



DEVELOPMENT OF 'LOOK-UP' ENVIRONMENTAL VALUE ESTIMATES FOR INITIAL APPRAISAL WITHIN COST-BENEFIT ANALYSIS

Technical Report

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LIST OF ABBREVIATIONS

Cefas	Centre for Environment, Fisheries and Aquaculture
CBA	Cost-benefit analysis
BERR	Department for Business, Enterprise and Regulatory Reform
BIS	Department for Business, Innovation and Skills
DCMS	Department for Culture, Media and Sport
Defra	Department for Environment, Food and Rural Affairs
DFID	Department for International Development
DfT	Department for Transport
DCLG	Department of Communities and Local Government
DECC	Department of Energy and Climate Change
EA	Environment Agency
EVL Tool	Environmental Value Look-up Tool
EVRI	Environmental Valuation Reference Inventory
FCO	Foreign and Commonwealth Office
FSA	Food Standards Agency
FC	Forestry Commission
HMRC	Her Majesty's Revenue and Customs
HO	Home Office
HSE	Health and Safety Executive
JNCC	Joint Nature Conservation Committee
MCZ	Marine Conservation Zone
MOJ	Ministry of Justice
NE	Natural England
NWEBS	National Water Environment Benefits Survey
RBMP	River Basin Management Plan
RSPB	Royal Society for the Protection of Birds
TEEB	The Economics of Ecosystems and Biodiversity
TIM	The Integrated Model
UK NEA	UK National Ecosystem Assessment
UK NEAFO	UK National Ecosystem Assessment Follow-On
WebTAG	Web Transport Appraisal Guidance
WTP	Willingness to pay

EXECUTIVE SUMMARY

The aim of this study is to develop a set of (default) ‘look-up’ values to help analysts take better (monetary) account of environmental impacts in Government appraisals. The focus is on cases where primary valuation or detailed value transfer analysis would be disproportionate to the scale of the impacts being appraised.

The role for such look-up values was identified in the study for Defra ‘*Baseline Evaluation of Environmental Appraisal and Sustainable Development Guidance*’ (eftec and Cascade Consulting, 2014). This highlighted the need to: (i) supplement environmental appraisal guidance with strong and effective training in its use; and (ii) provide ‘default’ values for some environmental impacts, to be applied where they might otherwise be overlooked.

The look-up values are intended to be used at the early stage of an appraisal, helping to establish an indication of the possible scale of costs and benefits. This ‘first cut’ assessment will complement - rather than replace - the option for more detailed analysis of environmental costs and benefits. Further analysis will be required where the effort of doing this is proportionate to the type and scale of impacts considered in the appraisal.

Whilst the primary audience is Government analysts, the outputs of this project may also be relevant to private sector and non-government organisations with an interest in using valuation evidence; for example for investment appraisals and corporate natural capital accounting exercises. In general, where there is a requirement to measure and value environmental impacts and/or the provision of ecosystem goods and services, the look-up values may provide a useful ‘entry-point’ to valuation.

ES.1 Environmental Value Look-up Tool

The look-up values are presented in an Excel-based appraisal tool - the Environmental Value Look-Up (EVL) Tool - with an accompanying User Guide. The EVL Tool comprises three main components:

- **Database:** the set of look-up values drawn from the available valuation evidence. In the tool and User Guide the look-up values are referred to as ‘indicative’ values. This is to emphasise that they represent broad generalisations of the value of different environmental goods and impacts.
- **User interface:** that allows users to select indicative values according to: (i) the type of environmental impact/good; and (ii) the broad habitat they choose.
- **Aggregation:** a worksheet for calculating aggregate environmental benefit and cost estimates based on the selected indicative value. The user can specify the time period for calculating equivalent annual values and present value costs and benefits, which are discounted in line with HM Treasury (2003) Green Book guidance.

The User Guide describes the structure of EVL Tool and provides guidance on the interpretation and use of the indicative values in appraisals. This includes: (i) the policy and appraisal contexts in which the indicative values can be applied; (ii) the appropriate interpretation of the values in informing decision-making; and (iii) worked examples demonstrating how the indicative values may be used.

Other project outputs are detailed in Section 1.4 of the Technical Report.

ES.2 Designing the Environmental Value Look Up Tool

The development of the EVL Tool was informed by an initial scoping exercise, which included consultation with a group of potential users. This entailed:

- **Review of impact assessments:** approximately 350 impacts assessments for the period 2008 - 2015 were screened. This identified 85 that considered environmental impacts. The main findings were:
 - Most environmental impacts identified in the sample were typically assessed to be ‘insignificant’ and not subject to formal assessment.
 - The impacts most likely to be monetised included air quality regulation and climate regulation, reflecting the well-established guidance for these topic areas (Defra, 2013; DECC, 2014). This suggests that ease of access to environmental values is a primary factor for their actual use in appraisals.
 - Cultural services (e.g. recreation, aesthetics) were found to be frequently identified in assessments but were usually not valued in monetary terms.
- **User consultation:** interviews were carried out with potential users of the EVL Tool to help understand: (i) the varying levels of experience among analysts in assessing environmental impacts; (ii) the types of impacts typically assessed; and (iii) the types of impacts that they had been able to value in monetary terms. In total 12 interviews were undertaken, supplemented by an online survey which provided a further 16 responses (from over 100 invites).

Overall, a key barrier that was identified was analysts’ lack of familiarity with the ecosystem services framework. Some interviewees also suggested that the existence and accessibility of carbon guidance hindered further valuation because analysts thought they had covered environmental impacts if they had valued changes in greenhouse gas emissions. A further barrier was a lack of both scientific and economic evidence to inform the valuation of environmental impacts. This was reinforced by feedback from survey responses that indicated a lack of valuation evidence and low confidence in the robustness of available evidence as the most common reasons for not valuing environmental impacts in monetary terms.

ES.3 Compiling indicative values

The EVL Tool includes approximately 40 indicative values. In addition to these, there are approximately 40 entries that relate to environmental impacts covered by existing Government guidance (e.g. climate regulation, air quality regulation, etc.). The process for compiling the indicative values for the EVL Tool is illustrated in Figure ES. 1 and described below.

Figure ES. 1: Evidence review process



1. **Screening:** over 350 UK-relevant studies published since the year 2000 were screened in the evidence review process (excluding existing Government guidance). Table ES. 1 provides a count of studies classified by habitat type.

Table ES. 1: Summary of scope of evidence review by habitat type¹

Habitat type	No. identified studies	No. screened studies	No. classified studies
Enclosed farmland	56	13	7
Freshwater, wetlands and floodplains	46	32	8
Marine and coastal margins ²	54	19	11
Mountains, moors and heaths	59	12	6
Semi-natural grasslands	55	12	6
Urban (green space)	29	11	4
Woodland	100	15	8

Note: Excludes existing Government guidance. ¹A study that covers multiple habitat types is counted more than once. ²Valuation evidence for marine and coastal margins is combined because these two habitat types tend to be covered or discussed simultaneously in the literature.

- Classification:** a subset of the screened studies were taken forward to the classification step. Studies were selected based on assessment of their suitability for being interpreted in a broad and generalised way. The selection was guided by the scoping activities described in Section ES.2, and good practice principles for valuation such as those set out in Defra's value transfer guidelines.
- Consolidation:** classified studies were consolidated to produce a single range of indicative values (high, central, low) for each combination of broad habitat and environmental impact/good. For some combinations the classification stage was sufficient; i.e. cases where there is single source study for the indicative values. For others, multiple valuations from different source studies were consolidated to provide indicative values.
- Indicative values:** the indicative values in the EVL Tool are presented as broad generalisations of the values for impact / habitat combinations that have been captured in the literature. Accompanying guidance notes in the tool explain the interpretation of the range of values (low, central high). Specifically, they are not conventional statistical ranges, but instead reflect some of the context-specific factors that are found to influence valuations in the source studies, allowing users to incorporate these into their analyses.

ES.4 Conclusions and recommendations

The use of indicative values will be appropriate in a select set of policy and appraisal contexts, which can accommodate the level of uncertainty associated with the valuations. The EVL Tool can help analysts move from a position of taking no monetary account of environmental impacts to demonstrating indicative monetary values in appraisals. As a 'first cut' assessment, this can inform the level of further effort that is warranted for appraising environmental impacts.

The findings from the study indicate that further challenges remain. These include:

- Barriers to valuing environmental impacts in general:** the main barriers faced by analysts relate to understanding and interpreting the various existing frameworks that are described in current guidance (e.g. ecosystem services, wider environmental impacts, etc.). The volume of guidance and the level of technical detail are obstacles to 'non-specialists' attempting to value environmental impacts.
- Gaps in valuation evidence:** key areas that may require further valuation effort to support the use of indicative values include urban green space, mountains, moors and heaths, and semi-

natural grasslands, as well as regulating ecosystem services (e.g. pest regulation, waste regulations) across the majority of UK NEA habitat types.

- **Valuing biodiversity:** this issue is examined in detail in the accompanying discussion paper (*'Valuing Biodiversity'*), which highlights the complexities faced, the difficulty in applying valuation methods in this context, and the limited nature of the UK-focused evidence. The paper concludes that, at present, it is not appropriate for the EVL Tool to contain specific values for biodiversity and further research effort is required to develop a workable approach for practical policy analyses. In the interim, the EVL Tool includes a list of existing biodiversity valuation studies to assist interested users in undertaking more formal value transfer analysis.
- **Applying indicative environmental values in ecosystem accounting:** indicative values could be used in an ecosystem accounting context, even though the focus for the development of the EVL Tool has been policy and project appraisals. A key issue to address, however, is improving the understanding of the actual and likely uses of ecosystem accounts and their interpretation by stakeholders, since these will determine the acceptability of indicative values in this setting. Further recommendations are provided in the accompanying discussion paper (*'Applying Values in Ecosystem Accounting'*).

In conclusion, a number of recommendations are outlined with respect to the practical use of the EVL Tool:

- **Review current appraisal guidance:** for the EVL Tool to be effective in increasing the practical use of environmental values in Government appraisals, the route to using the tool must be clear, allowing users to circumvent (non-essential) technical guidance. Links between current guidance and the EVL Tool should be mapped in a concise fashion and this 'route map' should be the first document that analysts encounter.
- **Develop further practical appraisal tools for specific environmental impacts:** there is scope for improving the valuation evidence base in several policy areas, and these developments could then be used to update the evidence included in the tool. This may be the case for recreation where the evidence base is relatively rich. There may also be a case for developing a valuation tool relating to the water environment. This will likely require further primary valuation but the research could be undertaken in a way that also yields indicative values that could be applied more generally.
- **Maintain and update the EVL Tool:** the EVL Tool should be periodically updated. Routine updates to the tool should include updating the price base on a yearly basis. More substantive updates to the tool will also be required such as incorporating new valuation evidence as it becomes available. Consideration should also be given to continuing consultation with users of the tool to gain live feedback and log 'lessons learnt' to help improve the functionality of the tool.
- **Availability of the EVL Tool:** the EVL Tool should be made widely available for applications beyond public policy appraisals. It potentially provides an entry-point for environmental valuation in a number of contexts both within Government and beyond. There will also be opportunities for organisations to adapt the tool and database for use in their own assessment contexts.

1. INTRODUCTION

1.1 Background

The Natural Environment White Paper *'The Natural Choice'* (HM Government, 2011) stated the case for growing a sustainable economy in which the benefits of nature would be recognised and valued. Included within this was a commitment to fully consider the value of nature in all relevant impact assessments. Subsequently, the Natural Capital Committee has highlighted that there are substantial economic benefits to be gained from maintaining and improving natural assets; however the benefits will only be realised if their full value is incorporated into decision-making (Natural Capital Committee, 2014).

Following the White Paper, the supplementary guidance *'Accounting for Environmental Impacts in Policy Appraisal'* (HM Treasury and Defra, 2012) was published. This set out in more detail the application of non-market valuation methods outlined in the HM Treasury *Green Book* (HM Treasury, 2003). The guidance recommends the use of an ecosystem services framework and it is intended to support the appraisal of policies that have specific environmental outcomes and also those with a different focus but include impacts on the environment. The guidance includes a checklist for 'wider environmental effects' (including air quality, landscape/townscape, water pollution, flood risk, waste management and climate change) and ecosystem services (described in terms of provisioning, regulating and cultural services). It also draws on the more detailed practical guidance that is provided by Defra's value transfer guidelines, *'Valuing Environmental Impacts: Practical Guidelines for the Use of Value Transfer in Policy and Project Appraisal'* (eftec, 2009).

The support available for appraisal practitioners has more recently been supplemented by guidance in 2013 for valuing air quality impacts on health and the environment (Defra, 2013), as well as updates in 2014 to the more established guidance for valuation of energy use and greenhouse gas emission in policy appraisals (DECC, 2014).

Despite the progress made in developing more formal guidance for undertaking the appraisal of environmental impacts, there remain challenges in establishing this as routine practice across Government departments and agencies. These challenges were highlighted in the *'Baseline Evaluation of Environmental Appraisal and Sustainable Development Guidance'* study for Defra (eftec and Cascade Consulting, 2014). This examined the use of environmental appraisal and sustainable development guidance in impact assessments across Government. It highlighted the following as the two key challenges for increased uptake and use of guidance:

- Establishing a culture across Government departments and agencies that expects environmental and social impacts to be taken seriously and addressed on an even-footing with other (especially economic/business) impacts; and
- Improving evidence and methods for presenting environmental and social impacts in monetary terms, where appropriate and feasible.

Recommendations from the study included: (i) supplementing the environmental appraisal guidance with strong and effective training in its use; and (ii) providing 'default' values for some environmental impacts, to be applied where otherwise they might be overlooked. These recommendations are particularly relevant for the majority of appraisal cases, where significant valuation effort for any particular impact would be likely to be disproportionate, but where there is potential for multiple small to moderate impacts to add up together (either within that appraisal or across several) to have a high impact. At present, many of these impacts are ignored, or treated

only briefly in qualitative terms in appraisals. The challenge is to help analysts take better (monetary) account of these impacts, without incurring the disproportionate effort of primary valuation or detailed value transfer analysis.

1.2 Project objectives

The aim of this study - '*Development of look-up environmental value estimates for initial appraisal within cost-benefit analysis*' - is to address these challenges, with the primary purpose of increasing the practical use of environmental values in Government appraisals. This is to be achieved by developing a set of (default) 'look-up' values that are consistent with existing guidance and Green Book principles. The look-up values are intended to be used in the initial assessment of environmental impacts in an appraisal, helping establish an indication of the possible scale of costs and benefits. This initial assessment will complement - rather than replace - the option for more detailed analysis of environmental costs and benefits through formal valuation methods. More detailed analysis will be required where the effort of doing this is appropriate and proportionate to the type and scale of impacts considered in the appraisal.

The project specification sets out the following objectives for the development of the look-up values and the associated guidance for analysts:

1. Assess the policy and project contexts in which look-up values can be applied;
2. Develop a user-friendly format for presenting the look-up values for a range of ecosystem services and environmental impacts;
3. Provide accompanying guidance and training for users of the look-up values including: (i) the policy and appraisal contexts in which the values can be applied; (ii) the appropriate interpretation of the values in informing decision-making; (iii) the consistency and link to the value transfer guidelines and other supplementary Green Book guidance for environmental appraisal; and (iv) worked examples demonstrating how the look-up values may be used (including when it is proportionate to use them);
4. Review the potential for developing look-up values for biodiversity by assessing alternative options based on willingness-to-pay metrics (demand-based values) and target- and opportunity-cost- based metrics (cost-based values); and
5. Provide guidance to Defra on related issues to the look-up values: (i) how the valuation data and guidance should be updated in the future; (ii) the extent to which the values can be used in ecosystem accounting applications; and (iii) opportunities for developing further practical appraisal tools for specific ecosystem services and/or environmental impacts.

The development of the look-up values covers all (non-market) environmental impacts and ecosystem services as is practically feasible given the currently available evidence. The values are primarily intended to be used in an economic appraisal setting, providing an input to cost-benefit analyses. However, there are potentially wider applications for environmental values including demonstrating the importance of an issue (e.g. policy briefings), policy, programme or project evaluation, setting priorities within a sector or across sectors, determining socially desirable levels for taxes, subsidies, permits and other instruments, and determining compensation when economic or environmental damages are caused. Look-up values will not be appropriate in all of these contexts, particularly the setting of incentives and compensatory damages as the type and scale of impacts are likely to be significant and warrant more detailed analyses.

A further potential application for look-up values is environmental accounting applications, including natural capital and ecosystem accounts (ONS and Defra, 2014). The suitability of using look-up values in ecosystem accounting applications and their consistency with associated guidance such as the SEEA-EEA¹ framework (2012) is considered in a separate discussion paper that accompanies this report (see Section 1.4). The paper takes a broad view and considers the key principles for applying environmental valuations in ecosystem accounts.

The valuation of biodiversity (and of impacts on biodiversity) is a complex issue and this is also addressed in a separate discussion paper, which considers the underlying principles and reviews alternative approaches to biodiversity valuation.

Finally, whilst the primary audience for the look-up values is Government analysts, the outputs of this project may also be relevant to wider organisations, including the private sector and non-government organisations (e.g. for investment appraisals and corporate natural capital accounting exercises). Indeed there are several initiatives that are seeking to draw the full value of natural assets into decision-making, including for example, the Natural Capital Protocol². In general, where there is a requirement to measure and value environmental impacts and/or the provision of ecosystem goods and services, the look-up values may provide a useful ‘entry-point’ to valuation.

1.3 Environmental value look-up tool

The key practical output of the project is an ‘Environmental Value Look-up Tool’ (EVL Tool). An early example of a look-up table format that supports appraisal guidance for valuing environmental impacts is the Department of Communities and Local Government (DCLG) ‘Valuing the External Benefits of Undeveloped Land’ publication (eftec and Entec, 2001). This informs DCLG appraisals concerning land development and remediation of contaminated land³ and the Department of Transport (DfT) methodology for monetary valuation of landscape impacts (DfT, 2013). The 2001 report is based on valuation studies published before 2000 and the evidence base is now dated.

More recent examples include Defra (2013) valuation of air quality impacts, DECC (2014) valuation of energy use and greenhouse gas emissions, DfT (2014) WebTAG databook (DfT), and Environment Agency’s ‘*Economic Valuation of Environmental Effects*’ (EVEE) handbook (eftec, 2010). With the exception of the WebTAG databook, the format for these look-up references is largely based around written guidance documents with accompanying tables of default values to be applied in appraisals.

The approach taken in this project has been to develop the look-up values in a specifically designed Excel-based ‘appraisal tool’, with an accompanying User Guide document outlining its use. The EVL Tool comprises three main components:

- **Database:** this contains the set of look-up values drawn from the available valuation evidence. In the tool and User Guide, the ‘look-up’ values are referred to as ‘indicative’ environmental values. This is to emphasise the ‘first-cut’ nature of the analyses that are intended to be supported by the tool. The process of compiling the indicative values is described subsequently in this report. Summaries of the indicative values are included in the database, structured in a format that is consistent with Defra’s value transfer guidelines (eftec, 2010) to help support any subsequent and more detailed analysis that is required.

¹ System of Environmental Economic Accounts - Experimental Ecosystem Accounting (SEEA-EEA, 2012).

² See: <http://www.naturalcapitalcoalition.org/natural-capital-protocol.html> [Accessed July 2015].

³ Pers comm. DCLG, June 2015.

- **User interface:** this helps users of the tool select indicative values based on a set of search criteria. The criteria are specified in terms of type of environmental impact/good and broad habitat. Links to supplementary Green Book guidance for environmental appraisal are also included, but the guidance itself is not reproduced in the tool.
- **Aggregation:** this provides users of the tool with a function for calculating aggregate benefit and cost estimates for environmental impacts based on the indicative value they have selected. Results are reported in a standard table format that details the parameters used in calculating the aggregate value estimates.

The User Guide document describes the use of the EVL Tool and provides guidance on the interpretation and use of the indicative values in appraisals. This includes: (i) the policy and appraisal contexts in which the indicative values can be applied; (ii) the appropriate interpretation of the values in informing decision-making; and (iii) worked examples demonstrating how the indicative values may be used.

1.4 Project outputs

Overall, the various project objectives set out in Section 1.2 are addressed through several project outputs. These are described in Table 1.1.

Table 1.1: Summary of project outputs

Project output	Objective(s)
Environmental Value Look-up (EVL) Tool	<ul style="list-style-type: none"> • Develop a user-friendly format for presenting indicative (look-up) values for a range of ecosystem services and environmental impacts.
User Guide	<ul style="list-style-type: none"> • Accompanying guidance for users of the EVL Tool.
Technical Report (this document)	<ul style="list-style-type: none"> • Assess the policy and project contexts in which indicative (look-up) values can be applied. • Provide guidance on related-issues to the indicative values: (i) how the valuation data and guidance should be updated in the future; and (ii) opportunities for developing further practical appraisal tools for specific ecosystem services and/or environmental impacts.
Valuing Biodiversity Discussion Paper	<ul style="list-style-type: none"> • Review the potential for developing indicative (look-up) values for biodiversity by assessing alternative options based on willingness-to-pay metrics (demand-based values) and target- and opportunity cost-based metrics (cost-based values).
Applying Values in Ecosystem Accounting Discussion Paper	<ul style="list-style-type: none"> • Provide guidance to Defra on related-issues to the indicative (look-up) values including the extent to which the values can be used in ecosystem accounting applications.
Training material (presentation and webinar)	<ul style="list-style-type: none"> • Provide accompanying guidance for users of the EVL Tool.

This document (Technical Report) is accompanied by the EVL Tool and User Guide, and two discussion papers that address the specific project objectives concerning the valuation of biodiversity and the use of indicative values in ecosystem accounting application, respectively.

Training material is also available to assist users of the EVL Tool in the form an accompanying slide pack.

1.5 Report structure

The remainder of this report is structured as follows:

- Section 2 summarises an initial scoping exercise that examined the potential role for and use of indicative values in Government appraisals, including a review of recent impact assessments and consultation with potential users of the EVL Tool;
- Section 3 summarises the approach taken to compiling the indicative (look-up) values, including the evidence review and process of identifying and classifying source studies, and consolidating this evidence into a set of indicative values included in the EVL Tool; and
- Section 4 concludes with recommendations stemming from this study including the development of the EVL Tool and indicative values, and the accompanying discussion papers on applying values in ecosystem accounting and on valuing biodiversity.

The content of the report is also supported by three supplementary annexes, which include:

- Evidence to support the user consultation as part of the scoping exercise (Annex 1);
- A list of screened valuation studies in the evidence (Annex 2); and
- The criteria used for classifying source studies (Annex 3).

2. USE OF INDICATIVE VALUES IN APPRAISAL

The scope for using indicative values in appraisals is potentially broad, covering most Government departments and agencies, as well non-government organisations and sectors that make use of economic value evidence in decision-making processes. Understanding the potential use of indicative environmental values provides a helpful framing for developing the EVL Tool and User Guide, particularly in terms of establishing the ‘target’ audience.

The initial scoping work for the project sought to examine the potential use of the EVL Tool and requirements for the accompanying guidance through: (i) reviewing recent Government appraisals and impact assessments to identify prominent policy contexts and environmental impacts; and (ii) consultation with a diverse potential user group of Government and non-government analysts. The main findings are summarised in the following.

2.1 Review of impact assessments

The purpose of the review of impact assessments was to provide an overview of prominent policy areas that have been the subject of Government appraisal in order to inform where the look-up tool may be usefully applied.

A sample of impact assessments were reviewed as part of the ‘*Baseline Evaluation of Environmental Appraisal and Sustainable Development Guidance*’ study for Defra (eftec and Cascade Consulting, 2014). This review was revisited and updated to include more recent impact assessments. Overall, nearly 350 impact assessments were screened based on the coverage of environmental impacts to produce a final list of 85 for the period 2008 - 2015. Impact assessments with no clear relation to the environment (e.g. those related to the reduction of red tape in implementing a policy) were screened out. A broad interpretation of “environmental impacts” was used - based on Defra’s supplementary guidance - including ecosystem services, noise and other disamenity impacts.

Overall, just over one-third of the 85 impact assessments that passed the screening phase were from Defra (Table 2.1). This reflects the fact that Defra deals more closely with policies with environmental impacts. Other departments with a notable number of impact assessments passing the screening phase were DfT (13), DECC (9) and DCLG (8).

Table 2.1: Impact assessments review by Government department (2008 - 2015)

Government department/organisation	No. impact assessments
Department for Business, Enterprise and Regulatory Reform (BERR)	1
Department for Business , Innovation and Skills (BIS)	1
Department for Communities and Local Government (DCLG)	8
Department for Culture, Media and Sport (DCMS)	3
Department for Energy and Climate Change (DECC)	9
Department for Environment, Food and Rural Affairs (Defra)	29
Department for International Development (DFID)	1
Department for Transport (DfT)	13
Foreign and Commonwealth Office (FCO)	2
Forestry Commission (FC)	4

Government department/organisation	No. impact assessments
Food Standards Agency (FSA)	4
Her Majesty's Revenue and Customs (HMRC)	1
Home Office (HO)	3
Health and Safety (HSE)	2
Marine Management Organisation (MMO)	3
Ministry of Justice (MOJ)	1
Total	85

As part of the screening process, impact assessments were classified in terms of their treatment of environmental impacts as shown in Table 2.2. In practice, most of the environmental impacts across the sample were found to be 'insignificant', with few policies explicitly identified as having impacts on the environment.

Table 2.2: Classification criteria for impact assessments

Treatment of environmental impact(s)	Description
Insignificant	No reference to environmental impacts, but this is proportionate for the case considered in the impact assessment.
Not covered	No reference to an environmental impact that could potentially be deemed significant; i.e. that may be considered a possible outcome of a policy. Hence it is unclear whether this was missed or considered not sufficiently relevant to include.
Noted	Environmental impacts are recognised, but no detail is given.
Described	Environmental impacts are described in some detail in qualitative terms.
Measured	The change in ecosystem service provision is quantified but not monetised.
Monetised	The change in ecosystem service provision is valued in monetary terms.

Table 2.3 presents an overview of how ecosystem service impacts deemed 'significant' were treated within the impact assessments reviewed. In general, 'marine', 'water' and 'waste' policy areas were found to have not covered environmental impacts most frequently. However as there were no quotas set for different policy areas considered as part of the review, this finding may be the result of 'marine', 'water' or 'waste' impact assessments being over-represented within the sample considered.

Table 2.3: Treatment of 'significant' impacts in reviewed impact assessments

Ecosystem service		No. of impact assessments					
		Not covered	Noted	Described	Measured	Monetised	Total
Provisioning	Food	4	12	1	0	1	18
	Fibre and Fuel	0	0	0	0	3	3
	Genetic Resources	4	6	0	0	2	12
	Biochemicals, medicine/pharma.	1	2	0	0	0	3
	Ornamental resources	0	0	0	0	0	0
	Freshwater	7	4	0	0	1	12
Regulating	Air quality regulation	2	4	2	0	16	24
	Climate regulation	2	5	5	0	13	25
	Water regulation	4	6	3	0	1	14
	Natural hazard regulation	1	2	3	0	1	7
	Pest regulation	1	2	1	0	0	4
	Disease regulation	1	9	2	0	3	15
	Erosion regulation	0	2	1	0	0	3
	Water purif. & waste treatment	8	5	2	0	1	16
	Pollination	2	0	0	0	0	2
Cultural	Cultural heritage	7	11	2	1	1	22
	Recreation and tourism	10	9	6	2	3	30
	Aesthetic values	13	9	5	0	3	30
Supporting	Soil formation	1	2	0	0	n/a	3
	Primary production	0	0	0	0	n/a	0
	Nutrient cycling	4	1	0	0	n/a	5
	Water cycling	2	2	0	0	n/a	4
	Photosynthesis	0	0	0	0	n/a	0
Total		74	93	33	3	49	252

Note: The classification of ecosystem services used here is consistent with the Defra ecosystem services guide (Defra, 2007).

The review of impact assessments also examined the ecosystem services most/least frequently addressed and how the addressed ecosystem services were treated. Cultural services (e.g. recreation, aesthetics) were found to be a key potential application for the EVL Tool. They were both frequently missed and also the most likely to be noted and described in appraisals, but not valued in monetary terms. Other frequently missing impacts included water purification and waste treatment, and freshwater impacts. Food, genetic resources, water regulation, pollination, and nutrient cycling impacts were missing within more than one impact assessments reviewed.

Impacts most likely to be monetised included air quality regulation and climate regulation, reflecting the well-established guidance that is available for these topic areas (Defra, 2013; DECC, 2014). In general, these results align with those from the review of impact assessments in the baseline evaluation of guidance study (eftec and Cascade Consulting, 2014), suggesting that ease of access to environmental values is indeed a primary factor for their actual use in appraisals. Hence despite there being a well-established evidence base for some types of environmental impacts/ecosystem services (e.g. non-market recreation benefits), the absence of an easy to use central reference point for analysts - particularly those outside of Defra - results in lower coverage of these impacts in monetary terms than might be expected.

2.2 User consultation

The user consultation phase of the study sought to understand the:

- Varying levels of experience among analysts of the appraisal of environmental impacts;
- Types of impacts they typically assess;
- Types of impacts they have been able to value in monetary terms;
- Types of impacts they have not been able to value in monetary terms; and
- Reasons for not valuing impacts in monetary terms.

The consultation consisted of a combination of interviews with analysts from different Government departments, as well as an online survey that was sent to previous interviewees from the '*Baseline Evaluation of Environmental Appraisal and Sustainable Development Guidance*' study and a wider network of Government officials.

2.2.1 Interviews

The interviews undertaken to inform the baseline evaluation study were reviewed and summarised in conjunction with 12 additional (telephone and in-person) interviews conducted in February and March 2015. Individuals from the following Government departments and agencies were interviewed:

- Centre for Environment, Fisheries and Aquaculture (Cefas);
- Department for Business, Innovation and Skills (BIS);
- Department for Environment, Food and Rural Affairs (Defra);
- Department for Transport (DfT);
- Department of Communities and Local Government (DCLG);
- Department of Energy and Climate Change (DECC);
- Environment Agency (EA);
- Food Standards Agency (FSA);
- Forestry Commission (FC);
- Health and Safety Executive (HSE); and
- Natural England (NE);

A representative from the Royal Society for the Protection of Birds (RSPB) also participated in the interviews, providing an external non-governmental organisation perspective.

The interviews focused on the barriers to quantifying and monetising environmental impacts and recommendations for the EVL tool.

Table 2.4 provides a summary of the main themes in the feedback from interviewees. Overall, a key barrier identified through the interviews was analysts' lack of familiarity with the ecosystem services framework. In particular, interviewees reported not being able to value environmental impacts because the net impact of different policies/impacts could not be determined (i.e. the impact of a policy relative to a baseline or counterfactual. An additional barrier identified in the interviews undertaken as part of the baseline evaluation of guidance study (eftec and Cascade Consulting, 2014) was that the existence and accessibility of carbon guidance hindered further valuation because analysts thought they had covered environmental impacts if they had valued carbon.

Another significant barrier to valuing environmental impacts highlighted by interviewees was a lack of both scientific and economic evidence. The examples given by interviewees are consistent with the findings from Section 2.1, particularly as impact assessments categorised as ‘marine’ or ‘water’ were frequently found to have ‘missed’ environmental impacts.

Table 2.4: Feedback from interviews

Key points	Feedback from interviewees
Screening out impacts in ‘cross-cutting’ policies	<ul style="list-style-type: none"> • Environmental impacts associated with ‘cross-cutting’ policies tend to be difficult to deal with. • Trade-offs between policies were also noted as posing difficulties when it came to assessing environmental impacts such as water, litter and noise in the context of the marine environment. • Analysts tend to focus on their area of expertise and screen out some negative environmental impacts, covered by other policies, in lieu of a more integrated approach to valuing environmental impacts.
Familiarity with the ecosystem services framework	<ul style="list-style-type: none"> • A common reason for not valuing certain environmental impacts was linked to analysts’ lack of familiarity with the concept of ecosystem services. • For some departments, the ecosystem services approach was not explicit in working processes and presented a barrier to the valuation of environmental impacts. • Certain environmental impacts are therefore not valued because the net impact from different pressures and/or policies on ecosystem service provision is not known or understood.
Lack of evidence (scientific and economic)	<ul style="list-style-type: none"> • For many impacts, the link between the policy and the environmental impact was deemed to be unclear particularly where a counterfactual or baseline scenario needed to be defined (e.g. designation of MCZs, impacts on landscapes). • For impacts where the science is relatively more advanced, monetary evidence is either available but not appropriate for the policy context or not available at all. An example of the former is found in the context of marine policy where existing data do not allow for a distinction between marine and terrestrial habitats. An example of the latter was mentioned in a case where the option value of groundwater needed to be valued but no suitable monetary evidence was available.
Concerns with proportionality of effort	<ul style="list-style-type: none"> • A key reason for not valuing certain impacts was indicated to be ‘proportionality’ of effort when undertaking appraisals. Generally judgements of ‘proportionality’ depend on precedents set within Government departments. • A lack of precedents (e.g. previous impact assessments) where environmental impacts were valued, made analysts uncertain over how much effort to put into valuing certain impacts. • Some interviewees stated that the default view was not to tackle such issues, leading to an implicit ‘zero value’ for wider environmental benefits.
Recommendations for the development of the look-up tool	<ul style="list-style-type: none"> • Interviewees were unanimous in saying that all indicative values need to be accompanied by context-specific information from original source studies (e.g. in a format consistent with the Defra value transfer guidelines). • The inclusion of caveats for the use of valuations was also noted as being a necessary requirement for the look-up tool. In addition, it would be helpful for key sensitivities to be set out to support sensitivity analysis in appraisals. • If an ‘uncertainty scale’ was included with the indicative values, this would need to be explained in the user guide and user interface. • It was also noted that the look-up tool should make links to existing guidance to avoid potential duplication (e.g. air quality guidance, carbon guidance, etc.). • One specific suggestion was to consider including an ecosystem services ‘checklist’ similar to the appraisal summary table used in the Environment Agency’s Water Appraisal Guidance (Environment Agency, 2013). This would help ensure that users are aware of the range of possible environmental impacts before selecting the appropriate indicative value from the look-up tool.

2.2.2 Survey responses

Over 100 individuals were contacted to take part in the online survey. In total, 16 responses were received: 8 from economists, 4 from scientists, and 4 from policy advisors. The majority of respondents were from the Environment Agency followed by Defra and the Joint Nature Conservation Committee (JNCC). Due to the small sample size, responses are not assumed to be representative of the breadth of potential users of the EVL Tool. Responses do, however, provide insights that can be usefully combined with findings from the other scoping tasks. The summary of findings from the online survey set out below are supplemented by the descriptive statistics provided in Annex 1.

Respondents were asked to identify the environmental impacts that they had experience assessing, as defined by Defra's supplementary Green Book guidance. Further questions asked respondents to detail whether they had monetised any of these impacts as well as which impacts they had tried but had not been able to monetise. Respondents' experiences ranged across different environment impacts (see Annex 1; Table A1. 2):

- 60% had experience in assessing water quality, abstraction and flood risk;
- 50% had experience in assessing vulnerability to climate change, and biodiversity;
- 40% had experience in assessing landscapes; *and*
- 30% had experience in assessing waste management, air quality and noise pollution.

Monetary valuation of environmental impacts was highest for biodiversity, air quality, and landscape impacts followed by vulnerability to climate change, water quality, abstraction and flood risk. Waste management and noise pollution were the least monetised impacts by respondents. Interestingly, of all the wider environmental impacts, respondents reported having the most experience assessing biodiversity even though the majority indicated not being able to express biodiversity impacts in monetary terms. This suggests that, while economic valuation evidence to value biodiversity impacts exists, analysts may not be aware of this or how to use it in value transfer applications, or it may be particularly policy/context specific.

Similarly, respondents were asked to provide feedback on the ecosystem service impacts that they had experience assessing (Table A1.3). Generally, respondents had the most experience assessing (all types of) cultural service impacts. This is somewhat contradictory to the findings from the impacts assessment review, but may be explained due to the small survey sample size and range of experience. Other experience by respondents included climate regulation, water regulation, and air quality regulation, water purification and waste treatments, and water cycling.

Experience with the monetary assessment of ecosystem service impacts was highest for recreation. This is in contrast to findings from the review of impact assessments where cultural services were most likely to be noted and described in appraisals, but not valued in monetary terms. Survey responses also indicated that air quality impacts were also frequently assessed in monetary terms, as in the impacts assessment review. Respondents most frequently stated that they had not been able to value other cultural and supporting ecosystem services. In general, though, there is a relatively even spread across the different ecosystem services that respondents stated they were not able to monetise.

Finally, respondents were asked to identify and/or specify the main reasons why they had not been able to monetise certain ecosystem service impacts (Figure A1. 1). A lack of valuation evidence and a lack of confidence in the robustness of evidence were the most commonly stated reasons for not valuing environmental impacts in monetary terms. Other reasons included uncertainty over the

scale of impact and a lack of scientific evidence. These findings are consistent with responses to the consultation interviews.

2.3 Illustrative valuation contexts

Based on the scoping and consultation activities outlined in Sections 2.1 and 2.2, a set of illustrative valuation contexts was identified to guide the task of compiling indicative values for the EVL Tool. These contexts provide a guide on the types of appraisal contexts (e.g. scenarios) in which indicative environmental values might be used, helping to frame the content and design of the tool. They span multiple habitats including terrestrial and marine across provisioning, regulating, cultural and supporting ecosystem services. They reflect the prominent policy areas where analysts have either been undertaking economic valuation of environmental impacts or have not been able to do so for various reasons. Note, however, that it follows that the identified scenarios are indicative and do not represent an exhaustive list of all policy areas that need to be assessed by Government analysts, or the breadth of economic valuation evidence requirements associated with this.

Figure 2.1 maps these scenarios broken down by ecosystem service type (provisioning, regulating, cultural or supporting) across the eight broad habitat types identified in the UK National Ecosystem Assessment (UK NEA, 2011). Blank spaces/cells within the matrix are policy areas that were not identified through the scoping and consultation tasks. As shown in Figure 2.1, some of the identified scenarios cut across multiple ecosystem services and/or habitat types, with a few cutting across either all ecosystem services or all habitat types such as “biodiversity”⁴. The interviews conducted confirmed that the cross-cutting nature of some of these valuation contexts is an understandable barrier to inclusion in impact assessments.

⁴ Biodiversity in particular represents a challenge for practical analysis in appraisals. This is a common theme that was reflected in the review of impact assessments, interviews and survey responses undertaken in this project. For further discussion see the accompanying biodiversity discussion paper, which reviews the valuation of biodiversity in a policy appraisal context.

Figure 2.1: Valuation contexts identified in the scoping and consultation tasks¹

	NEA habitat type							
	Freshwater, wetlands & floodplains	Coastal margins	Marine	Woodland	Enclosed farmland	Urban (green space)	Semi-natural grasslands	Mountains, moors & heaths
Provisioning			Fisheries	Marine Conservation Zones (MCZs)	Plant health			
Regulating		RBMPs ²				Air quality		
	Wetland creation	Groundwater remediation						
		Flood risk protection						
		Eutrophication						
Cultural		Diffuse pollution from agriculture			Contaminated land and clean-up			
		Landscapes						
		Recreation and tourism						
Supporting		Biodiversity						
					Loss of green space			
					Greening aspects of agriculture			
					Soil quality improvements			

Notes: ¹Shading is used to ensure clarity of presentation. Dark (blue) shaded cells are valuation contexts that cut across either all habitat types of all ecosystem services (provisioning, regulating, cultural and supporting). Light (blue) shaded cells are valuation contexts that do not cut across all habitats or all ecosystem services. Blank spaces/cells within the matrix are valuation contexts that were not identified through the scoping and consultation tasks. They represent areas for further consideration in conducting the evidence review. ²RBMPs: River Basin Management Plans.

3. COMPILING INDICATIVE VALUES

The population of the database that underpins the EVL Tool is based on a review of the available valuation evidence. The review of source studies was structured using a four-step process as depicted in Figure 3.1.

Figure 3.1: Evidence review process



3.1 Screening valuation studies

The first step of the evidence review was to identify economic valuation studies through a review of existing sources and literature. This included:

- The EVRI (Environmental Valuation Reference Inventory) database⁵;
- Habitat-specific chapters as part of the UK NEA (National Ecosystem Assessment);
- Additional literature reviews as part of the UK NEA follow-on;
- Publically available Government-funded research studies;
- The Economics of Ecosystems and Biodiversity (TEEB) database (Van der Ploeg and de Groot; 2010);
- Recent work from the Natural Capital Committee on building the economic case for investing in natural capital (eftec et al., 2015); and
- Existing Government guidance on valuing environmental impacts (e.g. DECC, 2014; Defra, 2011; etc.)⁶.

Available studies and evidence were organised based on the eight broad habitat types identified in the UK NEA: (i) coastal margins; (ii) enclosed farmland; (iii) freshwater, wetlands and floodplains; (iv) marine; (v) mountains, moors and heaths; (vi) semi-natural grasslands; (vii) urban (green space); and (viii) woodland.

The screening task focused on primary valuation studies and relevant analyses (e.g. meta-analysis studies) from the last 15 years (i.e. post-2000)⁷. Whilst this is a relatively arbitrary cut-off point for excluding older studies, it is intended to reflect the evolution in valuation methods and analysis since the 1990s. Moreover, based on empirical evidence, roughly a 10 - 15 year horizon is a reasonable limit for assuming that the underlying preferences that are captured in valuation studies remain consistent and are therefore appropriate sources for value transfer⁸.

⁵ Screened valuation studies were cross-referenced against studies in the EVRI database (www.evri.ca) to determine any gaps in the evidence review.

⁶ In particular, the objective of evidence review was to identify existing Government guidance on valuing specific environmental impacts. The purpose of doing so was not to reproduce the guidance and valuations in the look-up tool. Rather, these are referred to in the look-up tool and User Guide and users are directed to the relevant guidance.

⁷ Value transfer (secondary) studies were considered for the purpose of identifying further source (primary valuation) studies from which unit values could be obtained.

⁸ Various sources in the economic literature have examined the validity and reliability of the ‘temporal transfer’ of environmental values. See for example: Loomis and White (1996); Brouwer and Bateman (2005); Brouwer (2006); Rolfe and Brouwer (2011); Bliem et al. (2012); Dupont and Price (2014); Brouwer and Logar (2014). Whilst findings are not unequivocal, the empirical evidence tends to suggest that individuals’ preferences for environmental quality improvements do not vary significantly over the short term. Over longer

Finally, only UK studies (or meta-analyses including UK studies) were taken forward in the evidence review. This criteria is based on Defra value transfer guidelines (eftec, 2010) and to ensure that source studies reflect broader cultural constructs that influence environmental valuations, which are not necessarily consistent across countries.

Error! Reference source not found. presents a summary of the scope of the evidence review in terms of:

- The number of studies identified through the evidence review;
- The number of screened studies (UK relevant from 2000 onwards); and
- The number of ‘classified’ studies that input to the look-up value tool (see Section 3.2).

The evidence review covers over 350 UK-relevant studies from 2000 onwards (excluding existing Government guidance). The summary Table 3.1 provides a count of studies by habitat type; i.e. a study that covers multiple habitat types is counted more than once. For this reason, the number of identified, screened, and classified studies should not be summed and/or reported across habitat types.

Table 3.1: Summary of scope of evidence review by habitat type¹

Habitat type	No. identified studies	No. screened studies	No. classified studies
Enclosed farmland	56	13	7
Freshwater, wetlands and floodplains	46	32	8
Marine and coastal margins ²	54	19	11
Mountains, moors and heaths	59	12	6
Semi-natural grasslands	55	12	6
Urban (green space)	29	11	4
Woodland	100	15	8

Note: Excludes existing Government guidance. ¹A study that covers multiple habitat types is counted more than once; i.e. once for each relevant habitat type. ²For the purpose of the evidence review, valuation evidence for marine and coastal margins is combined because these two habitat types tend to be covered or discussed simultaneously in the literature. Indicative values are however presented separately for each habitat type in the look-up tool.

A full list of references for the set of screened studies is provided in Annex 2.

The evidence review and Table 3.1 provide some useful insights about the coverage of different habitat types in the valuation literature:

- **Freshwater** has the highest ratio of screened-to-identified studies compared to other habitat types. This implies that, while there are relatively fewer freshwater studies than woodland studies, for example, the former tend to be relatively recent and UK-focused. This likely reflects the underlying policy context where the EU Water Framework Directive (WFD) explicitly recognises the role of economic analysis in the implementation of water environment quality targets. This has provided the stimulus for a number of research projects by academic institutions and also required the development of valuation evidence to inform national and waterbody level planning.

time periods real WTP (i.e. accounting for changes in the purchasing power of money) can change by statistically significant amounts, but this is primarily related to factors that constrain WTP in the shorter term (e.g. household income). The underlying economic factors that determine WTP are found to remain stable over the short - medium term. Around 10 years would be a reasonable interpretation of the ‘short - medium’ term.

- **Enclosed farmland, marine and coastal margins** habitats are not extensively covered in the literature. For enclosed farmland, this finding is not unexpected given that provisioning ecosystem services from this habitat type are captured in existing markets. For marine and coastal margins, this is consistent with findings from research on coastal and marine ecosystem services as part of the UK NEAFO (WP4b: Turner et al., 2014), which noted that the main gaps in the literature were for biodiversity and seascape values (namely existence values).
- **Woodlands** are well covered in the valuation literature, particularly with regards to the provision of cultural services such as recreation and tourism. However, studies tend to be less recent, which explains the number of screened studies for woodland being among the lowest.
- **Urban green space** has the least number of identified studies and among the lowest number of screened studies compared to other habitat types. This is likely explained by the fact that, while there has been a growth in this area of research, it is still a relatively new field of investigation with limited evidence especially at the UK level. Further, when quantitative evidence does exist, it is often not in the form of transferable unit values given the spatially dependent nature of benefits from urban green space. This is particularly the case given the difficulty in explicitly establishing the contribution of green infrastructure when it is included as part of larger regeneration schemes (Evans and Shaw, 2004; Tyler et al., 2013).
- **Semi-natural grasslands and mountains, moors and heaths** are seemingly well covered in the literature. However, very few studies pass the screening criteria which implies that studies tend to be less recent and/or not UK-focused.

Overall, the evidence review suggests that key areas that may require further valuation effort to build the evidence base include urban green space, which generates significant benefits due to its proximity to beneficiary populations. In addition there are notable gaps with respect to mountains, moors and heaths, which include sub-habitats such as peatland that provide important regulating services, and semi-natural grasslands that can provide significant cultural ecosystem service benefits among others (e.g. 'landscape values').

3.2 Classifying valuation studies

Following the screening phase of the evidence review, the subset of UK-relevant, post-2000 studies were taken forward for potential inclusion in the EVL Tool database. These studies were summarised in line with the Defra value transfer guidelines to capture the important contextual factors that are shown as being important drivers of values that individuals place on environmental changes. By summarising this information when compiling indicative environmental values, a consistent basis is provided for presenting the valuation evidence and related information in the EVL Tool database. As such, evidence is summarised in a way that is readily comparable to appraisal contexts and can inform the decision-making process of users when choosing between multiple indicative values. It also frames the appraisal analysis in a structure that is consistent with the good practice principles set out in Defra's value transfer guidelines, and hence provides a basis for further detailed analysis if this is required (either through value transfer or primary valuation).

Annex 3 presents further detail on the structure for classifying studies, which uses a tabular format to summarise the key contextual factors and information from the source studies. The structure (as summarised in Table 3.2) is based on the value transfer criteria set out in efttec (2010).

Table 3.2: Classification criteria for valuation studies

Broad habitat	Habitat type(s) covered in the study based on the UK NEA habitat types (see Section 3.1).	
Environmental impact/ good	Environmental impact(s)/good(s) covered in the study based on the classification of ecosystem services and impacts in the Defra ecosystem services guide (Defra, 2007) and the supplementary guidance to the Green Book on valuing environmental impacts (Defra, 2012) respectively.	
Value	Low	Valuation evidence provided by the study including ranges of values that are driven by different factors including scenario analysis, types of users, etc.
	Central	
	High	
Units	The unit of the valuation(s). This information is needed when aggregating values. For example using number of visits to a habitat type to aggregate a £/visit value.	
Method(s)	Method(s) used in the study to estimate valuations.	
Quality	Covers the following: Whether the valuation/policy context, the good and the change in provision are described; Whether the affected population is defined with accompanying information on sampling; and Whether the validity of results and their robustness (including econometric analysis and validity testing) are discussed.	
Definition of good	Information about (dis)benefits provided by the broad habitat(s), physical characteristics, and components of total economic value measured.	
Change in provision	Qualitative and/or quantitative description of the change in terms of nature, direction, timing and scale.	
Location	Specific geographical area (e.g. region, area of habitat, etc.)	
Affected population	User/non-user beneficiary population including size, patterns of use and/or socio-economic profile.	
Substitutes	The number and quality of substitutes and whether they are accounted for in the selected indicative value(s)	
Market construct	Whether the good is a private good, public good, etc.	
Notes for value transfer	Explains the robustness and use of the indicative value(s) in terms of the limitations of method(s) and sampling of studies and applicability of values across different locations and populations. Some guidance on how values can be aggregated is also recorded including for the purpose of more detailed value transfer, if required.	

In moving from the screening of studies to classifying them for the purposes of the EVL Tool, a degree of informed judgement has been applied. This has been guided by the scoping activities described in Section 2 and good practice principles for valuation such as those set out in Defra's value transfer guidelines. In particular, greater emphasis has been placed on large-scale studies - for example Government-funded research studies developed to inform practical policy decisions - judged to have a reasonable degree of validity, robust results and that are widely used by practitioners in the field. The latter point is partly confirmed by the interviews with Government analysts and potential users of the tool. It is, however, noted that wide use of a study's results is not necessarily an endorsement of its validity or suitability for value transfer. Observations on the coverage of the classified evidence base and its suitability for informing the look-up tool are provided in Section 4.

3.3 Consolidating valuation evidence

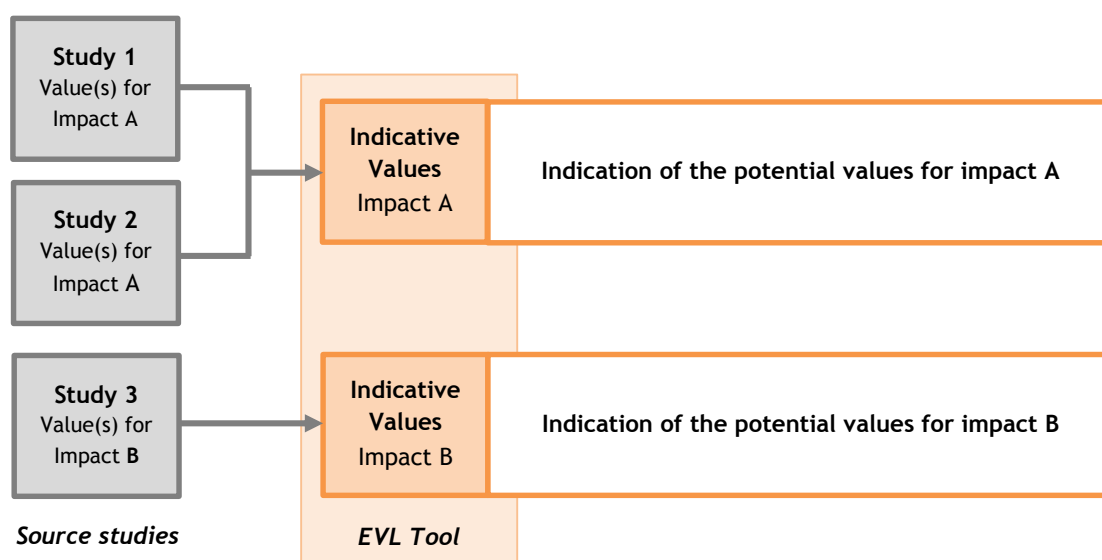
3.3.1 Overall approach

The final step in compiling indicative values consisted of 'consolidating' the valuation evidence to produce one range of indicative values (high, central, low) for each combination of broad habitat and environmental impact/good where valuation evidence exists. The resulting 'indicative values' that are presented in the EVL Tool should be interpreted as broad generalisations of the values that have been observed for different environmental goods and impacts in the review of valuation studies.

The need for the consolidation step arises from the structure of EVL Tool's user interface which requires users to select (i) the broad habitat followed by (ii) the environmental impact relevant to their application, in order to obtain a range of indicative values for that particular combination⁹. In this way, the consolidation of source evidence for populating the tool ensures that each combination of broad habitat and environmental impact is associated with a single range of values. The development of the user interface for the EVL Tool was subject to consultation and refined through the user consultation (Section 2.2) and a pilot testing workshop that took place with potential users on the structure of the look-up tool (June 2015).

For some valuations, the classification stage (Section 3.2) may be sufficient in preparing the values for inclusion in the look-up tool; i.e. having one set of indicative values per environmental impact/good. 'Impact B' in Figure 3.2 is an illustration of such a case where an impact is covered by a single valuation 'Study 3', and no further consolidation of evidence is required.

Figure 3.2: Example of environmental impact requiring 'consolidation' of values



However, for impacts such as 'impact A' multiple valuations from different source studies exist, and a further step is required involving the 'consolidation' of values. This additional step is needed in the following cases:

1. **Multiple studies cover the same impact and provide valuations in the same unit:** for certain habitat types there are multiple studies that estimate the benefits in the same per unit terms.

⁹ For further detail on the practical use of the EVL tool, refer to the accompanying User Guide document.

A prime example is woodland recreation, where *£ per visit* values for both general and specialist users are available from more than one valuation study (e.g. Scarpa, 2003; Christie et al., 2006; Sen et al., 2014). These values can therefore be used to compile a range of indicative values for recreational benefits from woodlands, such that lower end values reflect values for general users and upper end values reflect values for specialist users. In this way, the evidence from multiple studies is combined. Values within the range presented in the EVL Tool are not calculated/averaged across these multiple studies; rather the range incorporates the variation in values.

2. **Multiple studies cover the same impact but provide valuations in different units:** for example, a given type of benefit (e.g. amenity value due to an increase in urban green space) or dis-benefit may be covered by more than one classified study. ‘Consolidating’ values may involve a simple comparison of values which requires the conversion of estimates to a common unit (e.g. from £/household to £/ha). As in (1) above, each value within the range is still taken from an individual study and values within a range are not calculated/averaged across multiple studies.

For each set of indicative values representing a combination of broad habitat and environmental impact, accompanying guidance notes are provided in the EVL Tool user interface to help steer users in applying the appropriate value(s). This includes guidance on the interpretation of the range of values presented. In particular, the selection within a range of a single (low, central, or high) value depends on the key driver(s) of that range. In the example of woodland recreational benefits in (1) above, the driver of the range of indicative values is the type of beneficiary population (general vs. specialist recreation user). In this way, the range of values is not intended to be applied in conventional sensitivity analysis using lower and upper bound values, but to help users incorporate some context specific factors that are expected to influence unit values. This is intended to reflect some of the good practice principles that are highlighted in Defra’s value transfer guidelines, which highlights the limitation of analyses that do not control for context specific factors in appraisals, such as location and scope of beneficiary populations.

All values reported in the EVL Tool are in 2014 prices. Valuations from source studies are inflated to 2014 prices using the Consumer Price Index (CPI)¹⁰ and are rounded to the nearest £10, £100, £1,000, etc., depending on the order of magnitude of the source value.

3.3.2 Water environment valuation studies

A particular area of focus highlighted in the project specification is valuation evidence concerning the quality of the water environment. This is due to the considerable evidence that exists in this area due to the need for economic analysis in implementing water environment quality targets (see Section 3.1).

The evidence review identified a range of valuation studies examining changes in water environment quality. These include values from academic studies over the last 15 years (e.g. Bateman et al., 2006; Ferrini et al., 2014; Hanley et al., 2006; Lawrence and Spurgeon, 2007;

¹⁰ The use of the CPI is consistent with the Green Book (2003) and the Defra value transfer guidelines (eftec, 2009). The Green Book states that “over a long-term period, the Bank of England’s annual inflation target is the appropriate measure of prices to use as a general deflator”. The inflation target of 2% is expressed in terms of an annual rate of inflation based on the CPI (see: <http://www.bankofengland.co.uk/monetarypolicy/Pages/framework/framework.aspx>). The Defra value transfer guidelines state that the “choice of index may be influenced by the type of policy good, for example non-market goods valued in terms of willingness to pay may be more reflective of consumer purchases, and hence the CPI is an appropriate index”.

Rayment et al., 2014). Also included in the literature is the Environment Agency's National Water Environment Benefit Survey (NWEBS) (Nera Economic Consulting, 2007; Metcalfe, 2012).

Valuations in the literature tend to be expressed in different units, with most presented in £/household/year terms for a defined improvement in the water environment at a specific site or set of locations. The exception is the NWEBS catchment values that have been converted to in £/km/year terms for rivers and £/km²/year for lakes, coastal water and transitional waters, in order to support economic analyses that underpin implementation of the Water Framework Directive via RBMPs.

As part of the evidence review consolidation task, broad comparisons were drawn between the range of potential source studies included in the EVL Tool. In particular, the NWEBS catchment values were compared to studies by Bateman et al. (2006), Ferrini et al. (2014); Hanley et al. (2006); Lawrence and Spurgeon (2007) and Rayment et al. (2014). The studies reflect a variety of changes in water environment quality in different locations for both users and non-user population. Using readily available information - either reported in the studies, or sourced separately, valuations were converted to £/km/hh/year terms to provide a ready comparison to the NWEBS values. Household population information provided by the Environment Agency was used to convert the NWEBS catchment values also to £/km/hh/year terms. An example of the comparison is provided in Table 3.3.

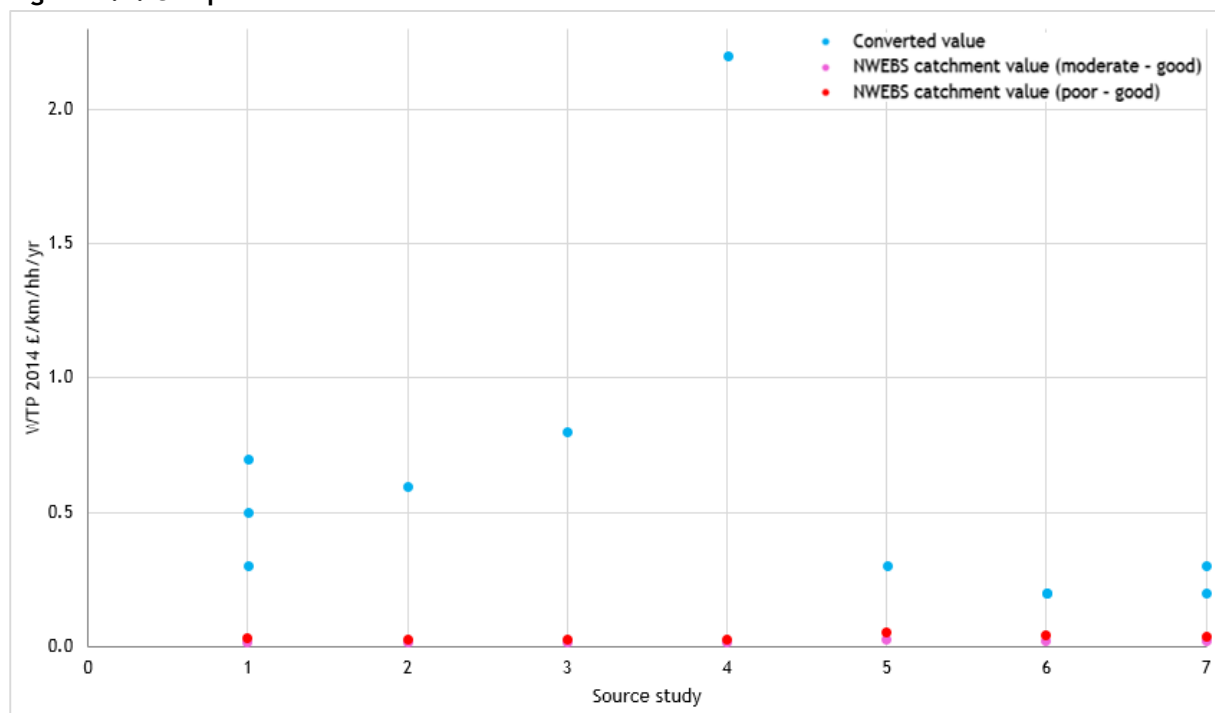
Table 3.3: Comparing water environment valuation studies

Data used	Hanley et al. (2006)	NWEBS - Wear Catchment (Metcalfe, 2012)
Unit values	Improvement in water body status from 'fair' to good status*: approx. £30/hh/yr	Moderate to good status: approx. £24.8k/km/yr Poor to good status: approx. £46.1/km/yr
Supporting information	Length of River Wear: 96 km	Beneficiary population: Approx. 891,000 (no. household within 30 miles)
Converted unit values	Approx. £0.3/km/hh/yr [Calculation: unit value / river length]	Moderate to good status: approx. £0.03/km/hh/yr Poor to good status: approx. 0.05/km/hh/yr [Calculation: unit value / beneficiary population]

Notes: Values are reported in 2014 prices. Hh = household. Yr = year. *: as described in the study.

Figure 3.3 provides a comparison across the potential source studies. In all cases, the converted unit values (blue data points) are an order of magnitude higher than the NWEBS values (red data points) for the relevant catchment.

Figure 3.3: Comparison of water environment valuations



Source studies: 1 = Bateman et al. (2006) (Tame Anker and Mease); 2 = Ferrini et al. (2014) travel cost estimate (Aire and Calder); 3 = Ferrini et al. (2014) contingent valuation payment card estimate (Aire and Calder); 4 = Ferrini et al. (2014) contingent valuation dichotomous choice estimates (Aire and Calder); 5 = Hanley et al. (2006) (Wear); 6 = Laurence and Spurgeon (2007) (Derwent (NW); North West Wales; Test and Itchen; Medway; Mersey Estuary; Ribble; Severn Vale; South East Valleys; South West Wales; Maidenhead to Sunbury; Wye; Wyre); 6 = Rayment et al. (2014) (Louth Grimsby and Ancholme; Medway; Maidenhead to Sunbury). WTP = willingness to pay. Hh = household. Yr = year.

The comparison illustrated in Figure 3.3 is limited, since it does not control for various factors that influence water environment valuations (e.g. scope of improvement, availability of substitutes, characteristics of beneficiary populations), nor differences in study methodology. However, it does illustrate that further analysis is required to reconcile the current evidence base concerning water environment values. As a pragmatic response, the EVL Tool reports the national average NWEBS values in order to ensure consistency with the valuation evidence that underpins RBMPs¹¹. Users of the tool are recommended to contact the Environment Agency for further guidance in applying NWEBS values in appraisals.

3.4 Coverage of indicative values in the EVL Tool

Overall, the EVL Tool includes approximately 40 indicative values. In addition to these, there are approximately 40 entries that relate to environmental impacts covered by existing Government guidance (e.g. climate regulation, air quality regulation, etc.). An overview of the current coverage of the EVL Tool is presented in Figure 3.4. The figure reflects how environmental impacts (provisioning, regulating, cultural) are covered across different broad habitats. Note that supporting ecosystem services are not covered in the tool as they constitute intermediate rather than final ecosystem services which, when valued with other final services, can lead to double counting of environmental impacts.

¹¹ A potential update of the indicative values would be to specify 'rural' and 'urban' values for the EVL Tool, based on NWEBS. In particular scope of beneficiary population is a key driver of the NWEBS values and it would be desirable to reflect this sensitivity in the EVL Tool indicative values if possible.

Figure 3.4: Overview of indicative values in the EVL Tool

	Urban	Woodland	Enclosed farmland	Semi-natural grasslands	Mountains, moors & heaths	Freshwater	Coastal margins	Marine
Provisioning		Fibre and fuel	Food			Biomass		Food
Regulating	Flood risk regulation							
	Climate regulation							
	Air quality							
Cultural	Bundled ecosystem service provision	Local environmental amenity (noise, litter, disturbance)			Bundled ecosystem service provision			
		Amenity value (local environmental amenity, recreation, cultural)			Water environment quality			
		Recreation					Human health impacts	
Supporting								

Note: Supporting ecosystem services are not covered in the EVL Tool as they constitute intermediate rather than final ecosystem services which, when valued with other final services, can lead to double counting of environmental impacts.

Figure 3.4 can be compared to the range of ecosystem services that are provided by habitat types as presented in the UK NEA (2011)¹². This comparison highlights the following gaps in the coverage of the look-up tool:

- Provisioning services for urban green space; mountains, moors and heaths; coastal margins are not covered by evidence in the tool. For urban green space, for example, this relates to the provision of trees and fresh water. Overall though, most provisioning services can be valued using market prices which feature in the EVL Tool (e.g. for enclosed farmland, semi-natural grasslands, woodland, etc.).
- Regulating services including pest regulation; waste regulation; pollination are not covered by evidence in the tool. This gap is due to a lack of evidence, which warrants further research given the importance of these ecosystem services across all habitat types.

¹² See Figure 5 in UK NEA (2011: 11) on the 'relative importance of Broad Habitats in delivering ecosystem services and overall direction of change in service flow since 1990'.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Summary

A lack of readily available environmental values is a recognised gap in the current guidance that supports the appraisal of environmental impacts in policy analyses. Whilst the key concepts and principles that underpin the valuation of environmental impacts are well-documented, the supplementary technical guidelines that are available for more detailed analyses (e.g. value transfer and primary valuation studies) can serve as a barrier to ‘entry-level’ use of environmental values. This is particularly the case where appraisal requires an initial screening or brief assessment of environmental costs and benefits to establish the possible scale of costs and benefits.

The development of the Environmental Value Look-up (EVL) Tool addresses this gap. The tool is intended to be used in the initial assessment of environmental impacts in an appraisal, complementing - and not replacing - the option for more detailed analysis through formal valuation methods. In effect, the tool can help analysts in moving from taking no account for environmental impacts in monetary terms, to a point from which better informed decisions can be made about the level of appraisal effort that is warranted for environmental impacts in a given assessment.

The task of developing the EVL Tool has sought to draw on the experiences and views of analysts across Government departments and agencies. The feedback from this exercise demonstrates that the potential use of the indicative environmental values spans a diverse set of policy contexts, covering the breadth of broad habitat types (terrestrial and marine) and the range of provisioning, regulating, and cultural ecosystem services. A key theme in the feedback received has been the challenge faced in the valuation of cross-cutting impacts. Multiple factors contribute to this situation, including lack of familiarity with underpinning valuation concepts, availability of suitable valuation evidence, and low confidence in the robustness of the available evidence. Indicative environmental values made available through an entry-point such as the EVL Tool can overcome these challenges to some extent by making environmental valuations readily useable in a consistent manner.

It is important, however, to ensure that evidence compiled for the EVL Tool is done so in a reliable way, and that the caveats concerning the use of indicative environmental values in appraisal are clearly communicated and factored into subsequent decision-making. In developing the EVL Tool the approach taken has been to align the evidence review with established principles for value transfer. This gives a systematic basis for compiling source valuations and means that use of the tool can also facilitate the scoping of more detailed assessments of environmental impacts, should this be required.

More fundamental challenges do, though, remain. In particular, in relation to the treatment of biodiversity in policy analyses. This issue is examined in detail in the accompanying discussion paper, which highlights the complexities faced, the difficulty in applying valuation methods to produce robust valuations, and the limited nature of the UK-focused evidence as a consequence. The paper concludes that, at present, it is not appropriate to incorporate indicative values specifically for biodiversity in the EVL Tool¹³. In the main, the available evidence does not lend itself to being interpreted and presented in the broadly generalised format that the EVL tool

¹³ Note that - as highlighted in the biodiversity discussion paper - the contribution of biodiversity to final ecosystem goods and services is expected to be captured in the value of these goods and services. Hence this aspect of biodiversity can be assumed to be incorporated within the relevant indicative values in the EVL Tool. For example, within values for single ecosystem services such as recreational benefits, and also values that reflect bundles of services from particular habitats (e.g. coastal margins).

adopts. More considered analysis is required when valuing biodiversity - particularly as a cross-cutting impact - which at the very minimum implies that formal value transfer approaches should be applied, and even these may not be sufficient if available evidence does not permit for appropriate assessment of spatial factors. In this respect, the EVL Tool includes a list of existing biodiversity valuation studies (in the 'Biodiversity Values' tab) as an entry point for users to identify potentially suitable studies to take forward in more detailed value transfer analysis.

Overall, the development of the database of indicative values for the EVL Tool is the product of the four-step process to review the current evidence base and compile valuations: (i) screening; (ii) classification; (iii) consolidation; and (iv) indicative values. Careful application is required when using the tool in practice. This is due to the inevitable uncertainty associated with taking source valuations and applying them in a 'generalised' way. The User Guide that accompanies the EVL Tool addresses these points of concern by highlighting the policy and appraisal contexts in which indicative values can be applied, drawing on the supplementary guidance on valuing environmental impacts (HM Treasury and Defra, 2012). The guide also covers the interpretation of indicative values in decision-making and how to present results in line with good practice points; e.g. from Defra's value transfer guidelines (eftec, 2009). Worked examples are also provided to illustrate the practical use of the tool. Hence the User Guide is an essential point of reference for users of the EVL Tool to ensure its appropriate use.

4.2 Findings

Key findings from the tasks undertaken to develop the EVL Tool include:

- **Barriers to valuing environmental impacts:** the main barriers faced by analysts relate to understanding and interpreting the various existing frameworks (e.g. ecosystem services, wider environmental impacts, etc.) that are described in current guidance. The volume of guidance and the level of technical detail is an obstacle to 'non-specialists' attempting to value environmental impacts.
- **Gaps in valuation evidence:** key areas that may require further valuation effort to support the use of indicative values include urban green space, mountains, moors and heaths, and semi-natural grasslands; as well as regulating ecosystem services (e.g. pest regulation, waste regulations, pollination) across the majority of UK NEA habitat types. Fewer valuations are also evident for broader cultural services that are supported by these habitats, including those that may be represented as 'landscape values'.
- **Applying indicative environmental values in ecosystem accounting:** following the conclusions in the accompanying ecosystem accounting discussion paper, a potentially important area for research may be to test the 'simulated exchange value' approach using practical examples. More generally, there are multiple issues to explore regarding selecting valuations for use in flow and asset accounts, such as the actual and likely uses of the accounts and their interpretation by users and stakeholders. Regarding the latter issue, if there is indeed confusion between welfare-based analyses (such as CBA for projects and investments) and exchange value-based accounts, then the risk of damage to decision-processes should be considered as part of the exploration of these issues in the future.

High level (top-down) ecosystem accounting exercises are potentially a suitable candidate for the use of indicative values. Here more emphasis may be placed on understanding the scale of values in terms of the order of magnitude and tracking these over time; an objective that could be supported by the use of indicative values. Conversely, if considerable effort is to be

expended on developing ecosystem accounts at the national level, then the evidence base for these accounts might be an ideal source of indicative values (in the future) for use in other accounting hierarchies (e.g. protected area accounts, corporate accounts, etc.) and in some appraisals. This is contingent though on resolving/clarifying the exchange value versus welfare value issue in a way that renders the values relatively compatible.

- **Valuing biodiversity:** further research effort is required to integrate the understanding of the role of biodiversity in contributing to human wellbeing in a workable approach for practical policy analyses. More valuation effort is also required to produce robust biodiversity valuation evidence for use in appraisals, particularly via value transfer analysis. Any new evidence that is developed will need to be reconciled with existing evidence for other non-biodiversity impacts to disentangle impacts and ensure that double-counting of biodiversity values is avoided. Whether this evidence can eventually be included in the EVL Tool or as a separate database in the future should also be explored.

Further consideration is also required with regard to cost-based biodiversity valuations based around policy targets. While a key concern is the insensitivity of cost-based approaches to spatial contexts at local scales, fundamentally the issue of concern is that the relationship between cost- and welfare-based values is not clear even though the former are intended to be proxies of the latter. This represents a significant conceptual barrier for the general use of cost-based values outside of target-based policy. Hence it is evident that a formal policy-led target-based approach is needed for justifying the use of cost-based measures.

An alternative approach of developing large-scale land use optimisation modelling such as TIM (Bateman *et al.* 2014) should be examined as a longer term solution. Whilst not currently a viable proposition, developments in the short term (e.g. the next five years) could lead to the use of such models to develop regionally-specific sets of (shadow) values for different kinds of biodiversity/land-use change (based on the opportunity costs of constraints in the models). Conceivably these can also take account of some local features, such as beneficiary populations and substitute sites, and therefore address concerns regarding the spatial context. The values would require periodic updating but could allow relatively straightforward estimation of values of changes to ecosystem extent and condition based on actual UK land-use and the services modelled.

With regards to the EVL Tool, the current conclusion is that where biodiversity is a critical impact/component of a policy or project, a formal value transfer analysis should be the starting point for an appraisal (rather than using the tool). A list of UK-based source studies that value changes in biodiversity is provided in the EVL Tool. The task should be to review existing evidence in line with good practice principles in order to determine whether current value evidence can appropriately adapted for the appraisal context being assessed.

4.3 Recommendations

In conclusion, a number of recommendations are outlined with respect to the practical use of the EVL Tool:

- **Review current appraisal guidance:** the EVL Tool is an 'entry-point' for the valuation of environmental costs and benefits. However current supplementary appraisal guidance appears to present some barriers to analysts. For the EVL Tool to be effective in increasing the practical use of environmental values in Government appraisals the route to using the tool must be clear, allowing users to circumvent (non-essential) technical guidance. Links and

pathways between current guidance should be mapped in a concise fashion and this ‘route map’ should be the first document that analysts encounter.

- **Develop further practical appraisal tools for specific environmental impacts:** the EVL Tool is database that provides a central reference point for indicative environmental values. There is scope for improving the valuation evidence base in several specific policy areas and these developments could then be used to update the evidence included in the tool. This may be the case for recreation where the evidence base is relatively richer and where current estimates capture the benefits derived by various types of users across most habitat types. Hence there is scope to further consolidate this evidence in a more systematic way than currently done so for the EVL Tool (e.g. via meta-analysis/transferable function). There may also be a case for developing a valuation tool relating to the water environment. Continued implementation of the WFD suggests the need to update the current valuation evidence that is available; this will likely require further primary valuation but the research could be undertaken in a way that also yields indicative values that could be applied more generally outside of formal water environment planning appraisals.
- **Maintaining and updating the EVL Tool:** the tool should be periodically updated to ensure its relevance and functionality with respect to intended users. In doing so, consideration should be given to continuing consultation with users of the tool to gain live feedback and log ‘lessons learnt’ over time. Basic updates to the tool should include updating the price base on a yearly basis, and dealing with minor feedback from users of the tool (e.g. fixing bugs, adding references to the ‘Useful Links’ tab, etc.). More substantive updates to the tool will also be required such as incorporating new valuation evidence as it becomes available. This is particularly relevant for areas where there are currently gaps in the evidence base. In this respect, it may be appropriate to tie-in updates of the tool with wider valuation evidence updates, such as continuing to contribute to the EVRI database (which essentially is a complementary task).
- **Availability of the EVL Tool:** the tool and User Guide should be made widely available for applications beyond policy appraisals. It potentially provides an entry-point for environmental valuation in a number of contexts both with Government and beyond. There will be opportunities for organisations to adapt the tool and database for use in their own assessment contexts (e.g. investment appraisals and corporate natural capital accounts); for example by providing their own supplementary guidance for using indicative values, or by using the format to summarise their own valuation evidence.

GLOSSARY

Biodiversity: the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species and ecosystems (Convention on Biological Diversity, Article 2).

Broad habitat: a means of classifying the natural environment. There are eight broad habitats based on the UK NEA (2011). These include: (i) coastal margins; (ii) enclosed farmland; (iii) freshwater, wetlands and floodplains; (iv) marine; (v) mountains, moors and heaths; (vi) semi-natural grasslands; (vii) urban (green space); and (viii) woodland.

Consumer Price Index (CPI): The CPI is a measure of consumer price inflation. It is the inflation measure used in the Government's target for inflation. The CPI is also used for purposes such as uprating pensions, wages and benefits and can aid in the understanding of inflation on family budgets (ONS, 2013).

Cost-benefit analysis: a decision-making tool that compares costs and benefits of a proposed policy or project in monetary terms.

Economic appraisal: the process of defining objectives, examining options and weighing up the costs benefits, risks and uncertainties of proposed policies, programmes or projects before a decision is made.

Ecosystem accounting: an integrated approach to the assessment of the environment through the measurement of ecosystems, and measurement of the flows of services from ecosystems into economic and other human activity (SEEA, 2012).

Ecosystem services: a term that is used to describe a framework for analysing how human populations are dependent upon the condition of the natural environment. The approach explicitly recognises that ecosystems and the biological diversity contained within them contribute to individual and social wellbeing.

Environmental Valuation Reference Inventory (EVRI): a database of economic valuation evidence (i.e. secondary evidence) for value transfer applications.

Impact assessment: a process to help policy-makers think through fully and understand the consequences of possible and actual government interventions in the public, private and third sectors; and a tool to enable the Government to weigh and present the relevant evidence on the positive and negative effects of such interventions, including by reviewing the impact of policies after they have been implemented (Department for Business Innovation and Skills, 2015).

Proportionality: the appropriate level of resources to invest in gathering and analysing data for appraisals and evaluations (Department for Business Innovation and Skills, 2015).

Value transfer: process by which readily available economic valuation evidence is applied in a new context for which valuation is required.

REFERENCES

Bateman, I.J., Cole, M.A., Georgiou, S., Hadley, D.J. (2006) "Comparing contingent valuation and contingent ranking: A case study considering the benefits of urban river water quality improvement," *Journal of Environmental Management*, vol. 79, pp.221-231

Bateman, I., Day, B., Agarwala, M., Bacon, P., Bad'ura, T., Binner, A., De-Gol, A., Ditchburn, B., Dugdale, S., Emmett, B., Ferrini, S., Carlo Fezzi, C., Harwood, A., Hillier, J., Hiscock, K., Hulme, M., Jackson, B., Lovett, A., Mackie, E., Matthews, R., Sen, A., Siriwardena, G., Smith, P., Snowdon, P., Sünnerberg, G., Vetter, S., & Vinjili, S. (2014) UK National Ecosystem Assessment Follow-on. Work Package Report 3: Economic value of ecosystem services. UNEP-WCMC, LWEC, UK.

Bliem, M.; Getzner, M.; and Rodiga-LaBnig, P. (2012). Temporal stability of individual preferences for river restoration in Austria using a choice experiment. *Journal of Environmental Management*, 103, pp. 65 - 73.

Brouwer, R. (2006). Do stated preference methods stand the test of time? A test of the stability of contingent values and models for health risks when facing an extreme event. *Ecological Economics*, 60, pp. 399 - 406.

Brouwer, R. and Bateman, I. (2005). Temporal stability and transferability of models of willingness to pay for flood control and wetland conservation. *Water Resources Research*, 41(3), pp. 1 - 6.

Brouwer, R. and Logar, I.L. (2014). Do choice experiments produce more stable welfare measure than contingent valuation? A test-retest. Fifth World Congress of Environmental and Resource Economists. June 28 - 2 July 2014.

Christie, M., Hanley, N., Garrod, B., Hyde, T., Lyons, N., Bergmann, A., & Hynes, S. 2006, Valuing Forest Recreation Activities: Final Phase 2 Report. Forestry Commission: Edinburgh

Department for Business Innovation and Skills (2015), Better Regulation Manual: Practical Guidance for UK Government Officials. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/421078/bis-13-1038-Better-regulation-framework-manual.pdf [Accessed August 2015].

Department for Energy and Climate Change (DECC) (2014). Valuation of energy use and greenhouse gas emissions, supplementary guidance to the HM Treasury Green Book on Appraisal and Evaluation in Central Government. <https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal> [Accessed July 2015].

Department for Environment, Food and Rural Affairs (Defra) (2007) An introductory guide to valuing ecosystem services. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191502/Introductory_guide_to_valuing_ecosystem_services.pdf [Accessed October 2015].

Department for Environment, Food and Rural Affairs (Defra) (2013). Valuing Impacts on Air Quality: Supplementary Green Book Guidance. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/197893/pu1500-air-quality-greenbook-supp2013.pdf [Accessed October 2015].

Department for Environment, Food and Rural Affairs (Defra) (2014) Invitation to Tender: Tender for Development of 'look-up' environmental value estimates for initial appraisal within cost- benefit analysis. Tender Reference: BE0111.

Department for Transport (2013) Value for Money Assessment: Advice Note for Local Transport Decision Makers.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/267296/vfm-advice-local-decision-makers.pdf [Accessed October 2015].

Department for Transport (DfT) (2014). WebTAG: TAG data book - November 2014.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/381897/TAG_data_book_Autumn_2014_FINAL_v1.3b__1_.xls [Accessed October 2015].

Dupont, D. and Price, J. (2014). Temporal stability of water quality values across stated preference question formats. Fifth World Congress of Environmental and Resource Economists. June 28 - 2 July 2014.

Evans, G., Shaw, P. (2004). The contribution of culture to regeneration in the UK: a review of evidence. A report to the Department for Culture Media and Sport.

eftec (2009). Valuing Environmental Impacts: Practical Guidelines for the Use of Value Transfer in Policy and Project Appraisal. Report for the Department for Environment, Food and Rural Affairs.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/182376/vt-guidelines.pdf [Accessed October 2015].

eftec (2010a). Flood and coastal erosion risk management: Economic valuation of environmental effects. Handbook for the Environment Agency for England and Wales.

eftec (2015a). Applying values in ecosystem accounting. Final discussion paper to Defra.

eftec (2015b). Valuing biodiversity. Final discussion paper to Defra.

eftec and Entec (2001). Valuing the External Benefits of Undeveloped Land: Main Document. Final report for the Department for Communities and Local Government (DCLG).

eftec & Cascade Consulting (2014). Baseline Evaluation of Environmental Appraisal and Sustainable Development Guidance Across Government. Final report for Department for Environment, Food and Rural Affairs.
http://randd.defra.gov.uk/Document.aspx?Document=11937_131003_ERG1222_Appraisals_Final_2014_03_07.pdf [Accessed October 2015]

eftec, CEH, ABPmer and Regeneris Consulting (2015). Developing Economic Evidence on the Costs and Benefits of Investing in Natural Capital.
<http://nebula.wsimg.com/8755553ec25d9cd0dc9407fa5e4aa408?AccessKeyId=68F83A8E994328D64D3D&disposition=0&alloworigin=1> [Accessed October 2015].

Ferrini, S., Schaafsma, M., and Bateman, I. (2014) Revealed and stated preference valuation and transfer: A within-sample comparison of water quality improvement values, Water Resources Research, Vol. 50, No. 6.

Hanley, N., Wright, R. E., & Alvarez-Farizo, B. (2006). Estimating the economic value of improvements in river ecology using choice experiments: an application to the water framework directive. *Journal of environmental management*, 78(2), 183-193.

HM Treasury. (2003). *The Green Book: Appraisal and Evaluation in Central Government*. London: HM Treasury.

HM Treasury and Department for Environment, Food and Rural Affairs (2012). Accounting for environmental impacts: Supplementary Green Book guidance. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191500/Accounting_for_environmental_impacts.pdf [Accessed October 2015].

Landers, D.H, and Nahlik, A.M. (2013). Final Ecosystem Goods and Services Classification System (FEGS-CS). EPA/600/R-13/ORD-004914. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

Lawrence, K.S., and Spurgeon, J. (2007) 'Economic evaluation of inland fisheries: Welfare benefits of inland fisheries in England and Wales - Science Report', Environment Agency: Bristol, UK.

Loomis, J.B. and White, D.S. (1996). Economic benefits of rare and endangered species: summary and meta-analysis. *Ecological Economics*, 18, pp. 197 - 206.

Metcalf, P.J. (2012) "Update of CRP WFD Benefit Value - Economic Component," report for the Environment Agency.

Millennium Ecosystem Assessment (MEA), 2005. *Ecosystems and Human Well-being: General Synthesis*. Island Press, Washington, DC.

NERA Economic Consulting (2007). The Benefits of Water Framework Directive Programmes of Measures in England and Wales. Final report to Defra.

Office for National Statistics (ONS) (2013). Consumer price indices: a brief guide. <http://www.ons.gov.uk/ons/guide-method/user-guidance/prices/cpi-and-rpi/consumer-price-indices--a-brief-guide.pdf> [Accessed October 2015].

Office for National Statistics (ONS) and Department for Environment, Food and Rural Affairs (Defra) (2014). Principles of Ecosystem Accounting. <http://www.ons.gov.uk/ons/guide-method/user-guidance/natural-capital/related-publications/principles-of-ecosystems-accounting.pdf> [Accessed October 2015].

Rayment, M.; Conway, M.; Bartrakova, S.; McNeil, D.; Christie, M.; and Remoundou, K. (2014) "Estimating the Impact on Public Benefits from Changes in Investment in the Environment Agency Waterways: Final Report" Submitted by ICF GHK

Rolfe, J. and Brouwer, R. (2011). Testing for value stability with a meta-analysis of choice experiments: River health in Australia. Australian National University, Environmental Economics Research Hub.

Scarpa, R. (2003) "The recreation value of Woodlands". Report for the Forestry Commission

SEEA (2012) Experimental Ecosystem Accounting, System of Environmental-Economic Accounting 2012, European Commission, Organisation for Economic Co-operation and Development, United Nations, World Bank, 2013.

Sen, A., Harwood, A. R., Bateman, I. J., Munday, P., Crowe, A., Brander, L., Raychaudhuri, J., Lovett, A.A., Foden, J. & Provins, A. (2014). Economic assessment of the recreational value of ecosystems: Methodological development and national and local application. *Environmental and Resource Economics*, 57(2), 233-249.

Turner, K., Schaafsma, M., Elliott, M., Burdon, D., Atkins, J., Jickells, T., Tett, P., Mee, L., van Leeuwen, S., Barnard, S., Luisetti, T., Paltriguera, L., Palmieri, G., & Andrews, J. (2014) UK National Ecosystem Assessment Follow-on. Work Package Report 4: Coastal and marine ecosystem services: principles and practice. UNEP-WCMC, LWEC, UK.

Tyler, P., Warnock, C., Provins, A., and Lanz, B. (2013). Valuing the Benefits of Urban Regeneration. *Urban Studies*. Volume 50, Issue 1.

UK National Ecosystem Assessment (2011). The UK National Ecosystem Assessment: Synthesis of the Key Findings. UNEP-WCMC, Cambridge.

Van der Ploeg, S. and R.S. de Groot (2010) The TEEB Valuation Database - a searchable database of 1310 estimates of monetary values of ecosystem services. Foundation for Sustainable Development, Wageningen, The Netherlands.

ANNEX 1: SURVEY RESPONSES - DESCRIPTIVE STATISTICS

Table A1. 1: Breakdown of survey respondents by Government department

Government department/organisation	No. respondents
Department for Environment, Food and Rural Affairs (Defra)	4
Department for Transport (DfT)	2
Environment Agency (EA)	5
Forestry Commission (FC)	1
Joint Nature Conservation Committee (JNCC)	3
Marine Scotland	1
Total	16

Table A1. 2: Survey respondents' experience with assessing environmental impacts

Environmental impact	Experience assessing (n=14)	Experience monetising (n=9)	Unable to monetise (n=10)
Vulnerability to climate change	8	3	3
Waste management	5	2	3
Air quality	5	5	1
Landscapes	6	5	1
Water quality, abstraction and flood risk	9	4	5
Biodiversity	8	5	5
Noise pollution	5	2	3

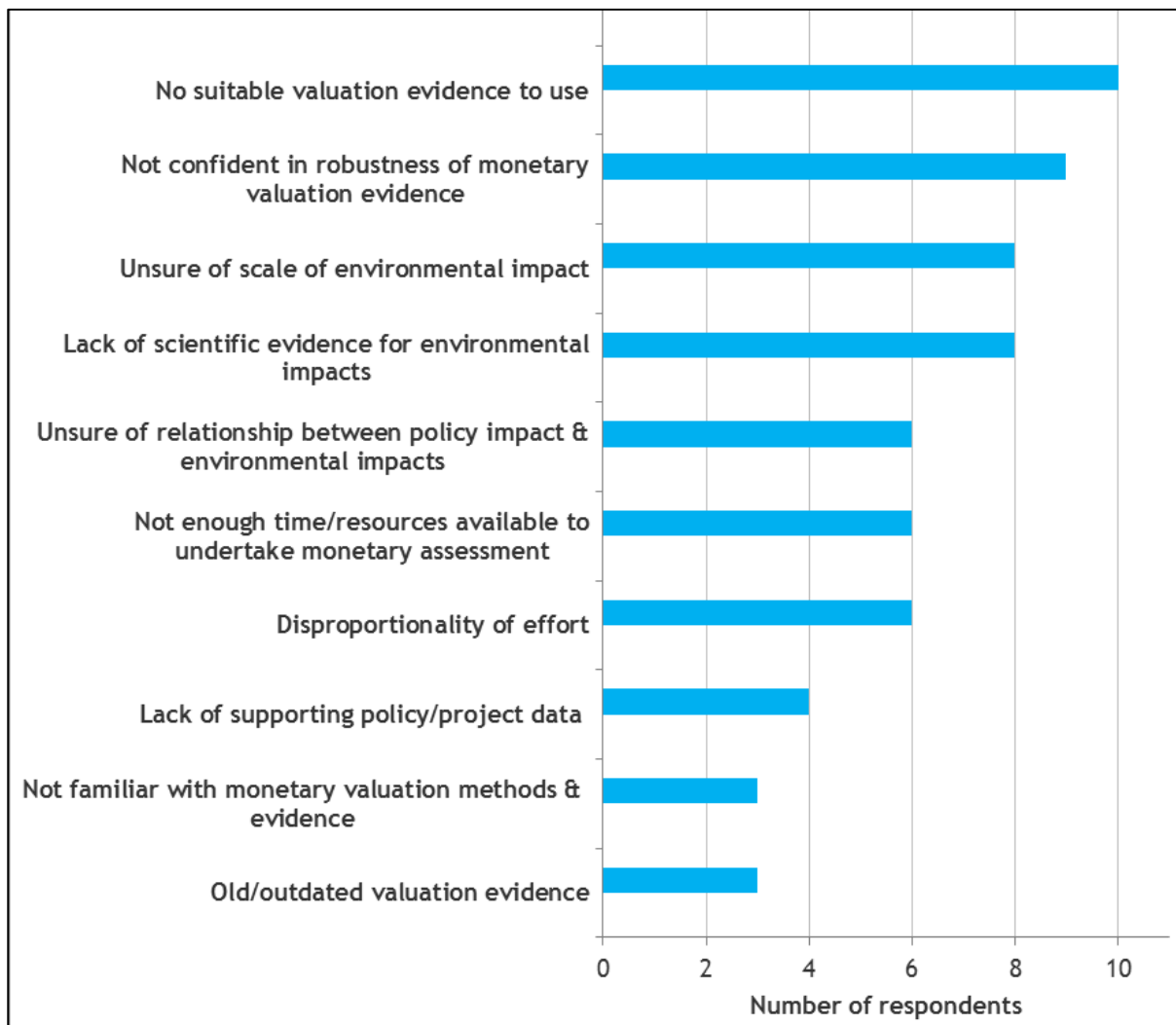
Note: number of respondents who answered each question varies.

Table A1. 3: Overview of online survey respondent experience with assessing ecosystem service impacts

Ecosystem service		No. respondents		
		Experience assessing	Experience monetising	Unable to monetise
Provisioning	Food	4	2	4
	Fibre and Fuel	6	3	1
	Genetic Resources	2	0	3
	Biochemicals, medicines, pharmaceuticals	1	0	3
	Ornamental resources	1	0	2
	Fresh water	6	2	4
Regulating	Air quality regulation	6	4	1
	Climate regulation	7	5	2
	Water regulation	6	2	4
	Natural hazard regulation	4	1	2
	Pest regulation	3	0	2
	Disease regulation	3	1	2
	Erosion regulation	1	1	3
	Water purification and waste treatment	6	2	3
	Pollination	3	1	0
Cultural	Cultural Heritage	6	3	6
	Recreation and tourism	12	7	6
	Aesthetic value	9	3	6
Supporting	Soil formation	1	-	2
	Primary production	1	-	2
	Nutrient cycling	3	1	4
	Water cycling	5	1	6
	Photosynthesis	1	-	2

Note: number of respondents who answered each question varies.

Figure A1. 1: Reasons for not monetising environmental impacts



ANNEX 2: SCREENED VALUATION STUDIES

A2.1 Enclosed farmland

Boatman, N., and Willis, K. (2010). Estimating the Wildlife and Landscape Benefits of Environmental Stewardship. Final report for Defra.

Christie, M., Hanley, N., Warren, J., Hyde, T., Murphy, K., and Wright, R. (2006). Valuing changes in farmland biodiversity using stated preference techniques. *Environmental Valuation in Developed Countries: Case Studies* (pp. 50-76).

Christie, M., Hyde, A., Cooper, R., Fazey, I., Dennis, P., Warren, J. M., Colombo, S., and Hanley, N. (2011). Economic Valuation of the Benefits of Ecosystem Services delivered by the UK Biodiversity Action Plan (Defra Project SFFSD 0702).

Christie, M., J. Warren, N. Hanley, K. Murphy, R. Wright, T. Hyde and N. Lyon (2004). Developing Measures for Valuing Changes in Biodiversity. Department for Environment, Food and Rural Affairs (DEFRA), London, UK.

Christie, M., Hanley, N., Warren, J., Murphy, K., Wright, R., & Hyde, T. (2006). Valuing the diversity of biodiversity. *Ecological economics*, 58(2), 304-317.

eftec (2006). Economic Valuation of Environmental Impacts in the Severely Disadvantaged Areas. For Defra.

Fezzi, C., Hutchins, M., Rigby, D., Bateman, I. J., Posen, P., & Hadley, D. (2010). Integrated assessment of water framework directive nitrate reduction measures. *Agricultural Economics*, 41(2), 123-134.

Garratt, M. P. D., Breeze, T. D., Jenner, N., Polce, C., Biesmeijer, J. C., & Potts, S. G. (2014). Avoiding a bad apple: Insect pollination enhances fruit quality and economic value. *Agriculture, ecosystems & environment*, 184, 34-40.

GHK Consulting (2011). Benefits of Sites of Special Scientific Interest. Final report to Defra.

Gibbons, S., Mourato, S., & Resende, G. M. (2014). The amenity value of English nature: a hedonic price approach. *Environmental and Resource Economics*, 57(2), 175-196.

Nix, J. (2014). The John Nix farm management pocketbook (No. Ed. 44). The Andersons Centre.

Sen, A., Harwood, A. R., Bateman, I. J., Munday, P., Crowe, A., Brander, L., Raychaudhuri, J., Lovett, A., Foden, J., Provins, A. (2014). Economic assessment of the recreational value of ecosystems: Methodological development and national and local application. *Environmental and Resource Economics*, 57(2), 233-249.

Tinch, D., S. Colombo, and N. Hanley (2014). The Impacts of Elicitation Context on Stated Preferences for Agricultural Landscapes. *Journal of Agricultural Economics*, 66 (1), pp. 87-107.

A2.2 Freshwater, wetlands and floodplains

ADAS Consulting Ltd. (2003). 'Survey of Rod Licence Holders 2003 - R&D Technical Report', Environment Agency: Bristol, UK

Atkinson, G., Morse-Jones, S., Mourato, S., Provins, A. (2012). "When to Take 'No' for an Answer? Using Entreaties to Reduce Protests in Contingent Valuation Studies," *Environmental Resource Economics*, vol. 51, pp.497-523

Bateman, I., Georgiou, S., Lake, I., (2006). The Aggregation of Environmental Benefit Values: A Spatially Sensitive Valuation Function Approach. CSERGE Working Paper EDM 05-04

Bateman, I.J., Cole, M.A., Georgiou, S., Hadley, D.J. (2006). "Comparing contingent valuation and contingent ranking: A case study considering the benefits of urban river water quality improvement," *Journal of Environmental Management*, vol. 79, pp.221-231

Bateman, I.J., Brouwer, R., Ferrini, S., Schaafsma, M., Barton, D.N., Dubgaard, A., Hasler, B., Hime, S., Liekens, I., Navrud, S., De Nocker, I., Sceponaviciute, R., Semeniene, D. (2011). Making Benefit Transfers Work: Deriving and Testing Principles for Value Transfers for Similar and Dissimilar Sites Using a Case Study of the Non-Market Benefits of Water Quality Improvements Across Europe. *Environmental Resource Economics*, vol. 50: 365-387

Bateman, I.J., Cooper, P., Georgiou, S., Navrud, S., Poe, G.L., Ready, R., Riera, P., Ryan, M., Vossler, C.A. (2004). 'Scope Sensitivity Tests for Preference Robustness: An Empirical Examination of Economic Expectations Regarding the Economic Valuation of Policies for Reducing Acidity in Remote Mountain Lakes', CSERGE Working Paper EDM 04-03

Black, A., Colombo, S., Hanley, N., Tinch, D., Aftab, A., & Bergmann, A. (2006). Transferring the benefits of water quality enhancements in small catchments. In *2006 Annual Meeting, August 12-18, 2006, Queensland, Australia* (No. 25790). International Association of Agricultural Economists.

Brander, L.M., Ghermandi, A., Kuik, O., Markandya, A., Nunes, P.A.L.D., Schaafsma and M., Wagtendonk, A. (2008) Scaling up ecosystem services values: methodology, applicability and a case study. Final Report, EEA May 2008.

Cooper, P., Gregory, L.P., Bateman, I.J. (2004). "The structure of motivation for contingent values: a case study of lake water quality improvement, " *Ecological Economics*, Vol. 50, pp.69-82

Entec UK Limited (2004). Valuing Water Use in Scotland and Northern Ireland for WFD Implementation Process. Report for the Scotland and Northern Ireland Forum for Environmental Research.

Ferrini, S., Schaafsma, M., and Bateman, I. (2014). Revealed and stated preference valuation and transfer: A within-sample comparison of water quality improvement values, *Water Resources Research*, Vol. 50, No. 6.

Gibbons, S.; Mourato, S.; and Mendes Resende, G. (2014) The amenity value of English nature: a hedonic price approach. *Environmental and Resource Economics*, 57 (2). pp. 175-196.

Glenk, K., Lago, M., & Moran, D. (2011). Public preferences for water quality improvements: implications for the implementation of the EC Water Framework Directive in Scotland. *Water Policy*, 13(5), 645-662.

Hanley, N., Wright, R. E., & Alvarez-Farizo, B. (2006). Estimating the economic value of improvements in river ecology using choice experiments: an application to the water framework directive. *Journal of environmental management*, 78(2), 183-193.

Johnstone, C., and Markandya, A. (2006), 'Valuing river characteristics using combined site choice and participation travel cost models', *Journal of Environmental Management*, 80: 237-247.

Lawrence, K.S., and Spurgeon, J. (2007). 'Economic evaluation of inland fisheries: Welfare benefits of inland fisheries in England and Wales - Science Report', Environment Agency: Bristol, UK.

Metcalfe, P.J. (2012). "Update of CRP WFD Benefit Value - Economic Component," report for the Environment Agency.

Peirson, G., Tingley, D., Spurgeon, J., & Radford, A. (2001). Economic evaluation of inland fisheries in England and Wales. *Fisheries Management and Ecology*, 8(4-5), 415-424.

Radford, Al, Riddington, G., Anderson, J. (2004), 'Technical Report: The Economic Impact of Game and Coarse Fishing in Scotland,' Scottish Environment and Rural Affairs Division: 1-144

Radford, A. Riddington, G. and Gibton, H. (2007). 'Economic evaluation of inland fisheries: Welfare benefits of inland fisheries in England and Wales - Science Report', Environment Agency: Bristol, UK.

Radford, A.F., G. Riddington and D. Tingley, 'Economic Evaluation of Inland Fisheries: Economic Evaluation of Fishing Rights', Report, 2001-01-01

Radford, Al, Riddington, G., Anderson, J. (2004), 'Technical

Rayment, M., Conway, M., Bartrakova, S., McNeil, D., Christie, M., and Remoundou, K. (2014). "Estimating the Impact on Public Benefits from Changes in Investment in the Environment Agency Waterways: Final Report" Submitted by ICF GHK

Sen, A., Harwood, A. R., Bateman, I. J., Munday, P., Crowe, A., Brander, L., Raychaudhuri, J., Lovett, A.A., Foden, J. & Provins, A. (2014). Economic assessment of the recreational value of ecosystems: Methodological development and national and local application. *Environmental and Resource Economics*, 57(2), 233-249.

Simpson, D. and Mawle, G. (2001), 'Survey of Rod Licence Holders: R&D Technical Report), Environment Agency: Bristol, UK

Simpson, D. and Mawle, G. (2005), 'Public Attitudes to Angling 2005: A survey of attitudes and participation in England and Wales', Environment Agency: Bristol, UK

Simpson, D. and Willis, K. (2004). 'Method for Assessing the Heritage Value of Net Fisheries,' Environment Agency: Bristol, UK

Spash, C.L., Urama, K., Burton, R., Kenyon, W., Shannon, P., Hill, G (2006). "Motives behind willingness to pay for improving biodiversity in a water ecosystem: Economics, ethics and social psychology." *Ecological Economics*, vol. 68, pp. 955-964

Soliño, M., Joyce, J., & Farizo, B. A. (2013). Improving water quality in England and Wales: local endowments and willingness to pay. *International Journal of Environmental Research*, 7(3), 623-632.

Spash, C.L.; Urama, K.; Burton, R.; Kenyon, W.; Shannon, P.; Hill, G (2006) "Motives behind willingness to pay for improving biodiversity in a water ecosystem: Economics, ethics and social psychology." *Ecological Economics*, vol. 68, pp. 955-964

Spurgeon, J., G. Colarullo, A.F. Radford and D. Tingley 'Economic Evaluation of Inland Fisheries Module B: Indirect Economic Values Associated with Fisheries - General Public Survey', Report, 2001-01-01

Willis, K. Garrod, G. & Scarpa, R. (2013). Customer preferences, Willingness to Pay and Willingness to Accept changes in water service measures: a choice experiment. Final report submitted to Yorkshire Water, March 2013

A2.3 Marine and coastal margins

Bateman, I.J., Turner, R.K., Adger, W.N., Boar, R., Brouwer, R., Crooks, S., Dockerty, T., Georgiou, S., Jones, A., Langford, I.H., Ledoux, L., Nishikawa, N., Powe, N., Wright, J. and Wright, S.D., (2001). Management of a Multi-Purpose Coastal Wetland: The Norfolk and Suffolk Broads, in Turner, R.K., Bateman, I.J. and Adger, W.N. (eds.). *Economics of Coastal and Water Resources: Valuing Environmental Functions*, Kluwer, Dordrecht, The Netherlands, pp 159-214.

Bateman, I.J., Turner, R.K., Klein, R.J.T. and Langford, I.H. (2001). The Application of the Cost Benefit Method to Sea Defence and Coastal Protection Management in England. In R.K. Turner, I.J. Bateman and W.N. Adger, eds. *Economics of Coastal and Water Resources: Valuing Environmental Functions*. Dordrecht, Kluwer Academic, 113-142.

Birol, E., & Cox, V. (2007). Using choice experiments to design wetland management programmes: The case of Severn Estuary Wetland, UK. *Journal of Environmental Planning and Management*, 50(3), 363-380. Brander, L. M., Van Beukering, P., and Cesar, H. S. (2007). The recreational value of coral reefs: A meta-analysis. *Ecological Economics* 63(1): 209-218.

Brander, L.M., Ghermandi, A., Kuik, O., Markandya, A., Nunes, P.A.L.D., Schaafsma and M., Wagtendonk, A. (2008). Scaling up ecosystem services values: methodology, applicability and a case study. Final Report, EEA May 2008.

Chae, D. R., Wattage, P., & Pascoe, S. (2012). Recreational benefits from a marine protected area: A travel cost analysis of Lundy. *Tourism Management*, 33(4), 971-977.

Drew Associates Ltd. (2003). Research into the economic contribution of sea angling. Final report to Defra

Georgiou, S., Bateman, I. J., Langford, I. H., & Day, R. J. (2000). Coastal bathing water health risks: developing means of assessing the adequacy of proposals to amend the 1976 EC directive. *Risk Decision and Policy*, 5(01), 49-68.

Gibbons, S.; Mourato, S.; and Mendes Resende, G. (2014) The amenity value of English nature: a hedonic price approach. *Environmental and Resource Economics*, 57 (2). pp. 175-196.

eftec (2002). Valuation of Benefits to England and Wales of a Revised Bathing Water Quality Directive and Other Beach Characteristics Using the Choice Experiment Methodology. Final report to Defra.

Jacobs (2004). Environment Group Research Report: An Economic Assessment of the Costs and Benefits of Natura 2000 Sites in Scotland, 2004 Final Report, The Scottish Government. <http://www.scotland.gov.uk/Resource/Doc/47251/0014580.pdf>

Jobstvagt, N., Hanley, N., Hynes, S., Kenter, J., and Witte, U. (2014). Twenty thousand sterling under the sea: Estimating the value of protecting deep-sea biodiversity. *Ecological Economics*, 97, 10-19.

Kenter, J. O., Bryce, R., Davies, A., Jobstvagt, N., Watson, V., Ranger, S., Solandt, J. L., Duncan, C., Christie, M., Crump, H., Irvine, K. N., Pinard, M. and Reed, M. S. (2013). The value of potential marine protected areas in the UK to divers and sea anglers. UNEP-WCMC, Cambridge.

Lawrence, K.S. (2005). Assessing the value of recreational sea angling in South West England. *Fisheries Management and Ecology*, 12, 369-375.

Luisetti T, Turner R K, Hadley D and Morse-Jones S (2010). Coastal and marine ecosystem services valuation for policy and management. CSERGE Working Paper EDM 10-04

Luisetti, T., R.K. Turner and I.J. Bateman. (2008). An ecosystem services approach to assess managed realignment coastal policy in England. CSERGE Working Paper ECM 08-04, CSERGE, University of East Anglia, Norwich, UK.

Luisetti, T., Turner, R.K., Bateman, I.J., Morse-Jones, S., Adams, C. and Fonseca, L. (2011). Coastal and marine ecosystem services valuation for policy and management: managed realignment case studies in England. *Ocean & Coastal Management*, 54, 212-224.

McVittie, A., and Moran. D. (2010). Valuing the non-use benefits of marine conservation zones: An application to the UK Marine Bill. *Ecological Economics* 70: 413-424.

MMO (2013). UK Sea Fisheries Statistics 2013. Edited by Lucy Radford. London: MMO. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/358342/UK_Sea_Fisheries_Statistics_2013_online_version.pdf [Accessed April 2015].

Sen, A., Harwood, A. R., Bateman, I. J., Munday, P., Crowe, A., Brander, L., Raychaudhuri, J., Lovett, A.A., Foden, J. & Provins, A. (2014). Economic assessment of the recreational value of ecosystems: Methodological development and national and local application. *Environmental and Resource Economics*, 57(2), 233-249.

A2.4 Mountains, moors and heaths

Cambridge Econometrics, in association with eftec and WRc (2003), "A Study to Estimate the Disamenity Costs of Landfill in Great Britain", Report for the Department for Environment, Food and Rural Affairs. http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/environment/waste/strategy/legislation/landfill/documents/landfill_disamenity.pdf [Accessed August 2015].

Christie, M., Hyde, T., Cooper, R., Fazey, I., Dennis, P., Warren, J., Colombo, S., and Hanely, N., 2011. Economic valuation of the Benefits of ecosystem services delivered by the UK Biodiversity Action Plan. London, Report to Defra NE0112.

eftec (2006). "Economic valuation of environmental impacts in severely disadvantaged areas", Report to Defra.

Gibbons, S.; Mourato, S.; and Mendes Resende, G. (2014) The amenity value of English nature: a hedonic price approach. *Environmental and Resource Economics*, 57 (2). pp. 175-196.

GHK Consulting (2011). Benefits of Sites of Special Scientific Interest. Final report to Defra.

Ham, Y. J., Maddison, D. J., & Elliott, R. J. (2013). The valuation of landfill disamenities in Birmingham. *Ecological Economics*, 85, 116-129.

Hanley, N., G. Koop, B. Alvarez-Farizo, R.E. Wright and Ceara Nevin (2001), An Application of Recreation Demand Models to Rock Climbing, *Journal of Agricultural Economics*, 52(1): 36-52.

Holden, J., Walker, J., Evans, M.G., Worrall, F. and Bonn, A. (2008). A compendium of peat restoration and management projects. Report to Defra SP0556. <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=14620>

Jacobs Ltd. (2004). "An Economic Assessment of the Costs and Benefits of Natura 2000 Sites in Scotland". Scottish Executive Environment and Rural Affairs Department (SEERAD), Edinburgh, United Kingdom

Martin-Ortega, J., Allott, T.E.H., Glenk, K., Schaafsma, M. (2014). Valuing water quality improvements from peatland restoration: Evidence and challenges. *Ecosystem Services*. Volume 9 pp 34-43

Oglethorpe, D. R. (2005), "Environmental Landscape Features (ELF). Model Update", Report to Defra.

Sen, A., Harwood, A. R., Bateman, I. J., Munday, P., Crowe, A., Brander, L., Raychaudhuri, J., Lovett, A.A., Foden, J. & Provins, A. (2014). Economic assessment of the recreational value of ecosystems: Methodological development and national and local application. *Environmental and Resource Economics*, 57(2), 233-249.

A2.5 Semi-natural grasslands

Atkinson, G., Day, B., Mourato, S., & Palmer, C. (2004). 'Amenity' or 'eyesore'? Negative willingness to pay for options to replace electricity transmission towers. *Applied Economics Letters*, 11(4), 203-208.

Burgess, D.E., Jackson, N., Hadley, D., Turner, K., Georgiou, S., Day, B. (2004), "Assessing the value of a scientifically important wetland ecosystem: the case of the Culm Grasslands", CSERGE report.

Cambridge Econometrics, in association with eftec and WRc (2003), "A Study to Estimate the Disamenity Costs of Landfill in Great Britain", Report for the Department for Environment, Food and Rural Affairs.

http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/environment/waste/strategy/legislation/landfill/documents/landfill_disamenity.pdf [Accessed August 2015].

Christie, M., & Rayment, M. (2012). An economic assessment of the ecosystem service benefits derived from the SSSI biodiversity conservation policy in England and Wales. *Ecosystem Services*, 1(1), 70-84.

Defra (2014). Wide Scale Enhancement of Biodiversity (WEB). Final report on phase 2, and overview of the whole project. Project BD5208.

eftec (2006). "Economic valuation of environmental impacts in severely disadvantaged areas", Report to Defra.

GHK Consulting, "Benefits of Sites of Special Scientific Interest", Report, 2011-06-01

Gibbons, S., Mourato, S., and Mendes Resende, G. (2014). The amenity value of English nature: a hedonic price approach. *Environmental and Resource Economics*, 57 (2). pp. 175-196.

Ham, Y. J., Maddison, D. J., & Elliott, R. J. (2013). The valuation of landfill disamenities in Birmingham. *Ecological Economics*, 85, 116-129.

Hanley, N., Salt, C.A., Wilson, M. and Culligan-Dunsmore, M. (2001), Evaluating alternative "countermeasures" against food contamination resulting from nuclear accidents, *Journal of Agricultural Economics*, 52(2): 92-109.

Nix, J. (2011, 2012, 2013, 2014). *Farm Management Handbook*. Agro Business Consultants Ltd, 41st, 42nd, 43rd, 44th editions.

Sen, A., Harwood, A. R., Bateman, I. J., Munday, P., Crowe, A., Brander, L., Raychaudhuri, J., Lovett, A., Foden, J., Provins, A. (2014). Economic assessment of the recreational value of ecosystems: Methodological development and national and local application. *Environmental and Resource Economics*, 57(2), 233-249.

A2.6 Urban (green space)

Alberini, A., Riganti, P., and Longo, A. (2003). Can people value the aesthetic and use services of urban sites? Evidence from a survey of Belfast residents. *Journal of Cultural Economics*, 27(3-4), 193-213.

Brander, L.M., and Koetse, M.J. (2011). The value of urban open space: Meta - analyses of contingent valuation and hedonic pricing results. *Journal of Environmental Management*, 92, pp.2763-2773.

CABE (2005). Does money grow on trees? Available Online: <http://webarchive.nationalarchives.gov.uk/20110118095356/http://www.cabe.org.uk/files/does-money-grow-on-trees.pdf>

Cambridge Econometrics, in association with eftec and WRc (2003), "A Study to Estimate the Disamenity Costs of Landfill in Great Britain", Report for the Department for Environment, Food and Rural Affairs. http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/environment/waste/strategy/legislation/landfill/documents/landfill_disamenity.pdf [Accessed August 2015].

Day, B., Bateman, I., & Lake, I. (2006). *Estimating the demand for peace and quiet using property market data* (No. 06-03). CSERGE Working Paper EDM.

Gensler and the Urban Land Institute (2011). *Open Space: An asset without a champion? Report for the Urban Investment Network*. Available Online: http://www.gensler.com/uploads/documents/Open_Space_03_08_2011.pdf

Ham, Y. J., Maddison, D. J., & Elliott, R. J. (2013). The valuation of landfill disamenities in Birmingham. *Ecological Economics*, 85, 116-129.

Jones, A., Hillsdon, M. and Coombes, E. (2009). Greenspace access, use, physical activity and obesity: understanding the effects of area deprivation. *Preventive Medicine*, 49 (6), pp.500-505.

Mell, I., Keskin, B., Hehl-Lange, S., and Henneberry, J. (2012). Valuing Attractive Landscapes in the Urban Economy, Action 4.2, Level II Report, A Contingent Valuation of Green Investments in The Wicker Riverside, Sheffield.

Perino, G., Andrews, B., Kontoleon, A., and Bateman, I. (2012). The value of urban green space in Britain: a methodological framework for spatially referenced benefit transfer.

Sen, A., Harwood, A. R., Bateman, I. J., Munday, P., Crowe, A., Brander, L., Raychaudhuri, J., Lovett, A.A., Foden, J. & Provins, A. (2014). Economic assessment of the recreational value of ecosystems: Methodological development and national and local application. *Environmental and Resource Economics*, 57(2), 233-249.

A2.7 Woodland

Bateman, I. and Jones, A. (2003). Estimating the value of informal recreation at British Woodlands: A multilevel meta-analysis, Part 2 in Jones, A., Bateman, I. and Wright, J Estimating arrival numbers and values for informal recreational use of British woodlands, Final report to the Forestry Commission, CSERGE.

Cambridge Econometrics, in association with eftc and WRc (2003), "A Study to Estimate the Disamenity Costs of Landfill in Great Britain", Report for the Department for Environment, Food and Rural Affairs. http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/environment/waste/strategy/legislation/landfill/documents/landfill_disamenity.pdf [Accessed August 2015].

Christie, M., Hanley, N., Garrod, B., Hyde, T., Lyons, N., Bergmann, A., & Hynes, S. 2006, Valuing Forest Recreation Activities: Final Phase 2 Report. Forestry Commission: Edinburgh

Christie, M., Hyde, T., Cooper, R., Fazey, I., Dennis, P., Warren, J., Colombo, S. and Hanley, H. (2011), Economic Valuation of the Benefits of Ecosystem Services delivered by the UK Biodiversity Action Plan. Report to Defra,

Crabtree, B., N. Chalmers, A. Thorburn, D. Macdonald, D. Eiser, J. Potts, D. Colman (2001). Economic evaluation of the community woodland supplement. Forestry Commission, Edinburgh, United Kingdom.

Edwards, D., Elliott, A., Hislop, M., Martin, S., Morris, J., O'Brien, L., Peace, A., Sarajevs, V., Serrand, M. and Valatin, G. (2009), A Valuation of the Economic and Social Contribution of Forestry

for People in Scotland. Forestry Commission Research Report 101, Forestry Commission Scotland, Edinburgh, 190 pp.

Garrod (2002). Landscape Benefits, Report to Forestry Commission.

Garrod, G.D. (2003), Landscape Values of Forests. Social & Environmental Benefits of Forestry Phase 2, Report to the Forestry Commission, Edinburgh. Centre for Research in Environmental Appraisal and Management, University of Newcastle upon Tyne.

Gibbons, S.; Mourato, S.; and Mendes Resende, G. (2014) The amenity value of English nature: a hedonic price approach. *Environmental and Resource Economics*, 57 (2). pp. 175-196.

Ham, Y. J., Maddison, D. J., & Elliott, R. J. (2013). The valuation of landfill disamenities in Birmingham. *Ecological Economics*, 85, 116-129.

Hill, GW and Courtney, PR (2006). "Demand analysis projections for recreational visits to countryside woodlands in Great Britain" *Forestry*, Vol. 79, No. 2, 2006. doi:10.1093/forestry/cpl005

Scarpa, R. (2003). "The recreation value of Woodlands". Report for the Forestry Commission

Sen, A., Harwood, A. R., Bateman, I. J., Munday, P., Crowe, A., Brander, L., Raychaudhuri, J., Lovett, A.A. Foden J. and Provins, A. (2014). Economic assessment of the recreational value of ecosystems: Methodological development and national and local application. *Environmental and Resource Economics*, 57(2), 233-249.

Social and Economic Research Group (2008). A Valuation of the Economic and Social Contribution of Forestry for People in Scotland, Forestry Commission Scotland.

Van-Rensburg, T. M., Mill, G.A., Common, M. and Lovett, J. (2002). Preferences and Multiple Use Forest Management, *Ecological Economics*, December - 43(2-3): 231-44.

ANNEX 3: CRITERIA FOR CLASSIFYING VALUATION STUDIES

Habitat type	<ul style="list-style-type: none"> • Include both broad habitat and sub-habitat. See List 1.
The good	<ul style="list-style-type: none"> • Use the MEA (2005) ecosystem services classification. See List 2. • Use the ecosystem service benefits in List 3 where possible - this is a secondary classification for the good that is being tested. • State if the good is market or non-market. • Describe the physical characteristics of the good, e.g.: <ul style="list-style-type: none"> ○ A 'commodity' (e.g. carbon emissions) ○ A single dimension of an environmental good or service (e.g. air quality, water quality) ○ Multiple attributes or dimensions (e.g. a land management change that affects habitats, recreation and landscape amenity). ○ Characteristics of the good may also include aspects such as designations (e.g. SSSIs, SPAs, SACs). • State which component(s) of total economic value is measured. Use the terminology in List 4 taken from the Defra ecosystem services guide (Defra, 2007).
The change	<p>Describe the change in the provision of the good concisely in qualitative terms.</p> <ul style="list-style-type: none"> • State the nature of the change: <ul style="list-style-type: none"> ○ A quantity change (e.g. an increase in carbon emissions); ○ A quality change (e.g. an improvement in water quality); or ○ Both. • State the direction of the change (increase/decrease), the temporal nature of the change (immediate/gradual/limited time period), and the scale of the change (marginal/non-marginal). • Report the quantitative information for the change: <ul style="list-style-type: none"> ○ The change and measure/metric; and ○ The units
Value evidence	<ul style="list-style-type: none"> • Provide the value evidence and units from the study, including ranges where available (e.g. £/visit; £/tonne). • Convert values to 2014 prices using the Consumer Price Index (CPI). • State whether the value is annual or one-off.
Method(s)	<ul style="list-style-type: none"> • State the method(s) used in the study. Use List 5.
The location	<ul style="list-style-type: none"> • Describe the specific geographical area that is the subject of the study. It is usually defined such as region, or a particular area of wetland, lake or national park, etc.
The affected population's characteristics	<ul style="list-style-type: none"> • State the user population(s). Be as specific as possible: <ul style="list-style-type: none"> ○ User population: individuals deriving use values (direct consumptive and non-consumptive, indirect) from the good. There can be different types of users (e.g. specialist recreational users - anglers, bird-watchers, etc.; informal recreation users; households benefiting from flood protection; etc.). ○ Non-user population: individuals deriving non-use value from the good due to altruistic, bequest and existence motivations. • Use the beneficiary classes in List 6 where possible - this is a secondary classification for the user and non-user population that is being tested. • State the size of the affected population if available (e.g. number of visitors). • State the user population's patterns and frequency of use if available.

	<ul style="list-style-type: none"> • Note if information is provided on the following socio-economic and demographic characteristics of the affected population: <ul style="list-style-type: none"> ○ Income ○ Education ○ Household Size ○ Age/sex distribution ○ Employment and/or occupations profile ○ Population of cities, towns ○ Unemployment rate ○ Employment and/or occupations profile ○ Population density
The number and quality of substitutes	<ul style="list-style-type: none"> • Describe the substitutes for the good (e.g. other recreational sites).
The market constructs	<ul style="list-style-type: none"> • Describe the market constructs (e.g. an open-access good, a public good, a private good, etc.)
Study quality	<ul style="list-style-type: none"> • Answer the following 3 questions: <ul style="list-style-type: none"> ○ Is the valuation/policy context, the good and the change in provision described? ○ Is the affected population defined and, is information provided on sampling (where relevant)? ○ Is there a discussion of the validity of results and their robustness (including econometric analysis and validity testing)?

List 1: Broad habitat types and associated sub-habitats

UKNEA broad habitat	Associated sub-habitat	Scope
Coastal margins	Coastal dunes and sandy shores	Dune systems and the upper zone of sandy shores
	Saltmarsh	The upper zone of vegetated intertidal habitat - transition into other intertidal habitats
	Transitional and coastal waters	Estuaries, coastal lagoons and other near shore waters (Water Framework Directive definition)
Enclosed farmland	Enclosed arable farmland	Arable, horticultural land and improved grassland as well as associated boundary features e.g. hedgerows
Freshwaters, wetlands and floodplains	Standing open waters	Lakes, ponds, reservoirs and canals
	Rivers and streams	Streams and rivers down to the tidal limit
	Groundwaters	Aquifers and significant quantities of below ground water
	Wetlands	Lowland fens, raised bogs, swamps, reedbeds and floodplain wetlands
Marine	Intertidal rock	Bedrock, boulders and cobbles which occur in the intertidal zone. Colonised by mussels/barnacles and seaweeds depending on exposure
	Intertidal sediment	Shingle (mobile cobbles and pebbles), gravel, sand and mud in the intertidal zone
	Subtidal rock	Bedrock, boulders and cobbles in the subtidal zone colonised by seaweeds (infralittoral zone) or animal communities (circalittoral zone)
	Shallow subtidal sediment	Shingle (mobile cobbles and pebbles), gravel, sand and mud in the subtidal zone
	Deep sea bed	The sea bed beyond the continental shelf break
	Pelagic water column	The water column of shallow or deep sea; beyond the coastal waters
Mountains, moors and heaths	Blanket Bog	Rainfall-fed bog in upland environments
	Mountains, Moorlands and Upland Heaths	Upland heath, montane habitats and associated wetlands (flushes, fens). Also include rock and scree habitats such as limestone pavements
	Lowland Heath	Lowland habitats dominated by heather family or dwarf gorse species
Semi-natural grasslands	Semi-natural grasslands	All grasslands unimproved for agricultural purposes
Urban (green space)	Built urban	The built environment elements of urban space e.g. buildings, roads, industrial works
	Green space	The natural environment elements of built up areas e.g. parks, gardens, towpaths, urban trees
Woodland	Woodland	Includes broadleaved and coniferous woodlands both natural woods and planted. (Wet woodland included here)

List 2: MEA (2005) ecosystem services classification*Provisioning*

- Food
- Fibre and fuel
- Genetic resources
- Biochemicals, natural medicines, pharmaceuticals
- Ornamental resources
- Fresh water

Regulating

- Air quality regulation
- Climate regulation
- Waste regulation
- Natural hazard regulation
- Pest regulation
- Disease regulation
- Erosion regulation
- Water purification and waste treatment
- Pollination

Cultural

- Cultural heritage
- Recreation and tourism
- Aesthetic value

Supporting

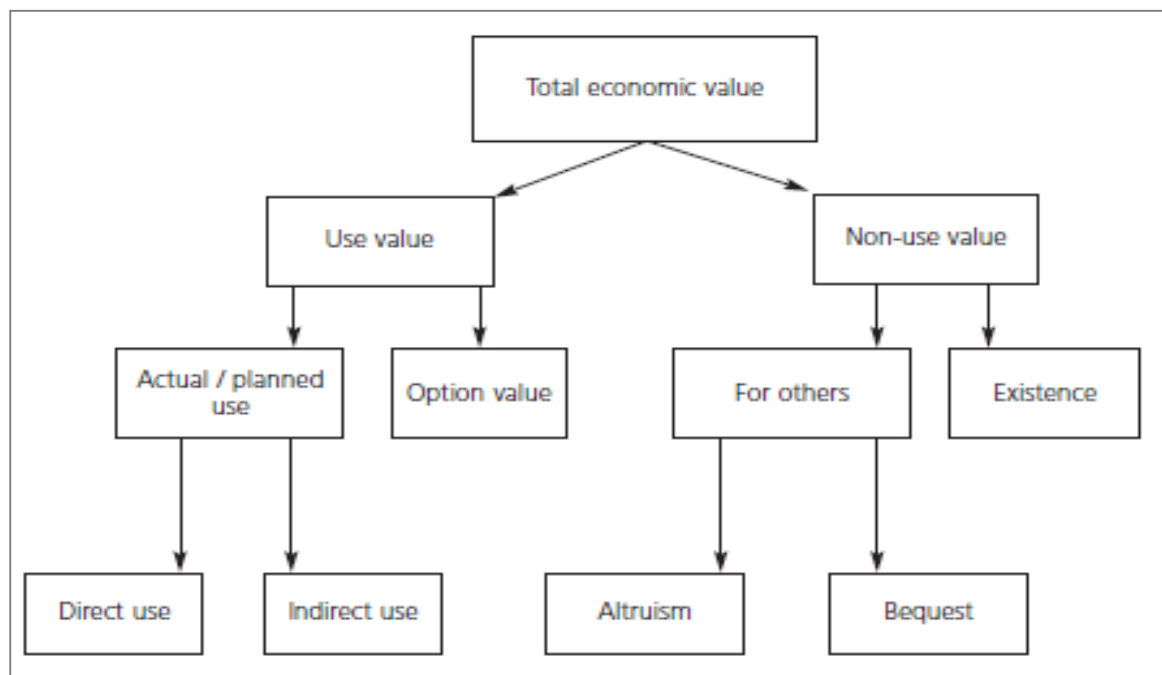
- Soil formation
- Primary production
- Nutrient cycling
- Water cycling
- Photosynthesis

List 3: Ecosystem service benefits

Ecosystem service benefit	Definition
Food	Plant, animal and fungi consumed by people. Both wild and cultivated sources
Fibre	Plant and animal materials used by people for building, clothing and other objects, including timber
Energy	All sources of energy used by people (fossil fuels, wind, tidal, wave, hydro, biomass and solar)
Clean water	Water for human use (e.g. drinking, bathing, industrial processes); a combination of quality and quantity
Clean Air	Air quality that has no adverse impact upon human health or wellbeing
Recreation	Active enjoyment of the natural environment e.g. walking, fishing, canoeing
Aesthetics	Passive enjoyment of the natural environment e.g. landscape appreciation and views
Wildlife	Wild species diversity and abundance which have aesthetic and recreational value, and cultural and spiritual significance, including through the conservation priorities for species and habitats. This is distinct from the natural capital assets, species and ecological communities, in that these represent the species that are significant to England and that people care about.
Protection from hazards	Natural regulation of extreme events such as flooding, drought and landslides.
Equable climate	A comfortable climate that has no adverse impact upon human health or wellbeing. The result of both global scale and local scale effects (e.g. urban cooling by trees)

List 4: Total economic value component

- Direct consumptive use
- Direct non-consumptive use
- Indirect use
- Option value
- Non-use value

**List 5: Economic valuation methods**

- Market price / exchange value
- Replacement cost
- Defensive/avertive expenditure
- Expenditure on complements (e.g. to recreation)
- Hedonic pricing method
- Travel cost method: single-site, multi-site, zonal, individual
- Random utility model (RUM)/discrete choice model (also termed multi-site recreation demand model)
- Stated preference: contingent valuation
- Stated preference: choice experiment
- Meta-analysis
- Value transfer

List 6: The affected population - beneficiary classes. Source: Landers and Nahlik (2013).*00.01 Agricultural*

- 00.0101 Irrigators
- 00.0102 CAFO operators
- 00.0103 Livestock grazers
- 00.0104 Agricultural processors
- 00.0105 Aquaculturists
- 00.0106 Farmers
- 00.0107 Foresters

00.02 Commercial/ industrial

- 00.0201 Food extractors
- 00.0202 Timber, fiber, and ornamental extractors
- 00.0203 Industrial processors
- 00.0204 Industrial dischargers
- 00.0205 Electric and other energy extractors
- 00.0206 Resource-dependent businesses
- 00.0207 Pharmaceutical and food supplement suppliers
- 00.0208 Fur/ hide trappers and hunters

00.03 Government, municipal, and residential

- 00.0301 Municipal drinking water plant operators
- 00.0302 Waste water treatment plant operators
- 00.0303 Residential property owners
- 00.0304 Military/ coast guard

00.04 Commercial/ military transportation

- 00.0401 Transporters of goods
- 00.0402 Transporters of people

00.05 Subsistence

- 00.0501 Water subsisters
- 00.0502 Food subsisters
- 00.0503 Timber, fiber, and fur/ hide subsisters
- 00.0504 Building material subsisters

00.06 Recreational

- 00.0601 Experiencers and viewers
- 00.0602 Food pickers and gatherers
- 00.0603 Hunters
- 00.0604 Anglers
- 00.0605 Waders, swimmers, and divers
- 00.0606 Boaters

00.07 Inspirational

- 00.0701 Spiritual and ceremonial participants and participants of celebration
- 00.0702 Artists

00.08 Learning

- 00.0801 Educators and students
- 00.0802 Researchers

00.09 Non-use

- 00.0901 People who care (existence)
- 00.0902 People who care (option/bequest)

00.10 Humanity

- 00.01001 All humans