lower lying areas making it more difficult to drain in wet weather; and
- *Small* (the impact on assets affected only likely to be minor): for example, the 100 ha of arable land may be affected infrequently due to flooding from rivers.

The final step on this worksheet is to identify the significance. This takes account of the extent of the impacts across all the assets in that category, with four options:

- *Very significant* (all or almost all assets in this category are affected): for example, this would be the case where the 100 ha of arable land is the amount of arable land within the Drainage Board district;
- *Significant* (the great majority of assets in this category are affected): there is no threshold level defined for the great majority to give some flexibility to the assessment. For example, this might be the case if the 100 ha of arable land affected is out of a total of 120 ha or 140 ha;
- *Slightly significant* (assets are affected in specific areas only): in this case, the assets affected may be located in one or more specific areas. For example, this could be where the 100 ha is located in two pockets, one of 60 ha and one of 40 ha

but the total area of arable land within the Drainage Board district is several hundred hectares; and

- *Not very significant* (or none): this option would be chosen where the area or number of assets affected is very small. For the 100 ha to be 'not very significant', it is likely that many thousands or tens of thousands of hectares of arable land would be present in the Drainage Board district.

Finally, you should give an indication of the uncertainty associated with the description of impacts and the ratings you have assigned. Again, there are pre-defined definitions to choose from, reflecting the implications of the type of data available to you and the data gaps that may exist on the level of uncertainty that is likely to result.

- *Low*: assessment supported by specific data and information, expert opinion and local knowledge
- *Moderate*: limited data and information available, limited expert opinion and local knowledge on data gaps; and
- *High*: no data or information that are directly relevant, assumptions made and judgements made to fill data gaps.

6 Calculation worksheets

6.1 What are these worksheets for?

The 17 calculation worksheets can be used when you want to estimate the monetary value of the impacts (benefits and damages). Table 6-1 lists the minimum data needs to enable monetary estimates to be made, plus the additional data needs if the default assumptions are to be revised to reflect the specific IDB.

Table 6.1: Data needs for estimating monetary values of benefits and damages

Category	Data needs	
	Minimum data needs	**Data needed to adjust default assumptions**
Residential properties	• Number of residential properties at risk • Change in probability of impacts (baseline to current) • Number of properties allocated to each probability band	• Regional market value (e.g. from Land Registry data) • Comparison of percentage of properties at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook).
Business properties	• Number of business properties at risk • Change in probability of impacts (baseline to current) • Number of properties allocated to each probability band.	• Regional market value (e.g. from Rateable Value data, Valuation Office Agency) • Comparison of percentage of properties at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook) • Number of years over which business properties are annualised (25 years is default) • Breakdown of business properties into specific types (by number, floor area).
Social infrastructure	• Number of social infrastructure assets at risk by type (schools, universities; hospitals, surgeries; day centres, care homes, nurseries; local authority depots; village halls; post offices, sorting offices) • Need for inclusion of any other types of social infrastructure • Change in probability of impacts (baseline to current) • Number of assets allocated to each probability band.	• Regional market value (e.g. possibly from Rateable Value data, Valuation Office Agency) • Typical floor areas (or actual) • Comparison of percentage of assets at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook) • Number of years over which social infrastructure assets are annualised (25 years is default) • Breakdown of social infrastructure assets into specific types (by number, floor area).
Emergency services	• Number of emergency services assets at risk by type (only have one police station identified) • Change in probability of impacts (baseline to current) • Number of assets allocated to each probability band.	• Regional market value (e.g. possibly from Rateable Value data, Valuation Office Agency) • Typical floor areas (or actual) • Comparison of percentage of assets at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook) • Number of years over which emergency services assets are annualised (25 years is default) • Breakdown of emergency services assets into specific types (by number, floor area).

Table 6.1: Data needs for estimating monetary values of benefits and damages		
Category	**Data needs**	
	Minimum data needs	**Data needed to adjust default assumptions**
Utilities	• Number of utility assets at risk by type (sewage treatment works, water treatment works, phone masts, electricity sub-stations, telephone exchanges, gas works/pipelines, oil refineries plus any others) • Change in probability of impacts (baseline to current) • Number of assets allocated to each probability band.	• Regional market value (e.g. possibly from Rateable Value data, Valuation Office Agency) • Typical floor areas (or actual) • Comparison of percentage of assets at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook) • Number of years over which utilities are annualised (25 years is default).
Transport (road)	• Length of A roads and critical B roads, and other roads affected • Change in probability of impacts (baseline to current) • Length of road (by type) allocated to each probability band.	• Breakdown of traffic impacts (by type, car, LGV, OGV, etc.) • Number of vehicles per hour by type of road • Total number of vehicles affected per hour (by type) • Estimated delay that would be caused • Estimated change in free flow speeds along affected roads • Relocation/rebuild and repair costs • Number of years over which roads are annualised (25 years is default) • Comparison of percentage of roads at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook).
Transport (rail)	• Length of mainline and branch line and number of stations affected • Type of railway line (based on National Rail definitions) • Change in probability of impacts (baseline to current) • Length of railway (by type) allocated to each probability band.	• Relocation/rebuild and repair costs • Number of years over which railways are annualised (25 years is default) • Comparison of percentage of railway line at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook) • Number of days over which lines might be closed (default is four days).
Food production	• Area of land affected by type (arable (combinable, non-combinable), livestock land, pigs/poultry, horticulture) • Change in probability of impacts (baseline to current) • Area of land (by use) allocated to each probability band.	• Whether land would be permanently affected under the different probability of impacts • Land values (these are national averages and do not reflect the different uses of land) • Gross margins (by land use type) • Number of years over which agricultural land is annualised (20 years is default) • Comparison of percentage of agricultural land at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook).
Energy (direct)	• Number of power stations and length of power lines affected • Change in probability of impacts (baseline to current) • Number or length allocated to each probability band.	• Relocation/rebuild and repair costs • Number of years over which power stations/lines are annualised (25 years is default) • Comparison of percentage of energy assets at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook) • Mean floor area of power stations.

Table 6.1: Data needs for estimating monetary values of benefits and damages		
Category	**Data needs**	
	Minimum data needs	**Data needed to adjust default assumptions**
Energy (indirect)	• This worksheet is linked to other worksheets so no inputs are needed; a monetary estimate will be automatically generated based on number of residential and business properties affected	• Number of electricity sub-stations by type affected • Typical customer distribution across the sub-stations • Typical cost of power outage • Number of hours per power outage • Comparison of percentage of sub-stations at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook).
Designated biodiversity sites	• Area of habitat (by designation: international, national and other/local) affected • Change in probability of impacts (baseline to current) • Area (by designation) allocated to each probability band.	• Whether designations would be permanently affected under the different probability of impacts • Relocation costs • Willingness to pay values used as damage costs • Number of years over which habitats are annualised (20 years is default, for consistency with agricultural land) • Comparison of percentage of area of designations at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook).
Biodiversity non-designated	• Change in habitat and areas allocated to different management or habitats • Change in length of watercourse by management.	• Appropriateness of scores allocated to change in biodiversity value from change in habitat or watercourse management (this is a simple approach from -2 to +2) • Willingness to pay values used as basis for estimating benefits of protecting biodiversity • Average width of a watercourse (default is 1m, used to convert km of watercourses to an area so the willingness to pay value can be applied).
Carbon	• very similar to those required for non-designated biodiversity, although the management aspect of habitats is not considered • Change in habitat and areas allocated to different habitats.	• Appropriateness of carbon sequestration values allocated to each habitat type (these are based on a review of the available scientific literature) • Value attributed to CO_2 (this is based on the untraded value for CO_2 from DECC).
Water supply	• Number of licences by type (public water supply, spray irrigation, other agriculture, electricity supply, other industry, fish farming, private water supply) • Number of licences by type affected • Change in probability of impacts (baseline to current) • Number of licences (by type) allocated to each probability band.	• Average Ml/day per licence by type, although these could be replaced by actual licence data, where known • Value of water (£/Ml/day) • Relocation/development of new abstraction point costs • Number of years over which the relocation/development costs are annualised (default is 25 years) • Comparison of percentage of licences (abstraction points) at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook).

Table 6.1: Data needs for estimating monetary values of benefits and damages		
Category	**Data needs**	
	Minimum data needs	**Data needed to adjust default assumptions**
Heritage	• Number of heritage designations present (international (World Heritage Sites), national (listed buildings, scheduled monuments, registered parks and gardens, registered battlefields), local (conservation areas, local listing/local heritage assets)) • Number of heritage assets by type affected • Change in probability of impacts (baseline to current) • Number of heritage assets (by type) allocated to each probability band.	• Typical number of visitors to heritage assets (could be replaced by actual number of visitors, where known) • Value per visitor of a trip to a heritage asset • Whether impacts are likely to be permanent or occasional • Relocation costs • Number of years over which the relocation costs are annualised (default is 25 years) • Comparison of percentage of heritage assets at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook).
Recreation and tourism	• Number of recreational assets present by type • Number of recreational assets by type affected • Change in probability of impacts (baseline to current) • Number of recreational assets (by type) allocated to each probability band.	• Weight assigned to each type of recreational asset • Typical number of visitors to the area (could be replaced by actual number of visitors, where known) • Value per visitor of a trip for recreational purposes • Whether impacts are likely to be permanent or occasional • Relocation costs • Number of years over which the relocation costs are annualised (default is 25 years) • Comparison of percentage of recreational assets at different probability bands (against the generic assumptions taken from the Multi-Coloured Handbook).
Jobs	• Leakage (percentage of money that the IDB spends that is spent outside the IDB district), this is set at a default value of 70%.	• Multiplier (this is based on generic data for the UK as a whole and for an aggregated sector spend that may not reflect IDB spend) • Expenditure per 1 staff (this is based on average across all IDBs).

6.2 How reliable are the estimates?

The estimates are based on generic monetary values from a number of sources, in particular the Multi-Coloured Manual (MCM) and Handbook (MCH). Wherever possible, they follow accepted approaches and existing guidance. However, as the values are generic and the approaches are designed to be relatively simple, there will be uncertainty associated with the estimates that are produced. To reflect this, the results in the output tables are given to two significant figures. Uncertainty ratings are assigned at the end of each calculation worksheet. As a default, these are set to 'high' to reflect that generic estimates have been used. Where you use data specific to your IDB, you can consider whether this is sufficient to reduce the amount of uncertainty. As an indication of the uncertainty, it can be assumed that if your IDB is 'typical' of the country as a whole, then the estimates will be reasonable. The more atypical your IDB is, the more uncertain the estimates will be.

You should also consider how much time and resources would be needed to collect the additional data and weigh up whether it is worth investing these time and resources.

Since most IDBs will be atypical, it is possible to refine the calculation sheets to reduce the level of uncertainty. The most important cells to change are likely to be the percentage area that is at risk under different levels of probability. The percentage areas are used in most of the calculations[3] to enable you to estimate annual impacts that take account of the probability that impacts will occur due to changes in water levels. To change these estimates, you can update the values in cells D16 to M16 in the 'Water levels-residential' worksheet, cells D16 to M16 in the 'Water levels-business' worksheet and cells D114 to M114 in the 'food production' worksheet. All other worksheets are linked to these values so they will update automatically, although you can, of course, change them in all the relevant worksheets if you wish, so that they are specific to the assets within the category in question. The default values on percentage area likely to be affected are taken from the Multi-Coloured Handbook for residential and non-residential properties, and based on information on the area of agricultural land at risk.

You should consider whether using data specific to your IDB is likely to be worthwhile. This may be the case where:

- your IDB is more atypical than typical for a specific benefit category, so the generic data are less likely to be relevant to your IDB;
- the estimated benefits under that category make up a relatively large proportion of the total benefits; and
- where the collection of additional data is likely to reduce uncertainty in the estimates (i.e. where the data you will collect will be directly relevant to the calculations being undertaken).

Uncertainties associated with the generic values used for each category are described in the relevant sub-sections below. Many of the sources of uncertainty are common to most of the categories. However, they are repeated for each category to emphasise how and where uncertainty will have been introduced.

6.3 What information is needed to estimate monetary values?

The type of information needed varies by worksheet. Therefore, guidance is given for each category's calculation worksheet. For all the calculation worksheets, though, you will need to enter data into some of the white cells to generate an estimate of the monetary impacts. Some of the white cells allow you to enter additional detail beyond the minimum needed to calculate a value. The guidance below will help you identify which cells you need to or can complete and when.

6.4 Water levels

6.4.1 Water levels - residential

Impacts on residential properties are estimated based on the damages that would be caused by changes to water levels. To complete this worksheet, you need to:

1. Identify or estimate how many residential properties are present in the IDB district.
2. Estimate how the change in water levels under the baseline scenario would change the probability of impacts from waterlogging or flooding of these properties (you can use the average percentages affected by different floods from Table 4.4 of the MCH

[3] The areas are not used in the carbon, non-designated biodiversity and jobs calculation worksheets.

to give default estimates if you do not have any other data. The worksheet includes a simple calculator that will estimate the number of properties at each probability level when you enter the total number of properties based on these default assumptions into cell D17).

3. Enter the number of properties whose probability of impacts changes according to the change from the baseline to the current situation. For example, if you have 2,300 properties whose probability of impacts changes from 100% to 1%, put 2,300 into cell K4. Use cells D4 to M13 to record the number of properties whose probability of impacts changes.

You can update the estimated damages (cells D36 to M36) to reflect new damage estimates. You can also change the percentage of the area at probability level (cells D35 to M35) if you know the area of the IDB district at each probability level, but not the number of properties.

If the probability of impacts is 100% or 50%, it is assumed that this would result in permanent loss. Where there are permanent losses, it is assumed that residential properties would be written off. Probabilities lower than 50% are assumed to result in one-off, or occasional losses.

6.4.2 Water levels - business

Impacts on businesses are estimated based on the damages that would be caused by changes in water levels. To complete this worksheet, you need to:

1. Identify or estimate how many businesses are present in the IDB district.
2. Estimate how the change in water levels under the baseline scenario would change the probability of impacts on these businesses (you can use the average percentages affected by different floods from Table 4.4 of the MCH to give default estimates if you do not have any other data. The worksheet includes a simple calculator that will estimate the number of properties in each risk band when you enter the total number of businesses based on these default assumptions into cell D17[4]).
3. Enter the number of businesses whose probability of impacts changes according to the change from the baseline to the current situation in cells D4 to M13, as required. For example, if you have 130 businesses whose probability of impacts changes from 100% to 1%, put 130 into cell K4.
4. The impacts on business properties are based on floor area. If you have data on floor area by business type (factory, retail, warehouse, office/other, non-bulk), you can enter this directly (in cells F54 to F58). If you do not have data on floor area by business type, leave these cells empty, and the calculation worksheet will use average flood area and typical percentage of each business type. You can also enter the number of each of these business types if you have it (in cells D54 to D58). That will allow you to use percentages that reflect your IDB. However, if you do not have these data, the calculation worksheet will use average values.

You can update the estimated damages (cells D45 to M50) to reflect new damage estimates per m^2 (for businesses the damages are estimated based on floor area). You can also change the percentage of the area at each probability level (cells D44 to M44) if you know the area of the IDB district at each probability level but not the number of businesses.

If the probability of impacts is 100% or 50%, it is assumed that this would result in permanent loss. Where there are permanent losses, it is assumed that business properties

[4] These are the same percentages as for residential properties as the MCH does not give estimates for the number of businesses at each probability level.

would be rebuilt or relocated outside the at-risk area (in many cases, this may need to be outside the IDB district). The spreadsheet does not take account of any impacts that might occur between the time that the property is impacted and the time when it is rebuilt. However, the spreadsheet does use a depreciation factor with a default assumption that the value of any asset impacted is 50% of its rebuild or relocation value. This factor is used to reflect that assets are likely to have been in place for some time, and so will not be worth their total 'new' value. On average, a value of 50% is taken since this reflects a mid-point between new assets and those with little, if any, residual value. Probabilities lower than 50% are assumed to result in one-off, or occasional losses.

6.4.3 Water levels – social infrastructure

Impacts on social infrastructure are estimated based on the damages that would be caused by changes to water levels. To complete this worksheet, you need to:

1. Identify or estimate how many schools and universities; hospitals and surgeries; day centres, nurseries and care homes; local authority depots; village halls; and post offices and sorting offices are present in the IDB district. There is space for one 'other' category if you have other infrastructure that provide services to the local communities (you can also revise the categories if necessary, you will then also need to revise the estimates of mean floor area (cells E134 to E140)).
2. Estimate how the change in water levels under the baseline scenario would change the probability of impacts on social infrastructure (you can use the average percentages affected by different floods from Table 4.4 of the MCH to give default estimates if you do not have any other data. The worksheet includes a simple calculator that will estimate the number of social infrastructure at each probability level when you enter the total number into cell D95, based on the default assumptions[5]).
3. Enter the number of social infrastructure whose probability of impacts changes according to the change from the baseline to the current situation in cells D4 to M13 (for schools and universities), cells D17 to M26 (for hospitals and surgeries), etc., as required. For example, if you have 4 schools whose probability of impacts changes from 100% to 1%, put 4 into cell K4.
4. Like businesses, the impacts on social infrastructure are based on floor area. If you have data on floor area by infrastructure type, you can enter this directly (in cells F134 to F140). If you do not have data on floor area, do not revise these cells (which will automatically give the total by type of social infrastructure), and the calculation worksheet will use average flood area and typical percentage of each type of social infrastructure.

You can update the estimated damages (cells D124 to M130) to reflect new damage estimates per m^2.

If the probability of impacts is 100% or 50%, it is assumed that this would result in permanent loss. Where there are permanent losses, it is assumed that social infrastructure assets would be rebuilt or relocated where the risk is removed (in many cases, this may need to be outside the IDB district). The spreadsheet does not take account of any impacts that might occur between the time that the property is impacted and the time when it is rebuilt. As with business premises, a depreciation factor is applied to the permanent losses with 50% used as the default assumption. Probabilities lower than 50% are assumed to result in one-off, or occasional losses.

[5] These are the same percentages as for residential properties as the MCH does not give estimates for the number of social infrastructure at each probability level.

6.4.4 Water levels – emergency services

Impacts on emergency services are estimated based on the damages that would be caused by changes to water levels. To complete this worksheet, you need to:

1. Identify or estimate how many emergency services (sub-divided into police stations, ambulance stations, fire stations, coastguard stations and lifeboat stations) are present in the IDB district. There is space for one 'other' category if you have other emergency services that could be affected.
2. Estimate how the change in water levels under the baseline scenario would change the probability of impacts on emergency services stations (you can use the average percentages affected by different floods from Table 4.4 of the MCH to give default estimates if you do not have any other data. The worksheet includes a simple calculator that will estimate the number of emergency services stations at each probability level when you enter the total number in cell D82, based on the default assumptions[6]).
3. Enter the number of emergency services whose probability of impacts changes according to the change from the baseline to the current situation in cells D4 to M13 (for police stations), cells D17 to M26 (for ambulance stations), etc., as required. For example, if you have 1 police station whose probability of impacts changes from 100% to 1%, put 1 into cell K4.
4. Like businesses and social infrastructure, the impacts on emergency services are based on floor area. If you have data on floor area by type of emergency service, you can enter this directly (in cells F118 to F123). If you do not have data on floor area by type of emergency service, do not change the data in these cells, and the calculation worksheet will use average flood area and typical percentage of each type of emergency service.

You can update the estimated damages (cells D109 to M114) to reflect new damage estimates per m^2.

If the probability of impacts is 100% or 50%, it is assumed that this would result in permanent loss. Where there are permanent losses, it is assumed that emergency services assets would be rebuilt or relocated where the risk is removed (in many cases, this may need to be outside the IDB district). The spreadsheet does not take account of any impacts that might occur between the time that the property is impacted and the time when it is rebuilt. A depreciation factor is applied to the permanent damages, set at a default level of 50%. Probabilities lower than 50% are assumed to result in one-off, or occasional losses.

6.4.5 Water levels – utilities

Impacts on utilities are estimated based on the damages that would be caused by changes to water levels. To complete this worksheet, you need to:

1. Identify or estimate how many utility services (sub-divided into sewage treatment works, water treatment works, phone masts, electricity sub-stations, telephone exchanges, gas works and oil refineries) are present in the IDB district. There is space for one 'other' category if you have other utility services that could be affected.
2. Estimate how the change in water levels under the baseline scenario would change the probability of impacts from waterlogging or flooding of utilities (you can use the average percentages affected by different floods from Table 4.4 of the MCH to give default estimates if you do not have any other data. The worksheet includes a simple

[6] These are the same percentages as for residential properties as the MCH does not give estimates for the number of social infrastructure at each risk level.

calculator that will estimate the number of utilities at each probability level when you enter the total number in cell D92, based on the default assumptions[7]).

3. Enter the number of utilities whose probability of impacts changes according to the change from the baseline to the current situation in cells D4 to M13 (for sewage treatment works), cells D17 to M26 (for water treatment works), etc., as required. For example, if you have 13 sewage treatment works whose probability of impacts changes from 100% to 1%, put 13 into cell K4.
4. Like businesses and social infrastructure, the impacts on utilities are based on floor area. If you have data on floor area by type of utility, you can enter this directly (in cells F152 to F159). If you do not have data on floor area by type of utility, leave these cells empty, and the calculation worksheet will use average flood area and typical percentage of each type of utility.

You can update the estimated damages (cells D141 to M148) to reflect new damage estimates per m^2.

If the probability of impacts is 100% or 50%, it is assumed that this would result in permanent loss. Where there are permanent losses, it is assumed that utilities infrastructure would be rebuilt or relocated where the risk is removed (in many cases, this may need to be outside the IDB district). The spreadsheet does not take account of any impacts that might occur between the time that the property is impacted and the time when it is rebuilt. A default assumption of 50% is used as the depreciation factor, in line with the assumption made for other non-residential properties. Probabilities lower than 50% are assumed to result in one-off, or occasional losses.

6.4.6 Water levels – transport (road)

Impacts on road transport are estimated based on the damages that would be caused by changes to water levels. To complete this worksheet, you need to:

1. Identify or estimate what length of road is affected, where possible, by length of motorway, A roads and critical B roads (those that are used by through traffic for access into and out of the IDB), and other roads (take care when considering other roads as you should not include any roads that only provide access to properties or other assets that would be written-off under the baseline).
2. Estimate the significance of impacts on the road network in terms of the length of the delay (in hours) that would be caused. The default value (cell D21) is 4 hours. You can replace this with an estimate specific to your IDB, for example, to reflect the likelihood of greater (or lesser) delays based on current congestion levels.
3. Enter the number of km of road whose probability of impacts changes, by type of road in cells D82 to M91 (for motorway). For example, if 6 km of motorway changes from having a probability of impacts of 20% under the baseline to 1% under the current situation, put 6 into cell K84.

You can also update the number of vehicles per hour if you have vehicle count data. This will be most important where there are roads that carry a lot of traffic as otherwise the estimated impacts may be significant under-estimates. Add your specific data into cells D11 to D13 to replace the national average data.

If the probability of impacts is 100% or 50%, it is assumed that this would result in permanent loss. Where there are permanent losses, it is assumed that the roads would be relocated and the risk removed (in many cases, this may need to be outside the IDB district).

[7] These are the same percentages as for residential properties as the MCH does not give estimates for the number of social infrastructure at each risk level.

The spreadsheet does not take account of any impacts that might occur between the time that the road is impacted and the time when it is relocated. As with non-residential properties, a depreciation factor of 50% is used for road assets that need to be relocated. Probabilities lower than 50% are assumed to result in one-off, or occasional losses.

The costs of relocation (permanent losses) or repair costs (one-off losses) for direct impacts on road transport can also be updated should better data be available. The values included in the spreadsheet are highly uncertain as they are based on generic data on construction costs of different types of roads.

6.4.7 Water levels – transport (rail)

Like road transport, impacts on rail transport are divided into direct damages (to service providers) and indirect damages (to rail users). Both calculations are based on the same data to minimise the amount of information you need to enter. Impacts are estimated based on the damages that would be caused by changes in water levels. To complete this worksheet, you need to:

1. Identify or estimate what length of railway is affected, by length of mainline and branch line. For direct impacts, the number of stations affected is also included.
2. For the indirect damages, identify which lines are at risk and then compare these with the 'typical' lines given in cells D52 to D60. You can record the specific lines and change the number of lines affected to greater than one, as appropriate.
3. Estimate the significance of impacts on the rail network in terms of the length of the time over which the railway lines would be closed. The default value is a closure of 4 days, based on advice from National Rail.
4. Enter the number of km of railway or number of stations whose probability of impacts changes, by type of rail in cells D5 to M14 (for mainline). For example, if 6 km of mainline railway changes from having a probability of impacts of 20% under the baseline to 1% under the current situation, put 6 into cell K7.

If the probability of impacts is 100% or 50%, it is assumed that this would result in permanent loss. Where there are permanent losses, it is assumed that the railway would be relocated and the risk removed (in many cases, this may need to be outside the IDB district). The spreadsheet does not take account of any impacts that might occur between the time that the railway is impacted and the time when it is relocated. A depreciation factor of 50% is applied to permanent losses, in line with the other benefit categories. Probabilities lower than 50% are assumed to result in one-off, or occasional losses.

The costs of relocation (permanent losses) or repair costs (one-off losses) for direct impacts on rail transport can also be updated should better data be available. The values included in the spreadsheet are highly uncertain as they are based on generic data on construction costs of railway or stations.

The indirect impacts are based on the number and type of lines that would be closed due to changes in water levels. The damages are based on data from National Rail for the revenue that would be at risk to train operators as a result of increased risks from reduced drainage. Indirect impacts are only assumed to occur where the lines would be affected occasionally. Where there are permanent impacts, it is assumed that the rail lines would be relocated outside the at-risk area, such that indirect impacts would not occur.

6.4.8 Uncertainty with the water levels category

The calculations are based on Weighted Annual Average Damages (WAAD), which the MCH recommends to be used where 'the appraiser has little or no understanding of the potential flood depths and return periods'. The generic nature of the estimates means that they are highly uncertain. However, they are considered proportionate given the high level benefit estimates being generated in the spreadsheet. This also means that property-specific data relating to the likely level of damages, such as thresholds, is not taken into consideration.

Relocation and repair costs are used for permanent losses, along with annualisation factors to convert the one-off costs to annual values and depreciation factors to take account of the depreciated value of the affected assets. All of these assumptions (the repair cost estimates, the annualisation factors and depreciation factors) will introduce uncertainty into the benefit estimates. Whether the benefits are over- or underestimated will depend on the specific circumstances within the IDB district. There is also an assumption that the relocation costs reflect the length or number of assets that are permanently affected. This will be most uncertain for length-based estimates (such as length of road or railway) as the relocation routes could be much longer than the length that they replace.

For non-residential properties, the Weighted Annual Average Damages (WAAD) are for properties without a basement. Although the classification of non-residential properties does include social infrastructure, emergency services and utilities, data on these properties is of a lower quality than for businesses. As such, the WAAD, when applied to social infrastructure, emergency services and utilities, are likely to be highly uncertain.

Further uncertainty is introduced where the number of properties (residential and non-residential) at each probability level is based on the generic assumptions from the MCH. Since these assumptions relate to the average proportion of residential properties in a 1 in 200 year flood plain, they are unlikely to reflect the situation within your IDB very well. This will also introduce a high level of uncertainty into the estimates and may underestimate the impacts on non-residential properties where there is a greater number at higher probability of impacts than suggested by the default assumptions, such as in low-lying areas. An OS map could be used to identify the location of non-residential properties, especially some social infrastructure, emergency services and utilities, and hence, provide a basis for an IDB-specific probability level for these assets, reducing the level of uncertainty to some degree.

Impacts on road transport may be underestimated in areas with above-average traffic levels or where roads are already at (or almost at) carrying capacity. The toolkit allows data specific to the roads in question to be included to reduce the level of uncertainty (such as vehicle counts or changes to the number of hours delay). Specific data should be used wherever transport impacts might be significant and they can be reasonably readily collected (this may be easier for road transport through Local Authority road count data than for rail impacts, although passenger data may be available).

The approach for railways for indirect costs is based on information and costs provided by National Rail. Therefore, these impacts may be of lower uncertainty than the direct effects. Some uncertainty will be introduced through the use of 'typical' lines to provide an estimate of the impacts on other lines, but this is considered proportionate given the level of uncertainty introduced through other assumptions for this and other categories.

The impacts of waterlogging are assumed to be the same as for flooding, which is unlikely to be the case. If the impacts relate only to waterlogging of ground and, perhaps, flooding of foundations, then the damages will need to be revised downwards to avoid significantly over-estimating the impacts. The depth-damage tables provided on the CD accompanying the

MCH can be used as the basis for revised damage values, although values for specific utilities may not be available, requiring extrapolation from other types of non-residential properties or engagement with service or utility providers. Conversely, impacts from permanent waterlogging may significantly affect use of some assets (especially roads and railways) and could result in an underestimate of benefits. It is important, therefore, to remember that the assessment is based on the probability of impacts on that asset, not the probability of flooding.

Caution should be applied if using the estimated impacts on residential property for Grant-in-Aid appraisals as the MCH recommends the use of WAAD for outline studies only. This means that the estimates may be questioned if they are used to justify the need for capital funding. Care is also needed as the monetary values estimated are annual values, ignoring that some properties with high probability of impact may be written-off (this may underestimate actual damages). The use of annual values means that no capping is used. The need for capping should be considered when estimating Present Value (PV) damages over a long appraisal time horizon. Furthermore, if you would like to use the annual values calculated in the spreadsheet in GiA appraisals, you will need to take account of the timing of impacts. This is because impacts that do not occur until sometime into the future will be discounted. This will be important where the impacts would not occur immediately. For example, if the pumps were switched off, you should consider the time before the assets would be affected by changes in water levels. If this would take, say five years, you would need to reflect this by delaying the onset of impacts until year four (assuming you start the appraisal in year 0).

6.5 Food production

6.5.1 Background and approach

Impacts on food production are estimated based on the change in productivity of land and the use of land from changes in water levels. To complete this worksheet, you need to:

1. Identify the area (in ha) of arable (combinable or non-combinable crops), grassland, pigs/poultry and horticulture that is affected.
2. Estimate the change in probability of impacts on arable (combinable or non-combinable crops), grassland, pigs/poultry and horticulture under the baseline scenario.
3. Enter the number of hectares whose probability of impacts changes, by type of land in cells D5 to M14 (for arable land-combinable crops), cells D18 to M27 (for arable, non-combinable crops), cells D31 to M40 (for grassland), cells D44 to M53 (for pigs/poultry), cells D57 to M66 (for horticulture) and cells D70 to M79 (for other). For example, if the probability of impacts for 2,200 ha of arable land used for combinable crops changes from 100% under the baseline to 20% under the current situation, put 2,200 into cell F5.

You can change the values included to estimate the impacts of agricultural land, update them, or make them locally specific (the default numbers are national averages, and therefore will not reflect the grade of land within the IDB district, so specific values should be used where available). You can also change whether the impacts are assumed to be as a result of permanent loss for food production or a one-off loss, as well as other input data such as the number of years over which land prices are annualised[8]. The default assumption is 20 years but you can increase or decrease this if you have local data that suggest land prices are annualised (sometimes referred to as capitalised) over a different time period. Take care though, as the discount rate used needs to be consistent with the HM Treasury

[8] Annualisation is used to convert the land value to a per year value.

rate of 3.5%; discount rates used by land valuers are likely to be higher so will have lower annualisation time periods.

6.5.2 Uncertainty with the food production category

The main uncertainties with the impacts on food production are the values used for loss of land and output, and the amount of land that is allocated to each probability level. The values used for loss of land and output are based on national averages and reflect just one year of data. You should use land values from your IDB area wherever possible, as the national averages do not reflect the grade of land present. Given the volatility of agricultural crop values, you may wish to use a moving average of gross margin for the one-off losses. This could be a five- or ten-year moving average, depending on the data you have available. The spreadsheet uses a value from 2012 to keep the data requirements to a minimum, but where food production is a significant benefit, you may wish to collect and use additional data.

The amount of land at each probability level is based on assumptions on the area of agricultural land at different levels of flood risk for the country as a whole. Clearly, basing the assumption of percentage of all agricultural land in England at each probability level will introduce a high level of uncertainty since much of the low-lying land within IDBs will require water level management to retain productivity. Therefore, you should change the proportion of land at each probability level wherever possible (cells D114 to M114).

The approach used in the food production worksheet follows Defra guidance on the treatment of agricultural land; hence, it is consistent with approaches used when estimating damages for capital Grant-in-Aid appraisals. Care is needed though, as the monetary values estimated in the food production worksheet are annual values. The use of annual values means that no capping is used. The need for capping should be considered when estimating Present Value (PV) damages over a long appraisal time horizon, especially if damages due to permanent loss of land are estimated and the time over which land values are annualised is less than the time horizon used for the GiA appraisal. Furthermore, if you would like to use the annual values calculated in the spreadsheet in GiA appraisals, you will need to take account of the timing of impacts. This is because impacts that do not occur until sometime into the future will be discounted. This will be important where the impacts would not occur immediately. For example, if the pumps were switched off, you should consider the time before agricultural land would be affected by changes in water levels. If this would take, say five years, you would need to reflect this by delaying the onset of impacts until year four (assuming you start the appraisal in year 0).

There may also be issues associated with taking one-off losses for agriculture. During testing of the toolkit, it was suggested that the one-off losses appear to significantly underestimate the damages since there is often no method by which crops being grown in an area can be relocated and grown in another area. However, the approach in the toolkit is currently based on Defra guidance which suggests using one-off costs where land is to be written off. This could add additional uncertainty to the damage estimates and may be considered to underestimate the damages where it would be difficult to replace land elsewhere. This is likely to be particularly important in areas of high grade agricultural land or where large areas of land would be affected.

6.6 Energy

6.6.1 Energy (direct)

Impacts on energy are estimated based on impacts in the amount of energy that can be produced and transmitted to, and around, the National Grid. To complete this worksheet, you need to:

1. Identify the number of power stations, windfarms, etc., and length of power lines (in km) that are affected (take care when including power lines as these may not be impacted adversely by an increase in water levels, although it will be important that they can be accessed for maintenance; occasional high water levels may not have significant impacts).
2. Estimate the change in probability of impacts on power stations and power lines under the baseline scenario.
3. Enter the number of power stations and length of power lines whose probability of impacts changes, in cells D4 to M13 (for power stations, windfarms, etc.) and cells D17 to M26 (for power lines). For example, if the probability of impacts for 35km of power lines changes from 100% under the baseline to 20% under the current situation, put 35 into cell F17.

You can update the cost associated with rebuilding or relocating power stations and power lines, or the repair costs associated with occasional impacts where you have more specific cost information. The values included in the spreadsheet are highly uncertain as they are based on generic data on construction costs of power stations.

If the probability of impacts is 100% or 50%, it is assumed that this would result in permanent loss. Where there are permanent losses, it is assumed that the power stations and power lines would be relocated and the risk removed (in many cases, this may need to be outside the IDB district). The spreadsheet does not take account of any impacts that might occur between the time that the power station or power lines are impacted and the time when they are relocated. A depreciation factor of 50% is applied to permanent losses, in line with the other benefit categories. Probabilities lower than 50% are assumed to result in one-off, or occasional losses.

6.6.2 Energy (indirect)

Indirect impacts on energy are estimated based on the change in probability of impacts of power outages affecting electricity consumers. This worksheet is automatically completed using information on the number of residential properties affected to determine the number of electricity sub-stations that could be impacted. You can replace the automatic assumptions if you have specific data on the type and number of sub-stations affected. The automatic calculations may underestimate the number of larger electricity sub-stations that could be affected if you have divided residential properties across a large number of different probability impacts. This is because the spreadsheet divides the number of properties associated with each change in probability by the typical number of customers supported by each type of sub-station. Therefore, if there are 28,000 properties but these are divided across 10 different probabilities, the spreadsheet would only identify distribution sub-stations (serving 150 properties each) and no primary sub-station (6,000 properties) or transformation sub-stations (28,000 properties). However, if you had allocated all the properties to one probability, the spreadsheet would assume that there is one transformation sub-station and four primary sub-stations, alongside the distribution sub-stations.

You can update the number of customers supplied by each type of electricity sub-station, the typical customer distribution, the cost of one hour's power outage for those customers and the typical number of hours affected, if you have specific or more up-to-date data.

Where there are permanent impacts on power stations or power lines, it is assumed that these would be relocated outside the at-risk area, such that indirect impacts would not occur.

6.6.3 Uncertainty with the energy category

The main uncertainties with the impacts on energy are the assumptions on the probability of impacts, the number and distribution of customers supplied by different types of sub-stations, the values used for relocation and repair costs, and costs and duration of power outages.

The percentage of total WAAD used as the basis for valuing the impacts from a change in probability of impacts for power stations, power lines and sub-stations is based on assumptions on the number of business properties at different levels (from the MCH). Clearly, these assumptions will introduce a high level of uncertainty since they may reflect the actual risk to energy assets.

The number of customers typically supplied by each of the four types of electricity sub-stations is based on information readily available from electricity companies. As the values are averages, they are unlikely to be applicable to all sub-stations, and so will introduce some uncertainty. Much more significant though is the uncertainty introduced from the assumptions made about the distribution of types of customers (90% being households, 9% being small and medium-sized businesses and 1% being large businesses). As this is an estimate, it is unlikely to reflect the actual distribution and so will introduce a high level of uncertainty. It may, though, be difficult to obtain specific data on customer distribution such that reducing this uncertainty may be very time-consuming and resource intensive.

The values for relocation, rebuild and repair costs are based on high-level cost data, and it is not always clear which costs are included and which are not included. This is likely to introduce a high level of uncertainty into the benefit estimates. In addition, uncertainty is introduced by ignoring any time delay between electricity assets being affected permanently and being replaced. This time may be minimised where there is the potential to plan for their replacement, such that uncertainty in the benefit estimates would be greatest where there is no warning that the IDB will stop all activities. As a result, it is assumed that there are zero indirect damages if power stations or power lines are to be relocated (i.e. under the 100% and 50% probabilities of impacts).

The costs of power outages are based on a study undertaken in the USA in 2003. The costs taken from this study have been converted to Pounds Sterling using the Purchasing Power Parity and uprated to 2012 values. However, the use of values from the USA may not reflect the value of electricity to UK consumers, and so will introduce significant uncertainty.

Energy damages are not usually monetised[9] for a GiA application since it would be assumed that the electricity production lost in one area could be replaced by energy from somewhere else (when monetised the impacts become a transfer payment). However, there may be a case for monetising the damages where there would be disruption to electricity services. This may require the annual values used on the energy worksheet to be reduced to reflect the time over which disruptions might be expected to occur. Furthermore, if you would like to use the annual values calculated in the spreadsheet in GiA appraisals, you will need to

[9] Unless power lines have to be relocated, in which case the costs of relocation may be included in the economic appraisal.

take account of the timing of impacts. This is because impacts that do not occur until sometime into the future will be discounted. This will be important where the impacts would not occur immediately. For example, if the pumps were switched off, you should consider the time before any assets associated with electricity provision would be affected by changes in water levels. If this would take, say five years, you would need to reflect this by delaying the onset of impacts until year four (assuming you start the appraisal in year 0).

6.7 Biodiversity sites

6.7.1 Designated biodiversity sites

Impacts on biodiversity are estimated based on impacts on designated sites from a change in water levels; those for non-designated sites are based on how changes in land use might affect the extent to which biodiversity is supported or enhanced, and are considered separately. To complete this worksheet, you need to:

1. Identify the area of internationally, nationally and other/locally designated sites.
2. Estimate the change in probability of impacts to designated sites, taking account of whether the impacts would be negative (damages, i.e. loss of biodiversity) or positive (benefits, i.e. gain in biodiversity). It may not always be possible to determine the net change in biodiversity. This is because an increase in water levels might be beneficial for some species but detrimental to others. If you are unsure, it is better to record your assumptions in the 'describe baseline' worksheet and avoid monetisation of these impacts. For designated sites, especially international and national designations, there may be negative impacts on the reasons for designation. There is, therefore, a stronger reason for monetising these impacts.
3. Enter the area of land whose probability of impacts changes, in cells D5 to M14 (for international designations), cells D18 to M27 (for national designations) and where there is strong evidence that biodiversity value would change in one direction or the other in cells D31 to M40 (for other/local designations). For example, if the probability of impacts for 55 ha of internationally designated land changes from 100% under the baseline to 20% under the current situation, put 55 into cell F5.

You can update the damages given for different types of habitat if you have specific damage data. The values given are based on Defra GiA funding contributions (Outcome Measure 4) for recreation/relocation of sites due to permanent impacts and willingness to pay values for different types of habitat for one-off losses or occasional impacts. The most important one to change may be that from relocation costs for international designations. By default, this is given as £50,000 per ha, based on the cost of creation of intertidal habitat. Where the habitat affected is wet grassland, a more appropriate relocation cost may be £30,000 per ha. As with the other categories, you can also change the default assumptions on the proportion of the area that is allocated to each probability level (cells D77 to M77); the implications of these assumptions for uncertainty are discussed below.

6.7.2 Non-designated biodiversity sites

The non-designated biodiversity calculation worksheet is more like the carbon worksheet than the designated biodiversity worksheet in that it is based on the likely change in land use from the baseline to the current scenario.

Cells D5 to Q18 provide space to record the number of hectares that change from one land use to another. Each land use type typically has two options:

- land use type with no specific action undertaken to enhance biodiversity (e.g. intensive arable, extensive arable);

- land use type with specific actions undertaken to enhance biodiversity (e.g. intensive arable managed to enhance biodiversity).

These two types of land use are needed to ensure that activities currently being undertaken by IDBs and landowners are reflected in the valuation of impacts. This is particularly important where the benefits are associated with the baseline of the IDB stopping all its activities as changes in land use to a large lake may not necessarily be a benefit to biodiversity. One way of identifying the proportion of land that is currently being managed to benefit biodiversity may be to identify the percentage that is under agri-environment agreements. This can be done by looking at countywide data published by Natural England: http://publications.naturalengland.org.uk/category/3573102#content[10].

To complete this worksheet, you need to:

- identify the land use that is expected under the baseline scenario (where possible, this should be consistent with the assumptions made for the carbon worksheet);
- identify how the land use will change from the baseline to the current scenario and record the ha that change in cells D5 to Q18 for land use types; and
- identify how the length of watercourses currently managed by the IDB will change and record the km affected in cells R19 to T21.

There are few studies that have estimated the change from one land use type to another for biodiversity value. As a result, a simple scoring system is used to reflect whether biodiversity will increase or decrease and whether this increase or decrease would be slight (±1) or significant (±2). Default scores have been assigned and are used as the basis for estimating how much of the willingness to pay for biodiversity value would be gained or lost due to the change in biodiversity value across the whole IDB district. A specific willingness to pay value can be used in place of the default value (£190 per ha) if this is available. The average width of a watercourse can also be changed from the default assumption of 1m, where appropriate.

6.7.3 Uncertainty with the designated biodiversity sites category

The main uncertainties with the impacts on biodiversity are the values used to reflect impacts on designated sites, assumptions on the probability of impacts, and the use of a simple scoring system to reflect change in biodiversity for non-designated sites. The values used for permanent losses for the designated habitats are based on relocation and recreation costs, using Defra GiA funding values. Willingness to pay values to conserve or improve habitats are used for one-off losses and for the non-designated habitats. The willingness to pay values have been determined for another site in another location but have been presented in such a way that they are considered appropriate to be used here to give an estimate of the impacts on biodiversity for IDBs. These assumptions can introduce considerable uncertainties because the biodiversity present in your IDB may differ considerably from the biodiversity in the original study. They should, therefore, be treated as an indication of the potential monetary value of the impacts. The value used for the non-designated habitats is based on a meta-analysis, which means that it takes account of a large number of studies to come up with an overarching figure but there is still uncertainty associated with it.

For designated biodiversity, the change in impacts from one level of probability to another is based on assumptions on the proportion of residential properties that are typically located at

[10] Link correct as of 11 June 2014.

different probability levels (from the MCH). Clearly, these assumptions will introduce a high level of uncertainty as they are not specifically related to the location of designated sites.

For non-designated biodiversity, the use of a scoring system to reflect the change in biodiversity value is a significant simplification of the differences between different land uses. However, given the lack of available valuations and the amount of data that would otherwise have to be included, it is assumed to be a reasonable approximation. Clearly, though, there will be considerable uncertainty in the estimated benefits or damages.

Many Grant-in-Aid appraisals will include some valuation of the impacts on biodiversity. Care is always needed that the valuation relates to a change in biodiversity or change in habitats, rather than a total value for a particular type of habitat. This is because it is the change that is important and needs to be valued. The values used in the designated biodiversity sites worksheet reflect the value of a change, and so could be used in a GiA appraisal, although the values for non-designated biodiversity may not be suitable. Care will be needed to make sure that the values are appropriate for the change that would be expected. Furthermore, if you would like to use the annual values calculated in the spreadsheet in GiA appraisals, you will need to take account of the timing of impacts. This is because impacts that do not occur until sometime into the future will be discounted. This will be important where the impacts would not occur immediately. For example, if the pumps were switched off, you should consider the time before any designated habitats would be affected by changes in water levels. If this would take, say five years, you would need to reflect this by delaying the onset of impacts until year four (assuming you start the appraisal in year 0).

6.8 Carbon

6.8.1 Background and approach

This category covers the sequestration of carbon by soils. This is a process by which carbon dioxide from the atmosphere is captured and stored in the soils. The amount of carbon that soils are able to sequester depends on the amount of biomass in the soil as well as the amount of oxygen that enters the soil. As a result, wetter soils (especially those with permanent water cover) can sequester more carbon[11].

The carbon worksheet allows you to estimate the change in carbon from changes in land use. The change in carbon sequestered by soils is based on Dawson & Smith (2007 in Ostle et al, 2009).

To complete this worksheet, you need to:

1. Identify or estimate how many hectares of each land use type (cropland, grassland, marsh, peatland and woodland) are present in the IDB area for the current situation.
2. Estimate how many hectares would be represented by each land use type in the baseline scenario.
3. For each land use type, enter the number of hectares that would change from the baseline scenario to the current situation by land use type. For example, if you predict that there would be 1,000 ha of grassland under the baseline that is cropland under the current situation, enter 1,000 into cell D5. If you predict that there would be 5,000 ha of marsh under the baseline that is grassland under the current situation, enter 5,000 into cell E6.

[11] This is simplistic since wetland soils can produce other greenhouse gases and may lose carbon during summer months (see for example, Holman & Kechavarzi, 2010).

You can use Table 9.1 in the MCH to help you decide how land use might change as this shows the tolerance to flooding of different land uses. For example, if the probability of impacts under the current situation is 10% and you have predicted that this will increase to 50% in some areas and 100% in others under the baseline, you might predict that the area where the probability of impacts increases to 50% would only be suitable as grassland, while the area where the probability of impacts increases to 100% would only be suitable as marsh, or peatland if water levels would mean the area is permanently waterlogged.

The value per tonne of CO_2 is based on the untraded value based on DECC guidance[12]. You can update this value by following the link in the carbon worksheet.

[12] To make the calculations easier, the table showing change in carbon sequestered by soils has been converted to CO_2 to enable you to use the DECC value directly.

6.8.2 Uncertainty with the carbon category

The estimated change in carbon sequestered by soils is based on the low end of a range, and so it is likely to underestimate carbon benefits or damages in most cases. The low end of the range was used rather than the high end as there was greater consistency between changes from and to different land uses. The source document for the figures on change in carbon gives a much larger range of different land types than is included here, hence, the estimate produced by following the method set out in the carbon worksheet is a simplification. This again will reduce the robustness of the estimated monetary value of impacts on carbon sequestration.

6.9 Water supply

6.9.1 Background and approach

The water supply category only covers water that is abstracted in the IDB but used outside. This is to avoid double counting with other categories, such as food production or biodiversity. The calculation worksheet for water supply allows both the direct benefits (water abstractors or water transfer) and indirect benefits (water abstracted for Public Water Supply) to be estimated. Impacts on water supply are based on the volume of water affected and the change in probability of impacts. To complete this worksheet, you need to:

1. Identify which Environment Agency region you are in, as that will affect the average Ml/day per licence. You can skip this step if you have actual licensed volumes (and enter the licensed volume into cells D18 to K18, or if you only have a total across all licences in L18).
2. Where you are using the default average licensed volumes, enter the total number of licences (cells D17 to L17). Again, you do not need to fill in these cells if you have entered known licensed volumes, but you can input the number of licences if you wish.
3. Estimate the change in probability of impacts to the different types of licence (this may depend on location of abstraction, especially where surface water abstraction requires a particular height of water) and enter the number of licences in the cell that reflects the change in probability of impacts (from the baseline to the current situation). For example, if there are 4 Public Water Supply licences with a probability of impacts of 100% under the baseline, and at 2% under the current situation, put 4 into cell I27.

As noted above, you can directly input the total licensed volume of water, by licence type or as a total, if these data are available. You can also update the value (per Ml/day) of water (cells D22 to L22) if you have site specific values. As with the other categories, you can also change the default assumptions on the proportion of the area that is allocated to each probability level (cells D85 to M85); the implications of these assumptions for uncertainty are discussed below.

6.9.2 Uncertainty with the water supply category

The main uncertainties for water supply come from the use of default assumptions on the average volume of water abstracted for different types of licence, the values used per Ml/day and the probability that licences and the water they provide may be impacted.

Use of average volumes per licence will be a simplification and could over- or underestimate actual impacts depending upon actual licensed volumes. To reduce the level of uncertainty to some degree, averages are calculated per Environment Agency region rather than nationally. Water transfers also need to be taken into consideration as the IDB watercourse

system may provide opportunities for transfer of water from one location to another, especially for Public Water Supply. This could involve very large volumes of water and average values are unlikely to be a good representative of the potential damages in such cases.

The values used per Ml/day are generally associated with the costs of replacing the 'lost' water by utilising other sources. This means it is assumed that licences that can no longer be used, or fully used, could be replaced with new abstraction licences. In many places, this may not be possible due to restrictions on new abstractions. In such cases, the values used are likely to underestimate the value of 'lost' water.

The change in impacts from one probability level to another for water supply is based on assumptions on the number of residential properties at different probability levels (from the MCH). Clearly, these assumptions will introduce a high level of uncertainty and, where possible, probabilities of impacts for abstraction points specific to the IDB should be determined to reduce the uncertainty.

Appraisals used to put forward a case for Grant-in-Aid funding usually include impacts on abstractions where abstraction points need to be moved. As such, the approach used here differs slightly in that it is based on the value of water that is lost rather than the cost of moving to an alternative abstraction location. The values produced by the water supply worksheet may, therefore, need to be capped at the cost of constructing an alternative abstraction point for GiA appraisals. Furthermore, if you would like to use the annual values calculated in the spreadsheet in GiA appraisals, you will need to take account of the timing of impacts. This is because impacts that do not occur until sometime into the future will be discounted. This will be important where the impacts would not occur immediately. For example, if the pumps were switched off, you should consider the time before any abstraction points would be affected by changes in water levels. If this would take, say five years, you would need to reflect this by delaying the onset of impacts until year four (assuming you start the appraisal in year 0).

6.10 Recreation and tourism

6.10.1 Background and approach

The calculation worksheet for recreation and tourism takes account of different types of recreation assets and their likely importance in terms of attracting local visitors and tourists to the area. Impacts on recreation are based on the effect that changes in water levels could have on the use of the recreational assets. To complete this worksheet, you need to:

1. Identify how many recreational assets of each type are present in the IDB. The types included are: long distance footpaths, other waymarked walks, cycle ways and bridleways, car parks, camp sites, picnic areas, golf courses, museums, pubs, racecourses, and horse riding centres. There is also space for two 'other' categories relevant to your IDB. Take care though not to double count with assets captured under other categories, especially heritage.
2. The recreation worksheet uses default estimates of visitor numbers as the basis for valuing the impacts, based on the likely importance of the different types of asset in terms of attracting visitors and the level of access. You can replace these with actual visitor numbers if you have them.
3. Estimate the change in probability of impacts of the different types of recreational asset and enter the number of assets in the cell that reflects the change in probability (from the baseline to the current situation). For example, if there are 4 car parks with an estimated probability of impacts of 20% under the baseline, and at 1% under the

current situation, put 4 into cell K85. All the recreational assets are entered into cells D83 to M92.

As noted above, you can directly input the total number of visitors to the IDB if these data are available (cell D34). You can also update the value per visit (cell D36) if you have site specific values. As with the other categories, you can also change the default assumptions on the proportion of the area that is allocated to each probability level; the implications of these assumptions for uncertainty are discussed below.

6.10.2 Uncertainty with the recreation and tourism category

The main uncertainties for recreation come from the use of default assumptions on the number of visitors, the values used per visit, and the estimated probability that recreational assets may be impacted.

Visitor numbers are based on guidance used for assessing water quality and water resources benefits (the Environment Agency's Benefits Assessment Guidance and Table 8.2 in the MCH) but, as with all generic values, may over- or underestimate the number of visitors to the IDB.

The values used for permanent loss are based on the costs of relocating assets, while those used per visitor for one-off losses are based on a valuation study from the United States that generates an overall recreation value across a wide range of recreational activities. The values have been converted to Pounds Sterling in line with Defra guidance, but the applicability of a study from the USA for recreation in England could be questionable. As a result, this could introduce considerable uncertainty into the assessment. To reduce the uncertainty, you would need to identify a value for each type of recreational assets and multiply this by the visitor numbers to each asset. This would be a much more detailed approach to estimating a recreational impact but may be worthwhile where recreation impacts make up a significant proportion of the total impacts.

The change in impacts from one probability level to another for recreational assets is based on assumptions on the number of residential properties at different probability levels (from the MCH). Clearly, these assumptions will introduce a high level of uncertainty unless the recreational assets affected are mainly located with residential areas, in which case the uncertainty may be somewhat reduced.

Appraisals for Grant-in-Aid funding may include valuation of recreational assets, but in many cases these damages are not included as it is considered that impacts on recreation and tourism lost in one area would be benefits to another area (when monetised, these are known as transfer payments). You will, therefore, need to adjust the recreational and tourism impacts for GiA appraisal to exclude any transfers. Furthermore, if you would like to use the annual values calculated in the spreadsheet in GiA appraisals, you will need to take account of the timing of impacts. This is because impacts that do not occur until sometime into the future will be discounted. This will be important where the impacts would not occur immediately. For example, if the pumps were switched off, you should consider the time before any recreational assets would be affected by changes in water levels. If this would take, say five years, you would need to reflect this by delaying the onset of impacts until year four (assuming you start the appraisal in year 0).

6.11 Heritage

6.11.1 Background and approach

The calculation worksheet for heritage takes account of different types of heritage assets and different designations. Impacts on heritage are based on impact that changes in water levels could have on the heritage value of the assets. To complete this worksheet you need to:

1. Identify how many heritage assets of each designation are present in the IDB. The designations included are: World Heritage Site, listed buildings, scheduled monuments, registered parks and gardens, registered battlefields, conservation areas and local listing/local heritage assets.
2. The heritage worksheet uses default estimates of visitor numbers as the basis for valuing the impacts. You can replace these with actual visitor numbers if you have them but be careful since not all heritage assets may be open to visitors, so you may underestimate the potential value of heritage assets if there are no visitors. This is because the number of visitors is used to enable an indicative value of the impacts to be estimated, since the only values that were considered applicable to IDBs were 'per visitor'.
3. Estimate the change in probability of impacts to the different types of heritage asset and enter the number of heritage assets in the cell that reflects the change in probability level (from the baseline to the current situation). For example, if there are 4 listed buildings with a probability of impacts of 20% under the baseline, and at 1% under the current situation, put 4 into cell K50.

As noted above, you can directly input the number of visitors by heritage type if these data are available. You can also update the value per visit (cells D26 to D31) if you have site specific values. As with the other categories, you can also change the default assumptions on the proportion of the area that is allocated to each probability level; the implications of these assumptions for uncertainty are discussed below.

6.11.2 Uncertainty with the heritage category

The main uncertainties for heritage come from the use of default assumptions on the number of visitors, the assumption that number of visitors is an appropriate surrogate for the value of heritage assets, the values used per visit, and the estimated probability that heritage assets may be impacted.

Visitor numbers are based on statistics from English Heritage but, as with all generic values, may over- or underestimate the number of visitors to heritage assets within the IDB. It is important to remember that the number of visitors is being used as a method for obtaining a 'typical' value for different types of heritage assets since the values available for monetising the impact are all 'per visit'. As a result, using actual visitor numbers could underestimate the value of impacts on heritage assets, especially where assets are not open to the public.

The values used per visitor are based on one valuation study and use the 'low' and 'high' willingness to pay values for entry to Warkworth Castle. Valuations for heritage assets tend to be very specific and focused mainly on unique assets such as Stonehenge. This makes it very difficult to identify values that can be used here to give a reasonable estimate of the impacts. Use of valuations for Stonehenge would clearly overestimate the value of the impacts. The Warkworth Castle value may mean that the estimates produced are on the conservative side.

The change in impacts from one probability level to another for heritage is based on assumptions on the number of residential properties at different probability levels (from the MCH). Clearly, these assumptions will introduce a high level of uncertainty unless heritage assets are mainly located with residential areas, in which case the uncertainty may be somewhat reduced.

Appraisals for Grant-in-Aid funding may include valuation of heritage assets. This can sometimes be as cost of relocation (as for the Beachy Head lighthouse). The approach used here is based on putting a value on impacts and is appropriate for use in GiA appraisals but the lack of available values mean that any damages or benefits reported may be questioned, so all assumptions and an assessment of uncertainty should be clearly included along with any benefit or damage estimates. Furthermore, if you would like to use the annual values calculated in the spreadsheet in GiA appraisals, you will need to take account of the timing of impacts. This is because impacts that do not occur until sometime into the future will be discounted. This will be important where the impacts would not occur immediately. For example, if the pumps were switched off, you should consider the time before any heritage assets would be affected by changes in water levels. If this would take, say five years, you would need to reflect this by delaying the onset of impacts until year four (assuming you start the appraisal in year 0).

6.12 Jobs

6.12.1 Background and approach

The jobs worksheet calculates the indirect benefits associated with expenditure of the IDB and the number of jobs that are supported in other sectors of the economy because of the money that the IDB spends. To reflect the benefits to the local area, you need to identify the percentage of expenditure that is spent outside the IDB area. In most cases, this percentage may be high, for example, on contractors or consultants. A typical estimate may be 70%, which means that for every £100,000 spent by the IDB, £70,000 is used to secure services from outside the IDB and £30,000 for services provided by companies located inside the IDB. However, this value will vary by IDB, and a specific value should be used wherever possible. It is not always easy to identify what this percentage should be, and an approximate percentage is usually sufficient.

The calculations undertaken in this worksheet include estimates of the indirect benefits resulting from IDB expenditure and number of jobs supported. This only covers IDB expenditure and not jobs supported by IDB activities to manage water levels (this can only currently be picked up in the qualitative assessment).

6.12.2 Uncertainty with the jobs category

The assumption on the percentage of money spent outside the IDB (leakage) is the main source of uncertainty. There is also uncertainty associated with the multiplier used to estimate the indirect benefits. This is taken from data provided by the Organisation for Economic Co-operation and Development (OECD) for knock-on benefits from spend in the construction sector. The broad nature of the construction sector means that the multiplier may over- or underestimate the knock-on impacts but specific data on IDBs or land drainage are not available.

7. Output worksheets

A series of output worksheets are provided that summarise the findings of the assessment in tables and charts. Summary reports using these output worksheets are provided for the six sample IDBs and can be referred to as examples. Many of the tables and charts include caveats surrounding how the benefit estimates and the division of benefits across beneficiaries should be used and/or reported. The main caveats and their implications are:

1. The benefit estimates are given as a per year value and ignore when particular impacts would occur. This simplification means that the total benefits cannot be compared with the costs incurred by IDBs when undertaking their activities. As a result, any attempts to estimate a benefit-cost ratio will be meaningless. To enable a benefit-cost ratio to be calculated, it would be necessary to identify when the impacts are likely to occur and discount them accordingly, and to cap any benefits that exceed the rebuild or relocation costs (or costs of undertaking specific activities to reduce or remove the impacts of changes in water levels).

2. The method of estimating benefits is based on impacts on one individual IDB. If a cumulative assessment of the benefits of two or more IDBs is required, a new assessment would have to be undertaken that reflects the antagonisms, especially where these IDBs are adjacent. As a result, just summing the benefits of the individual assessments is likely to significantly underestimate the benefits of the IDBs when considered together.

3. The approach to separating IDB benefits from those provided by Environment Agency assets is simplified. In many cases, the interaction between the two sets of assets/activities may be difficult to disentangle and, as such, the distribution of benefits between IDBs and the Environment Agency is likely to be highly uncertain. However, the current approach does try to distinguish between those benefits associated with ‘above ground’ (flooding) risks and those associated with ‘below ground’ (waterlogging/drainage) risks. It is the balance of importance of each of these risks that needs to be assessed for individual IDBs when determining whether the default percentages are likely to be applicable, or whether some changes are needed.

4. The uncertainty within the benefit estimates will vary according to how much specific data has been included. Where generic data are used, the uncertainty is likely to be high and total benefits should not be reported to greater detail than a maximum of two significant figures. In addition, it is recommended that the degree of uncertainty is reported alongside the benefit estimates, especially where these are being presented to and/or discussed with beneficiaries.

8. References

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