Homes England

The Housing and Regeneration Agency

eftec economics for the environment

SQW

Homes England – Measuring Social Value

Paper 5: Environmental Impact of New Housing Development

Date: August 2024

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List of Abbreviations

Abbreviation	Full Term
BAU	Business as usual
BCR	Benefit Cost Ratio
BGI	Blue Green Infrastructure
CBA	Cost Benefit Analysis
DCMS	Department for Digital, Culture, Media & Sport
Defra	Department for Environment, Food & Rural Affairs
DESNZ	Department for Energy Security and Net Zero
DfT	Department for Transport
FHS	Future Homes Standard
EIA	Environmental Impact Assessment
ENCA	Enabling a Natural Capital Approach
ENHAT	Environmental Impact of Housing Development Appraisal Tool
FBC	Full Business Case
GIS	Geographic Information System
HE	Homes England
HM Treasury	His Majesty's Treasury
LA	Local Authority
LVU	Land Value Uplift
MHCLG (DLUHC)	Ministry of Housing, Communities and Local Government (formally known as the Department for Levelling Up, Housing and Communities)
NPV	Net Present Value
OBC	Outline Business Case
PV	Present Value
SOC	Strategic Outline Case
STPR	Social Time Preference Rate
SuDS	Sustainable (urban) Drainage System
TAG	Transport Analysis Guidance
VfM	Value for Money
WTP	Willingness to Pay

1. Foreword

Within our Strategic Plan we have set ourselves the mission of driving regeneration and housing delivery, to create high-quality homes and thriving places. This will support greater social justice. We have five interconnected strategic objectives that work together to deliver our mission. One of these strategic objectives is to enable sustainable homes and places, maximising their positive contribution to the natural environment and minimising their environmental impact.

As a government agency, we are committed to investing public funds where they will deliver the greatest social value. Rigorous economic appraisal, alongside evaluation, plays a central role in ensuring that the interventions we support achieve this ambition. However, as was recognised in the HM Treasury Green Book review in November 2020, there are a number of challenges in undertaking economic appraisal in practice. This in turn can lessen its effectiveness in supporting the delivery of policy priorities.

One of the most notable issues is that the Benefit Cost Ratio (BCR), used in economic appraisal to inform judgements on value for money, can be misaligned to decision makers' objectives. This is commonly the result of the BCR being overly dependent on benefits that are easy to value in monetary terms. It can also be the result of insufficient attention being given to the appraisal of the options available.

Recognising the broad range of environmental impacts that may result from Homes England's work and the renewed focus on quality and sustainability in our strategic plan, we have undertaken a programme of work to **develop new guidance on the economic appraisal of environmental impacts resulting from housing interventions**. This work has involved several research projects that are used to inform the monetisation of our impacts, whether through new monetisation evidence or the modelling needed to apply existing evidence in the context of housing schemes.

The work sits as part of a broader programme of research we have been undertaking, working in close collaboration with colleagues in the Ministry of Housing, Communities and Local Government (MHCLG) and in consultation with HM Treasury, focused on strengthening Homes England's ability to **measure and assess the full social value** delivered through our housing and regeneration activities. All research published under the Homes England measuring social value series is available at www.gov.uk/government/collections/homes-england-measuring-social-value.

I would like to thank SQW, eftec and Daedalus Environmental for their work, both in undertaking the background research and translating this into this practical guidance and the associated ENHAT tool. I would also like to thank the many colleagues within Homes England, MHCLG, Defra and HM Treasury for their input to the project. In addition, I would like to thank Professor Nick Hanley, from the University of Glasgow, who provided peer review support.

Andy Wallis
Chief Economist, Homes England

2. Executive Summary

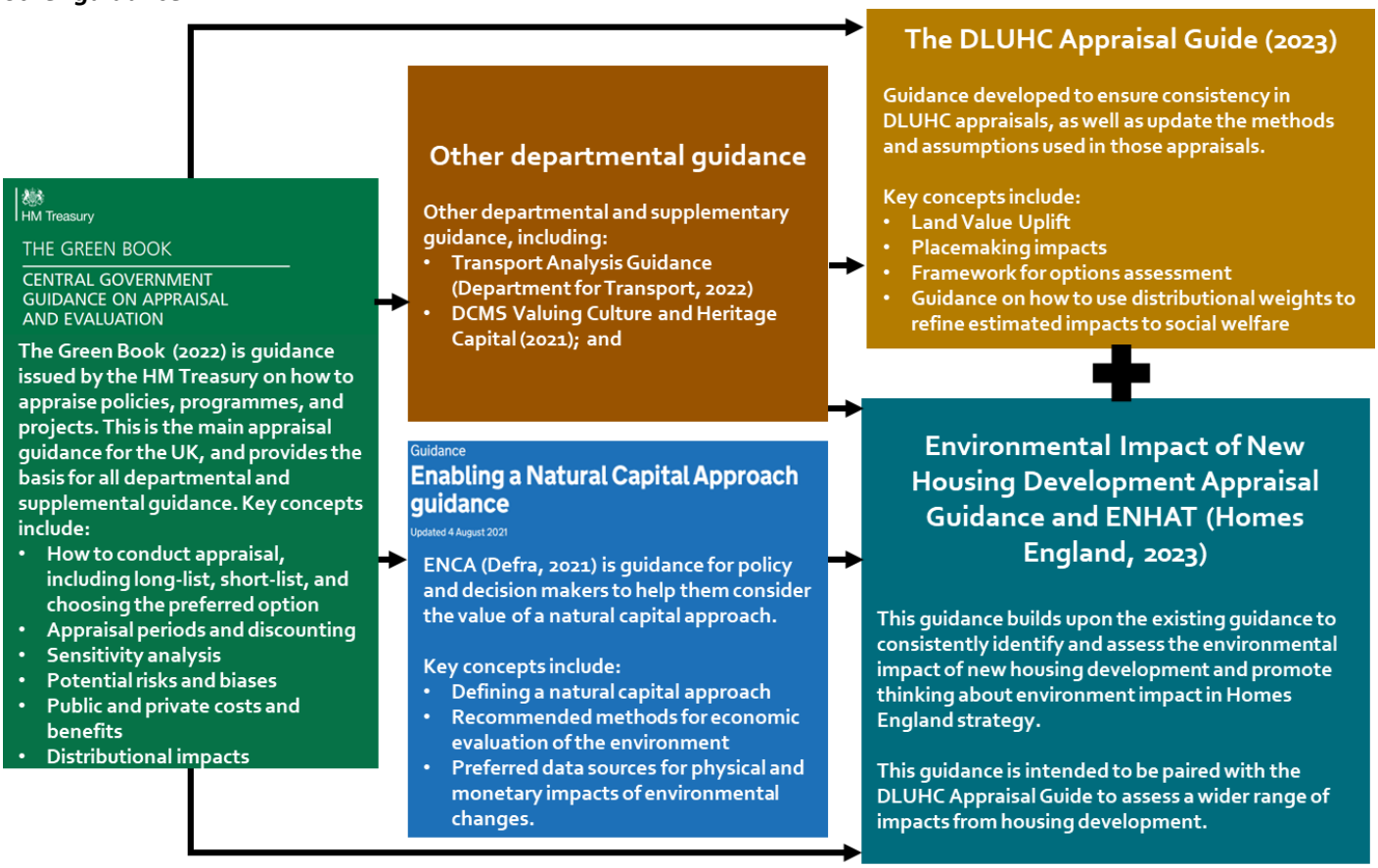
Background

1. Homes England is the government's housing and regeneration agency. We drive regeneration and housing delivery to create high-quality homes and thriving places. The assessment of a project's costs and benefits, in the form of economic appraisal, is an integral part of optimising the social value delivered through the use of public sector resources. Where possible, this should involve valuing and monetising all relevant costs and benefits. This goes beyond market effects and includes areas such as environmental and broader social impacts.

2. Substantial work has been undertaken across government to improve the approach to economic appraisal and the use of tools such as Cost Benefit Analysis (CBA), including through the 2023 update to the DLUHC Appraisal Guide. In collaboration with MHCLG, Homes England has implemented a comprehensive research programme, targeted at improving the way in which economic appraisal is used to accurately and consistently assess the full economic and social impacts of the Agency's activities.

3. This guidance document **– Environmental Impact of New Housing Development** – is provided for appraisal practitioners. The guidance is accompanied by a practical tool – **En**vironmental impact of **H**ousing development **A**ppraisal **T**ool (ENHAT). Both the guidance and ENHAT supplement existing guidance for the economic appraisal of Homes England's interventions and the creation of business cases for funding in line with departmental and government policy as shown in Figure 2.1.

Figure 2.1 – The Environmental Impact of New Housing Development Appraisal Guidance and ENHAT in relation to other guidance.



Approach

4. This guidance document has two central aims:

    - Help appraisal practitioners consistently identify and assess the environmental outcomes and the social value impact of new housing development.

    - Support identification of the preferred option to maximise social value.

5. The tool – ENHAT – provides a practical framework to identify and measure environmental outcomes from new housing development and to estimate the social value impact of those outcomes in a proportionate and credible way. The guidance and tool are intended to be used by appraisal practitioners and its use does not require specialised knowledge in non-market (environmental) valuation.

6. It is expected that ENHAT will primarily be used for the appraisal of new housing developments[1] at the Outline Business Case (OBC) stage, where the quantification and valuation of environmental outcomes can influence the development of options and identification of the preferred way forward for an intervention. It is therefore implicitly assumed that options appraised using ENHAT are based on a strong Strategic Outline Case (SOC), which explains how the preferred way forward has been established from a wide range of realistic and possible options. This expectation is consistent with the process that is described in the HM Treasury Green Book and DLUHC Appraisal Guide whereby the selection of the preferred option is based on testing a shortlist of options using CBA. ENHAT can also be used to inform appraisal at Full Business Case (FBC) stage, with consideration given to whether the assumptions used should be updated to reflect intervention specific information.

7. This guidance and ENHAT provide methods and data sources to assess several key environmental outcomes. These outcomes are organised throughout the guidance using three categories: (i) outcomes due to land take for development; (ii) outcomes due to the construction of homes; and (iii) outcomes due to the occupation of homes. These outcomes have different geographic scales of impact, different groups of affected populations, and may be included or addressed in other guidance.

8. Several key factors were considered when developing this guidance:

    - **The spatial scope of environmental outcomes and the affected populations of a housing scheme.** The populations affected by environmental outcomes, as a result of a housing scheme, differ between outcome types. This guidance assesses outcomes using three distinct boundaries: (i) outcomes affecting those inside the "redline" boundary[2]; (ii) outcomes affecting the local population; and (iii) outcomes affecting regional, national, or global populations.

    - **Potential double counting with Land Value Uplift.** Land Value Uplift (LVU) is a key concept and tool in the DLUHC Appraisal Guide. Care has been taken in developing this guidance and ENHAT to ensure that the methods provided for estimating the impact of environmental outcomes do not overlap with LVU calculations.

[1] This includes housing development on both brownfield and greenfield land but does not include refurbishment or interventions where a substantial portion of the development is for municipal, commercial, or industrial purpose. While many of the methods that are included here for individual environmental outcomes could be applied more widely, the overall framework of this guidance does not address or cannot accommodate the full set of outcomes from these other types of interventions.

[2] The redline boundary is the boundary of the development. See Section 5 "Spatial dimension of outcomes" for further explanation.

- **Defining intervention options and use of the guidance.** The outputs from this guidance can be used in options appraisal and value for money calculations (VfM), when combined with the DLUHC Appraisal Guide. ENHAT can also help at an early stage of option identification and judging the viability of enhancements such as added community features for developments and higher performance standards of homes.

- **Comparison to the counterfactual.**[3] The guidance considers how users can compare the environmental outcomes of an intervention option against the counterfactual (what is likely to occur without intervention) to estimate the environmental impact (change in social value) of that intervention option. However, this guidance does not provide any methodology on how to determine what the counterfactual might be (refer to the DLUHC Appraisal Guide, 2023 for discussion). The implicit counterfactual for outcomes that are calculated in ENHAT is that no change would occur to the site over the next 60 years. However, as this is unlikely on most sites, users should develop a counterfactual case for comparisons.

[3] This guidance will use "counterfactual" to refer to the business as usual (BAU) scenario, sometimes called the reference case. This is in keeping with the DLUHC Appraisal Guide.

3. Introduction

This guidance has been developed to inform the appraisal of environmental impacts of new housing developments.

- **The intended users are project teams and appraisal practitioners within Homes England** their partners who develop and appraise new housing development interventions[4].
- The guidance supplements economic appraisal guidance provided by HM Treasury, MHCLG and others. **It is primarily intended to be used at the Outline Business Case (OBC) stage to support the identification of a preferred option on value for money (VfM) grounds.**
- **The guidance is accompanied by a tool – ENHAT –** which contains a practical framework, methods, and evidence that will help users identify, quantify and value (in monetary terms) a range of environmental outcomes resulting from the land take, construction and occupation phases of a new housing development.
- **This guidance and ENHAT covers a wide range of environmental outcomes**, but practitioners should be aware of other guidance that is available for certain outcomes, as well as outcomes that may require bespoke appraisal if they are likely to occur.

Purpose

9. This appraisal guidance document **– Environmental Impact of New Housing Development** – is provided for appraisal practitioners. It supplements existing guidance on the economic appraisal of Homes England's interventions and the creation of business cases for funding in line with departmental and government policy. The main framing for this guidance is economic appraisal that uses Cost Benefit Analysis (CBA) to compare benefits and costs, to identify the impact of different (short-listed) intervention options on the basis of social value.[5]

10. Generally, the guidance is focused on new housing development interventions. However, some of the guidance and evidence could be applied more broadly so long as careful consideration is given to ensure that assumptions are appropriate.

11. The guidance is accompanied by a practical tool – **EN**vironmental Impact of New **H**ousing Development **A**ppraisal **T**ool (**ENHAT**) – which has been developed for use by appraisal practitioners to identify, quantify and value the environmental impact of new housing developments.[6] The tool provides a series of methods and approaches that utilise existing evidence on the social value impacts of various environmental outcomes. Using ENHAT, a set of monetary value estimates for these outcomes can be produced, and this set of values should be included in the overall economic appraisal for an intervention to capture a wider view of its potential social impact.

[4] When referring to the appraisal of new housing development interventions, the guidance specifically refers to economic appraisal completed in line with the HM Treasury Green Book.
[5] In keeping with the DLUHC Appraisal Guide, the change to overall societal welfare will be referred to as the social value or social value impact. This is sometimes also called public value or public welfare. This value or impact can be either positive or negative, depending on the environmental outcome that leads to the impact.
[6] As with the overall guidance, aspects of ENHAT could also be used for applications other than new housing, as long as due consideration are given to the underlying assumptions made in the underlying methods and calculations.

12. Economic appraisal is an essential component of creating good policy and choosing effective interventions. While the ideal is to assess all the outcomes resulting from an intervention, in practice it is not possible for all outcomes to be assessed to the same level of detail. Some outcomes can be defined qualitatively but may not be possible to measure quantitatively, while some may be possible to measure but not possible to value in monetary terms. Care has been taken to minimise these gaps within the guidance, but the users of this guidance and ENHAT should not ignore those impacts that cannot be quantified or monetised. To that end this guidance has two central aims:

    1) **To help appraisal practitioners consistently identify and assess the environmental outcomes of new housing development.** The guidance provides a practical framework for the economic appraisal of environmental outcomes of new housing developments, which is centred around ENHAT. It does not provide detail on conceptual foundations and takes guiding principles from existing guidance (see below).

    2) **To support the identification of the preferred option.** The framework is based around the comparison of alternative intervention options for new housing developments in business cases and VfM assessments. For example:

        a) Differentiating the scope and scale of environmental outcomes between options based on their design and performance levels.

        b) Encouraging more alternative options to be short-listed, particularly those that lead to better overall environmental profiles for new housing development.

13. The main building blocks for this guidance are the concepts and principles set out in the HM Treasury Green Book (HM Treasury, 2022), Defra's Enabling a Natural Capital Approach (Defra, 2021), and the DLUHC Appraisal Guide (2023).

14. It is expected that the guidance will be most useful at the **Outline Business Case (OBC)** stage of appraisal. At OBC stage, the optioneering process and identification of a "preferred option" on VfM grounds is key to the project development process. At this point information about the intervention should be sufficiently detailed to conduct an economic appraisal. The "minimum information" requirements for using the guidance are explained subsequently (Section 6) and within ENHAT's user guide (see ENHAT workbook). At the Full Business Case (FBC) stage the guidance may help users refine assumptions and test key sensitivities in the economic case for the preferred option.

15. It is intended that this guidance will be updated periodically, in line with updates to other relevant guidance, evolving methods, and the availability of new evidence for valuing environmental impacts. The key evidence sources for physical impacts and values that are applied in ENHAT are referenced there (Tabs 8.1 of ENHAT onward), including the date of publication and suggested timescales to review the evidence.

Structure

16. The document is structured in two parts, along with supporting appendices:

- **Part 1: Practical Framework – Valuing Environmental Impacts of New Housing Development.** This part explains the approach taken to produce the guidance.
    - **Section 4** describes the overall approach and structure, including the categorisation of environmental outcomes and under-pinning logic chain used to identify changes to social value.
    - **Section 5** discusses several over-arching considerations to ensure consistency between the appraisal of environmental impacts and wider aspects of an economic appraisal. This includes determining the spatial boundary for an assessment, potential overlap with LVU and establishing the additionality of the impact.
- **Part 2: Environmental Impacts of New Housing Development Appraisal Tool (ENHAT).** This part accompanies ENHAT and guides users through the following aspects:
    - **Section 6** introduces ENHAT, providing a basic overview of its contents and use.
    - **Section 7** describes the specific methods used in ENHAT for assessing land take outcomes.
    - **Section 8** describes the specific methods used in ENHAT for assessing construction outcomes.
    - **Section 9** describes the specific methods used on ENHAT for assessing occupation outcomes.
    - **Section 10** provides additional notes for interpreting ENHAT results, including aggregation and the inclusion of the results in the wider economic appraisal.
- **Appendices: Supporting information.**
    - **Appendix 1** provides a glossary of key terms.
    - **Appendix 2** describes the development of this guidance.

17. Note also that the accompanying ENHAT (workbook) includes a short user guide that provides instructions for using the tool and summarising (reporting) the monetary value estimates for environmental impacts that it produces.

Part 1: Practical Framework – Valuing the Environmental Impact of New Housing Development

4. Approach and structure

This section covers the approach of the guidance.

- **The approach follows principles set out in the HM Treasury Green Book, DLUHC Appraisal Guide, and Defra ENCA guidance.** As this guidance is focused specifically on the appraisal of environmental impacts, the outputs of ENHAT must be used alongside a broader assessment of other economic and social impacts to obtain a "full" view of the VfM of an intervention.

- **This guidance implements the Green Book 4-Step Approach to identify how an intervention affects the environment.** This is a systematic natural capital approach for identifying the physical changes to the environment that results from an intervention, who those changes impact, and how to value those impacts.

- **The guidance categorises environmental outcomes from housing developments based on the interventions lifecycle: land take, construction, and occupation.** This approach allows interventions to be mapped and grouped. Using this structure helps organise the approach to identifying impacts and minimises the risk of double counting when valuing impacts.

- **The valuation framework is based around impact pathways that link housing development interventions to changes in the natural environment and the resulting impact to human health and wellbeing.** The measured impact is the estimate of the net change in social value due to the environmental outcomes resulting from an intervention.

- **The guidance covers a wide range of outcomes that are expected to be relevant to many interventions**. The methods and approaches for valuing environmental outcomes draw on evidence sources that will be suitable for the proportionate economic appraisal of most interventions. There may, though, be cases where this evidence is not suitable and more detailed and tailored assessments will be needed. These cases are beyond the scope of this research and are highlighted in Part 2 of the guidance.

Consistency with other appraisal guidance

18. The guidance and ENHAT are intended to supplement and be used alongside the HM Treasury Green Book, the DLUHC Appraisal Guide, Defra ENCA and other guidance as summarised in Table 4.1.

Table 4.1: Relationship between ENHAT, this guidance and other relevant appraisal guidance.

Guidance document	Relationship to this guidance and ENHAT
HM Treasury Green Book (2022)	• Overall guiding principles for conducting economic appraisal to identify preferred option, including measuring change in social value. • Provides natural capital framing for understanding how interventions lead to changes to the environment that result in social impacts. • Provides guidance for discounting future costs and benefits, using declining discount rate schedule (standard Social Time Preference Rate(STPR)) or health discount rate, which is used in this guidance.
DLUHC Appraisal Guide (2023)	• Basis for assessing VfM of development interventions and calculating an initial and adjusted BCR. Environmental impacts will be included within these assessments. • Calculation of LVU and determining the split between "private" values and "external" (or public) values which helps determine the scope of environmental impacts covered in this guidance. • Guidance for estimating the additionality of an intervention, including deadweight and displacement effects, which relates to the definition of the no intervention/counterfactual in the overall appraisal, which should be applied consistently to the assessment of environmental impacts. • Guidance for applying distributional weights in the overall appraisal, which would include weighting of environmental impacts as appropriate.
Defra Enabling a Natural Capital Approach (ENCA) (2021)	• Overall guiding principles for valuing environmental impacts, along with using the natural capital approach in an appraisal context which underpins this guidance. • Identifies data and evidence sources that can be applied to quantify and value a range of environmental outcomes, which are included in ENHAT. • The ENCA databooks[7] collate evidence used to estimate and value environmental impacts are a key source that has been drawn on for developing this guidance and ENHAT.
Valuation of greenhouse gas emissions: for policy appraisal and evaluation (BEIS, now DESNZ) (2021)	• Overall guidance for valuing greenhouse gas emissions, including when and how to use traded and non-traded carbon values. • Provides social carbon values and projected traded carbon values.
DfT Transport Analysis Guidance (TAG) (2022)	• Refer to this guidance for transport related externalities of interventions (e.g. congestion, air pollution and carbon emissions from vehicles).[8]
DCMS Valuing Culture and Heritage Capital (2021)	• Refer to this guidance when including the value of cultural and heritage outcomes in economic appraisals.

Identifying the preferred option

19. The environmental outcomes that are quantified and valued using this guidance and ENHAT should be combined with values from the wider economic appraisal, such as estimates of LVU and delivery costs, to identify the preferred option. This requires a consistent approach to the calculation environmental impacts and other benefits, such as LVU, to ensure that costs and benefits are measured in the same relative terms for each intervention option under consideration.

[7] https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca

[8] Transport analysis guidance (DfT, 2022) - https://www.gov.uk/guidance/transport-analysis-guidance-tag; Transport analysis guidance unit A3 environmental impact appraisal (DfT, 2023) - https://www.gov.uk/government/publications/tag-unit-a3-environmental-impact-appraisal

20. At the OBC stage of an intervention, it is expected that five to six intervention options will have been identified, along with the counterfactual (or "business as usual" (BAU)) scenario. This counterfactual scenario, as described in the DLUHC Appraisal Guide, represents what would happen in the absence of the intervention under consideration. For example, the counterfactual scenario might be a development proceeding to a slower timetable without government funding, or development that never occurs on a site without government support. For some environmental outcomes, the counterfactual may also represent a positive contribution to social value, such as a case where land that has a high local amenity value is left undisturbed by development. For other outcomes, there will be opportunities for new housing development to target improved design and performance standards – for instance around energy and water efficiency – to reduce a negative social impact.

21. An appropriate consideration of environmental outcomes requires that short-listed options include enhanced options that go beyond the "do minimum" option. The guidance has been designed to identify where opportunities for enhanced options may exist, and to demonstrate which environmental outcome will have the greatest social impact within a specific intervention. This allows the added value of enhanced intervention options for design and performance standards to be readily tested. The HM Treasury Green Book recognises that there may already be an identified preferred option at the short-list stage. However, appraisal should be able to demonstrate the added value from alternatives. ENHAT's user guide details the alternative design and performance standards for new housing developments that have been pre-specified to assist appraisal practitioners in this regard (e.g. a set of energy performance standards).

Natural capital framework – 4-step approach

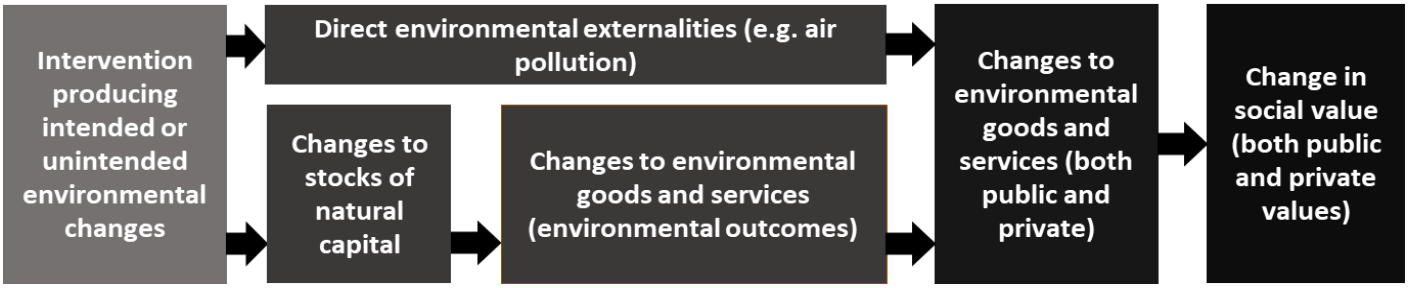
22. The HM Treasury Green Book promotes the use of natural capital as the standard analytical approach to understanding the elements of nature that have value to society. It notes that:

> "The natural capital approach provides a framework to systematically identify the stocks of natural capital assets and the flows of benefits they provide. This, in turn, enables identifying and appraising the impacts of changes to environmental assets and the benefits (costs) they provide."

23. The natural capital framework does not replace existing approaches to appraising and valuing environmental effects. Rather, it provides a comprehensive framework within which to develop and appraise policies and projects – either to identify additional options to meet policy goals and/or enable a fuller assessment of each option in terms of its potential to improve and/or damage the environment.

24. A high-level presentation of how the natural capital framework can be used for assessing impacts for appraisal is illustrated in Figure 4.1.

Figure 4.1: Using the natural capital framework for appraisal.



Source: Adapted from HM Treasury (2022) and Defra (2021).

25. The HM Treasury Green Book recommends a four-step approach to identify whether and how an intervention affects the stocks of natural capital and the flows of benefits they provide. Table 4.2 outlines how the four-step process frames this guidance and ENHAT. The development of the guidance included consultation with appraisal practitioners and environmental assessment experts within Homes England and MHCLG to understand both the evidence need and the level of detail and information that may be available at the OBC stage[9]. In part, both aspects depend on the size of the intervention and the potential scale of environmental impacts.[10]

[9] Note that the methods outlined in this guidance could also be used pre-OBC stage, subject to sufficient scheme and impact information being available. However, this guidance does not address objective setting or the longlisting and shortlisting processes and therefore the user will need to determine the scope of environmental impacts that should be included at this stage.

[10] Appraisal for very large interventions and interventions with specific environmental impacts (such as those occurring on contaminated sites) are likely to be supported by more overall information – and specialised appraisal of impacts (such as through the EA land contamination guidance).

Table 4.2: Four-Step Natural Capital Framework as applied to the appraisal of new housing interventions.

Step	Description and purpose	Practical application in this guidance
Step 1: Understand the environmental context to the housing intervention ("what and where?")	• Understand the scale, location, outputs and spatial reach of the environmental outcomes of the proposed intervention. • Understand what natural capital assets (or liabilities e.g., brownfield land) the intervention is expected to affect, directly or indirectly.	• **Input** information for the intervention (location, local population, proposed housing units, current land use, environmental features), including any objectives for enhanced environmental outcomes. Basic information inputs could be sourced from the intervention description and plan, along with any initial environmental assessment information (e.g. environmental screening/scoping).
Step 2: Consider how the local environment may be impacted by the proposed housing interventions ("how?")	• Identify which natural capital assets are likely to be most affected by the proposed intervention and which environmental outcomes are most significant. • Quantify the expected physical changes. • Consider the likely time frame for the impacts – are they relevant only for the construction phase or over the longer term?	• Classification of outcomes (land take, construction and occupation) based on typical project lifecycle for a new housing development. • Logic chains map intervention activities to quantifiable environmental outcomes (e.g. land take and loss of woodland). • **ENHAT** quantifies physical changes and social impact using available evidence (e.g. air pollutant removal by woodland vegetation).
Step 3: What are the social value implications of the impacts identified in Step 2 ("what consequences?")	• Identify who is impacted by the proposed intervention (the population). • Quantify the social value implications of the physical changes identified in Step 2. • Where these impacts cannot be monetised, the scale of the impact should still be assessed qualitatively and quantitatively for all appraisal options. • Consider potential overlaps between impacts.	• Logic chains map outcomes to valuations (e.g. avoided damage costs due to air pollutant removal). Emphasis has been placed on avoiding double-counting of costs or benefits in developing the logic chains. • **ENHAT** values changes using available evidence and applies these over an (assumed) affected population (e.g. air pollutant damage costs).
Step 4: Consider uncertainties and optimise outcomes	• Uncertainties around what the impacts are, their scale, duration and so on should be identified, and where possible, quantified. • Critical success factors should be identified and arrangements for monitoring included as part of intervention proposal to manage risks and optimise outcomes. • Mitigating measures should be identified so that impacts to natural capital assets can be minimised and benefits maximised.	• **Outputs** from this guidance need to be combined and interpreted alongside results of wider components of the economic appraisal. • **ENHAT** facilitates some sensitivity testing to allow practitioners to examine the influence of some assumptions and parameters for calculating aggregate costs and benefit estimates for environmental impacts.

Source: SQW & eftec, adapted from HM Treasury (2022)

Categorisation of environmental outcomes

26. In this guidance and ENHAT, the environmental outcomes of new housing development are categorised according to a pragmatic view of the project lifecycle and outputs: (i) land take; (ii) construction; and (iii) occupation (Table 4.3). This categorisation aids in structuring an appraisal, including organising inputs, outcomes, and social impact. The sub-classification of environmental outcomes is based on typical Environmental Impact Assessment (EIA) categories, along with reference to Defra ENCA and consultation with Homes England appraisal practitioners (e.g. typical intervention design characteristics).

Table 4.3: Categorisation of environmental outcomes from new housing intervention outputs – also see Table 6.1 for further descriptions of outcomes.

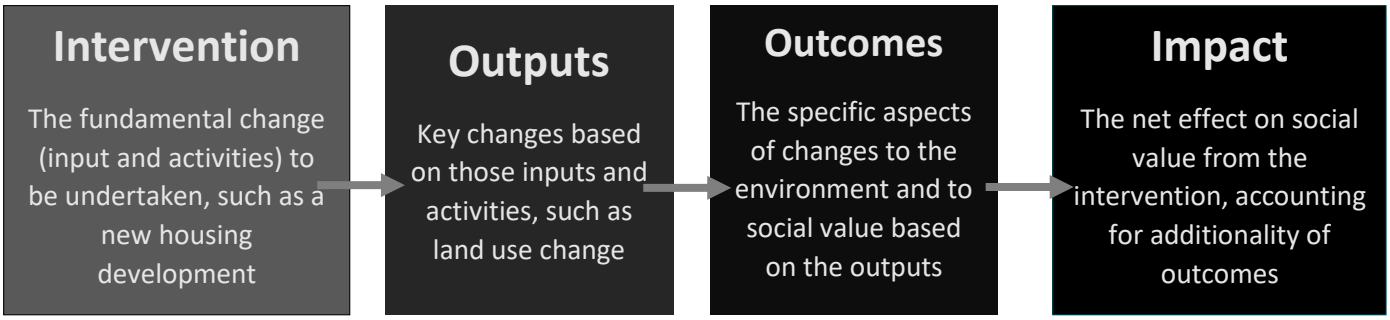
Category	Land take outcomes	Construction outcomes	Occupation outcomes
General description	Permanent net changes to ecosystem service provision resulting from land use change	One-off/temporary impacts from the production, use, transport and waste of materials used in the construction of housing	On-going impacts of occupant energy use, water consumption, transport and waste for the duration of the properties' life
Examples	• Amenity/disamenity. • Recreation. • Carbon sequestration/emissions. • Air pollutant removal/emissions. • Habitat provision/loss. • Blue green infrastructure provision (bundled). • Timber production. • Agricultural production. • Flood regulation. • Contamination removal. • Heritage. • Temperature regulation.	• Embodied carbon. • Amenity/disamenity. • Waste (bundled). • Transport (bundled).	• Energy use (bundled). • Water used (bundled). • Climate change adaptation. • Transportation (bundled). • Waste (bundled).
Generalised characteristics of impacts in the category	• Permanent changes to ecosystem service provision or local environmental amenity. • Most benefits or costs accrue to households beyond the intervention "red line" boundary.	• Temporary changes to local amenity/environmental quality. • Permanent and/or temporary costs specifically due to use of construction materials. • Benefits or costs that accrue to households beyond the intervention "red line" boundary.	• Annual costs or benefits due to resident occupation of the new homes. • Benefits or costs that are generated within and beyond the intervention "red line" boundary.

Environmental outcome logic chains

27. The guidance and ENHAT adopts a logic chain approach to map the links from new housing developments to environmental outcomes (and eventual social impacts) associated with land take, construction and occupation. This framing helps to organise the appraisal of those outcomes and minimise the risk of double-counting in terms of determining aggregate social impact or the net change in social value. The high-level logic chain is illustrated in

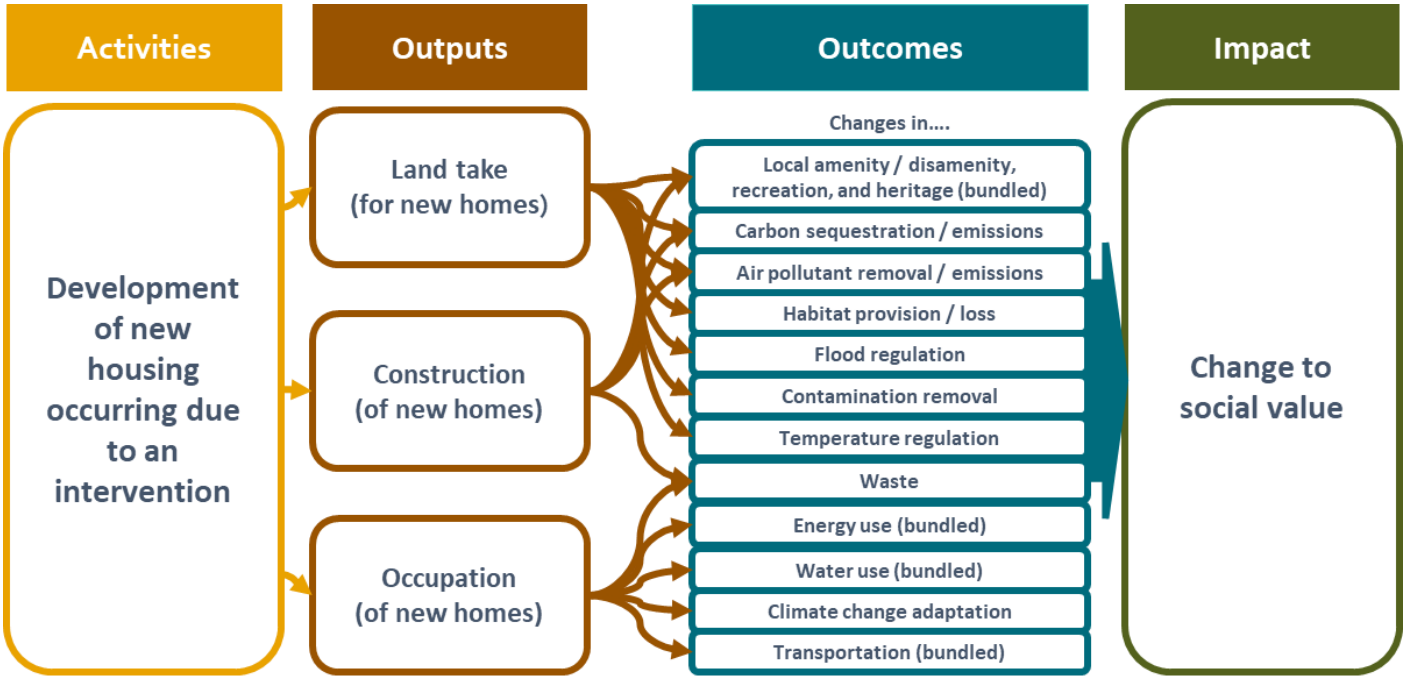
Figure 4.2. A causal relationship is assumed along the length of logic chain. This assumption requires that interventions are compared to a counterfactual, and that the counterfactual is appropriately considered (see Section 5). If it is not, then the resulting social impact of the intervention may be over or under-stated based on changes that would otherwise occur in the absence of the intervention.

Figure 4.2: High-level logic chain for appraising environmental impacts of new housing developments.



28. The high-level logic chain can be expanded to consider the most likely outputs and outcomes from housing development interventions as shown in Figure 4.3. This forms the "map" that is used to structure this guidance and ENHAT. Part 2 of this guidance document includes more specific logic chains that are used to describe the valuation approach for determining the impact of each outcome area. The outcome specific logic chains take account of practical factors such as the coverage and availability of suitable valuation evidence and are constructed to avoid the risk of double-counting. This means that some outcomes are valued individually (e.g. carbon sequestration), while other outcomes are valued as a bundle, particularly where it is not possible – nor necessary – to attribute values to particular components of the outcome (e.g. local amenity benefits).

Figure 4.3: Overall logic chain map for appraising environmental impacts of new housing.



Limitations of this guidance

Scope of impacts

29. This guidance and ENHAT are tailored to the evidence need for the appraisal of interventions concerning new housing developments on specific sites. The methods and approaches that are provided draw on evidence sources that are suitable for generalised application – subject to sufficient information about an intervention being available – to support a proportionate approach to economic appraisal that is consistent across different interventions. Whilst the guidance covers a wide range of environmental impacts that are expected to be relevant to many new housing developments, there may be cases where the evidence contained in ENHAT is not suitable and more intervention and location specific information and a bespoke approach will be needed. This could include, for example, interventions dealing with significant risks, such major contamination and pollution from previous land uses (i.e. when substantial remediation is needed) or impacts on unique cultural or heritage features that are of national or international significance. For example, the development is adjacent to a landmark site and would impact the character or setting for the site.[11]

30. In these cases, further guidance should be sought from appropriate sources. For example, DfT Transport Analysis Guidance (TAG) for transport externalities resulting from new housing developments (e.g. congestion, air pollution and carbon emissions from vehicles) should be referred to if there is likely to be substantial impacts to local congestion and/or transport. Defra ENCA guidance can be referred to if there are natural capital or ecosystem service impacts that are not adequately addressed in ENHAT, such as if development were to occur on specific habitats that are not included in the tool.

Marginal analysis

31. As explained in the HM Treasury Green Book, economic appraisal is principally concerned with measuring and valuing changes between alternative options. This applies to ENHAT too – for example a new housing development featuring enhanced levels of sustainable drainage versus the same development without this enhancement. Such differences between options are understood to be marginal changes that do not result in significant or irreversible changes in the *stock* or condition of other capital assets outside of the site. In the context of a natural capital approach this can be interpreted as valuing changes in the *flows* of services (e.g. ecosystem service provision) that are provided by natural assets. Quantifying the assets (or change in assets) must be done in order to better understand the flows, but this quantification is not an aim in and of itself for an economic appraisal.

32. If the impacts of an intervention are non-marginal, or the cumulative impacts of more than one intervention are appraised, alternative analytical perspectives may be appropriate. An example would be spatial planning and outcomes at the (sub)regional level. This could include natural capital baselines, natural capital accounts and scenario-based assessments. In such cases it is recommended that Defra ENCA is referred to for further guidance.

[11] While, to some extent, impacts on the historic environment and cultural heritage are outside of the definition of environmental impacts, there can be overlaps particularly in valuing the cultural services dimension of ecosystem service provision (e.g. recreational use of greenspaces that have historic significance). DCMS (2021) provides a framework for understanding the benefits provided by the historic environment and cultural heritage in similar terms to natural capital. Note, though, that currently the supporting economic evidence base is less well developed (Simetrica-Jacobs, 2021; available at https://www.gov.uk/government/publications/rapid-evidence-assessment-culture-and-heritage-valuation-studies) and it can be difficult to use this evidence in a generalised way given the uniqueness of such sites.

5. Overarching Considerations

This section reviews several overarching considerations addressed in the development of the guidance, including: LVU and the overlaps with environmental impact valuation; spatial dimensions of outcomes; defining options in appraisal; comparing options against the counterfactual; and sensitivity analysis.

- **The outputs measured in this guidance are specific to the site, but the area of impact for the environmental outcomes varies significantly.** For example, carbon emissions have a global impact, whereas improved environmental amenity is expected to only impact local residents and visitors. The logic chains for each specific environmental outcome contained in this guidance (such as air pollutant removal) define the relevant spatial boundaries.

- **LVU is a key part of appraising Homes England and MHCLG interventions.** This is thoroughly covered in the DLUHC Appraisal Guide (2023). Environmental outcomes within the interventions "red line" boundary that are priced into the value of (new) homes should not be included alongside LVU and are therefore not considered in ENHAT. These are private values that accrue to new residents or homeowners and double-counting will result otherwise. However, LVU may not always fully capture environmental impacts, such as not properly accounting for the future private costs associated with climate adaptations. Therefore, impacts within the redline boundary may be considered if they are not expected to be (fully) captured in LVU calculations.

- **The guidance aims to support the identification of additional options at OBC stage**. This requires an understanding of the aspects of an intervention that can be changed to reduce negative environmental outcomes and improve the positive outcomes. By quantifying the outcomes, and in some cases suggesting alternative options (such as in the case of improved performance standards for water or energy use), this guidance encourages a wider set of interventions to be considered.

- **A key part of appraisal is understanding the outcomes that will result from the intervention in comparison to the counterfactual.** To properly assess an intervention, a robust counterfactual must be developed as part of the appraisal process.[12] The counterfactual allows the net change in social value to be estimated, which is the change due to an intervention minus the change due to the counterfactual. Where a development occurs, where the people that move into those new homes come from, the standards reached in the intervention case, and the types of homes that are currently occupied can all affect this comparison.

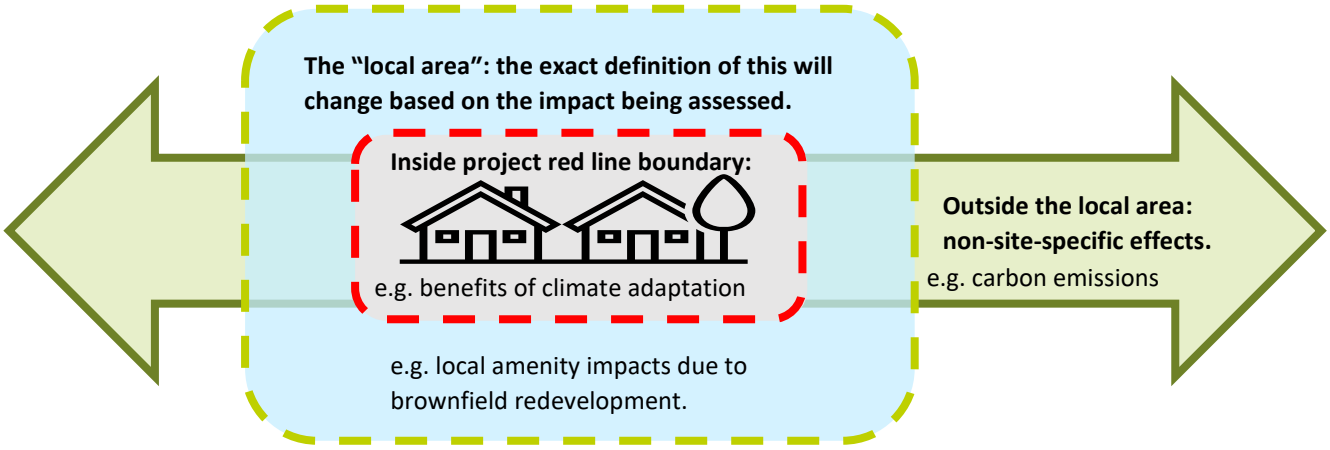
- **Due to uncertainties both in environmental impacts and outcomes, sensitivity analysis is a key part of this appraisal guidance**. The appropriate method(s) to address uncertainty varies from impact type to impact type, and therefore sensitivity analysis is covered in more depth in the sections describing the appraisal method for each impact. Sensitivity analysis themes include defining the affected population, uncertainty around the benefit values, and uncertainty around the scale of the impact.

[12] The comparison of the intervention against the counterfactual is sometimes called additionality. This topic is covered extensively in the HM Treasury Green Book, as well as in other guidance published by Government (e.g.: "Additionality Guide" - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/191511/Additionality_Guide_0.pdf

Spatial dimension of outcomes

33. The intervention outputs considered in this guidance are only those that occur on the site, such as land use change or increases in energy use occurring due to a new housing development.[13] The environmental outcomes, however, may be present far beyond the site itself. For example, reducing air pollutant removal services by developing on greenfield land may change the air quality in the wider local area, and therefore have health impacts to the surrounding population.

Figure 5.1: Spatial definition for assessment of environmental impacts of new housing developments.



34. Generally, three main spatial scales are considered in this guidance (Figure 5.1). They relate to the affected population(s) and the area over which different environmental outcomes may have an impact and be assessed and aggregated:

- **The area inside of the intervention "red line" boundary:** This is the area defined by the physical boundary of the site where construction or modifications for a new housing development will occur. The environmental benefits or costs that accrue within this boundary will only apply to the *new residents* of the development.

- **The "local area":** The surrounding area to the site that may be impacted by changing amenity, recreation opportunities, ecosystem service provision, or other changes due to the development. Benefits or costs that accrue here apply to residents in *existing* homes near to the site. The extent of the local area will need to be defined on a case-by-case basis, depending on the scale of the intervention, and expected outcomes. ENHAT includes some basic assumptions for determining the scale of local amenity benefits in urban areas, in terms of a distance decay effect.[14] Note that the local area is also where what DLUHC Appraisal Guide refers to as "wider area" impacts may occur.[15] Double counting between these types of uplifts and improvements in amenity from environmental changes will need to be addressed if both are included in the overall appraisal. Changes in net social

[13] Materials production and transport to the site are considered in so far as they are captured in embodied carbon or other construction outcomes, but not as separate outputs from the intervention.
[14] Distance decay is the reduction in an impact (either positive or negative) as the distance from a site or source of an impact increases.
[15] Wider area impacts "refer to positive spill-over or external impacts from supply-side housing interventions with explicit placemaking and regeneration objectives resulting in the surrounding area becoming more desirable." (DLUHC Appraisal Guide, 2023).

value from wider area impacts are most likely to overlap with impacts from brownfield disamenity removal (see Section 7).

- **"Outside" the local area:** Environmental impacts that are not localised in effect – such as the emission of regional or global pollutants – are assessed at this scale. These impacts could be global, national, or regional. These costs and benefits are not expected to be reflected in private costs and LVU. Therefore, the assessment of environmental impacts for these impacts are typically based on existing regional or national value estimates, which factor in the population size and scale of the impact. As the population changes due to the interventions considered in this guidance are marginal, no adjustment for population needs to be made for these types of environmental outcomes.

35. The spatial scales applied by ENHAT are noted in Sections 7-9.

Land Value Uplift and environmental outcomes

36. LVU when used in appraisals, represents the private benefit or change in economic efficiency, of one form of development on a particular site compared to its previous use.[16] In a housing development context, LVU is the value of land when used for housing minus the value of land in its current use. This is the preferred approach to valuing the benefits of development and plays a central role in estimating the benefits of Homes England interventions.

37. LVU is only calculated within the intervention red line boundary and is calculated based on the estimated changes to *private* land values. This means that any change to the property value, as well as any changes to other private values – such as market values for the production of goods and services that may be lost due to development – that occur within the red line boundary are captured in the calculation of LVU. Therefore, the loss of private ecosystem service values (such as agricultural production or timber production) that are already included in the LVU calculations should not be separately calculated in an appraisal. LVU is unlikely to contain social values, however, so many ecosystem services still need to be considered. This is reflected in the description of individual environmental outcome areas in sections 7-9.

38. As LVU relates to the red line boundary, it does not measure changes to the surrounding area, even if the intervention were to change private land values nearby to the intervention – for example an uplift in property values in adjacent neighbourhoods. Therefore, where these changes are environmental in nature (such as amenity) these private values need to still be considered within ENHAT. External costs and external benefits (externalities) that are excluded from the calculation of LVU are outlined in Figure 5.2. See section 6 for further details on what outcomes are covered in ENHAT, and which are covered in the DLUHC Appraisal Guide.

39. Several of the environmental outcomes considered within ENHAT are external benefits and costs that are not included in LVU for either new or existing residents (such as impacts due to water usage). Others – notably amenity and health impacts that affect the residents inside the red line boundary – have a greater risk of overlap with LVU, as they may be more likely to be reflected within the private price paid for the new homes. This guidance and ENHAT generally takes a cautious approach to this issue by not

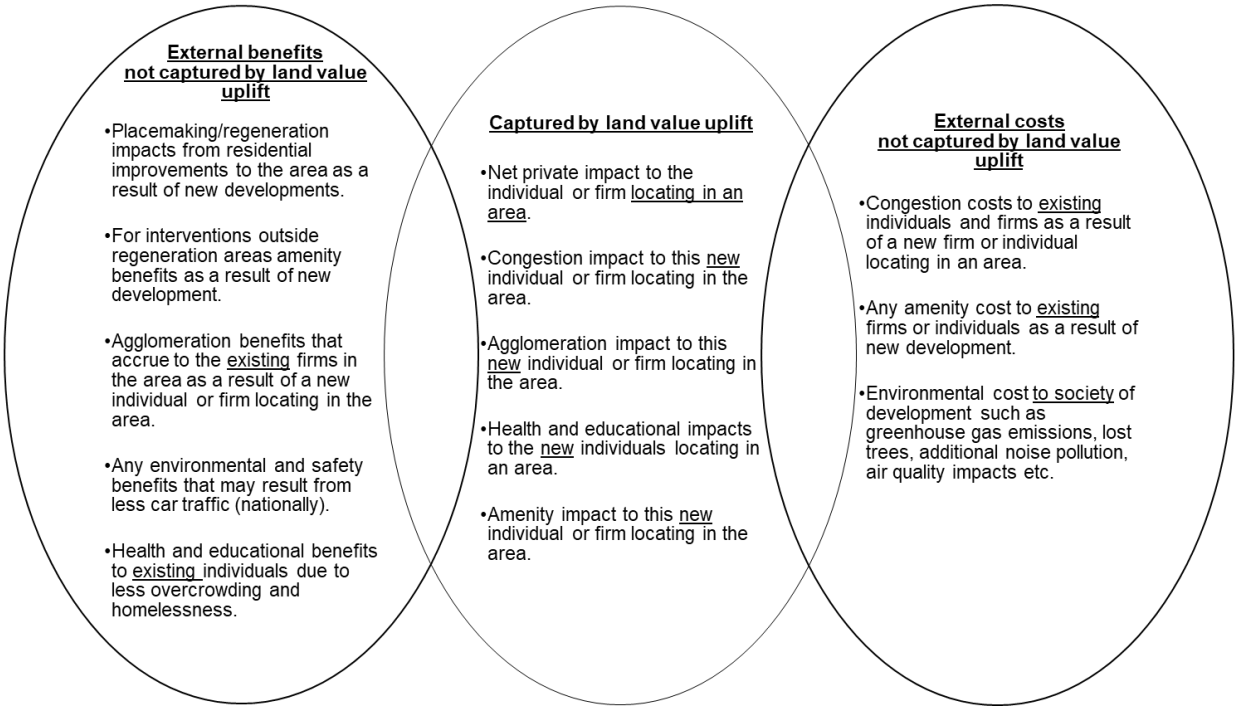
[16] DLUHC Appraisal Guide, 2023.

counting external impacts for the new population within the red line boundary – with the notable exception of the future costs of adaptation, which are considered to not be included in LVU. By doing so the risk of double counting with components of LVU is avoided. This does not mean that the outcome is ignored however, as it still may affect populations outside of the boundary.

40. There are, though, some blurred lines, such as blue-green infrastructure (e.g. sustainable drainage systems) that may be incorporated into new housing developments. These have both on-site and wider benefits (e.g. amenity from 'green streets', air pollutant removal, reduced urban run-off). In these cases, judgement is needed to determine how likely it is that the private values captured in LVU reflect these outcomes. The approach taken in ENHAT is to treat values related to 'regulating' services like flood risk regulation and air quality regulation (by vegetation) provided by blue-green infrastructure in developments as external benefits that are not captured by LVU and so can be included as additive values in an appraisal.

41. Further notes on how LVU may overlap with individual environmental values and how double counting is avoided are provided in Sections 7-9 as part of the description of the logic chains for each impact area.

Figure 5.2: Land Value Uplift framework for assessing externalities (DLUHC Appraisal Guide, 2023).



Defining intervention options

42. As described in Section 3, this guidance and ENHAT is intended to support the identification of the preferred option for a new housing development, primarily at the OBC stage. Pragmatically, this depends on there being a short-list of viable options that have been screened and sufficiently defined (i.e. the level of development of a proposal and detail that is available on its design) so that an economic appraisal can be carried out.

43. By enabling environmental outcomes to be assessed and valued, part of the aim of this guidance and ENHAT is to encourage a wider set of options to be identified as part of a long-list and then taken

forward to the short-list stage. Many of these options, which for example could include enhanced performance standards for housing or improved blue-green infrastructure, do not change the basic aspects of the intervention such as the number of housing units. Therefore, the appraisal of these enhanced intervention options could be analysed in isolation to other aspects of the intervention if that is helpful to the decision-making process in terms of demonstrating VfM of an enhanced proposal for an intervention.

44. Note, however, that ENHAT does not generally provide estimates for the costs of enhanced intervention options. These could be highly variable and dependent on intervention-specific factors and, ultimately, should be captured within the project costing (assuming whole life costs can be estimated). As such, an iterative approach may be required. For example, by highlighting the scale of the potential for improved environmental outcomes, this guidance can help Homes England and their partners identify where it should consider a specific enhanced option (at a higher cost) at the short-list stage. An estimate of the cost of such an option can then be provided, for example by cost advisors.

Comparisons and integration into the full appraisal

45. From an economic appraisal perspective, the environmental impacts of new housing development can be defined by:

$$\begin{aligned} &Net\ change\ in\ social\ value\ due\ to\ the\ environmental\ impacts\ of\ an\ intervention \\ &\quad = change\ in\ environemental\ impacts\ under\ the\ intervention\ option \\ &\quad - change\ in\ environmental\ impact\ under\ the\ counterfactual \end{aligned}$$

46. This is an expression of additionality, which is defined in the HM Treasury Green Book as "…[The] real increase in social value that would not have occurred in the absence of the intervention being appraised[17]."

47. The DLUHC Appraisal Guide (2023) highlights two key aspects of additionality:

- Deadweight – defined as the level of target outputs/outcomes that would have been produced if the intervention did not go ahead. This involves estimation of what scale and type of development, if any, would take place on the site in the absence of intervention, and over what time frame.

- Displacement – defined as the level of outputs/outcomes (occurring in the counterfactual and the intervention options) accounted for by reduced outputs/outcomes elsewhere.

48. From a practical perspective, this guidance and ENHAT addresses these two topics by requiring that the environmental outcomes for a site are estimated under both the counterfactual which estimates what would occur if there was no intervention, and in the intervention options. The counterfactual scenario values are then subtracted from the estimates of environmental outcomes under the intervention options to reveal the change in social value. The comparison between the counterfactual and the intervention option can be carried out for the full set of impacts featured in ENHAT. It can also be undertaken for isolated outcomes (for example a comparison of carbon sequestration rates under alternative options).

[17] HM Treasury (2022), p. 126.

49. Occupation impacts all have a high degree of displacement – for example, water use in new homes may decrease water use *elsewhere* to some extent, if the previously occupied homes are either no longer occupied or have fewer occupants leading to reduced water usage. These effects are addressed by assessing occupational impacts over the *additional* population to the local authority in a different manner than the *displaced* population in that local authority that a housing development will result in (for a local area). The basis for this is the population adjustment analysis provided by SQW (2023) along with some standardised assumptions on the performance standards in the previous homes of the displaced population. Further details are in the specific occupation outcome sections (Section 9).

Side note: Location of the development and population movements due to new housing

Development in certain areas may result in higher (or lower) overall estimated environmental impacts. Differences in the environmental impacts of housing development from place to place are further influenced by where the people that are moving into new homes are coming from. In this guidance, all people moving into the new homes are expected to move from either: (i) inside of the local authority (movement within); or (ii) anywhere in England from outside of the local authority (movement from outside).

This model of the people moving into new homes is a simplifying assumption, as movement patterns due to new development are expected to be more complex. However, data analysis carried out by SQW (2023) has identified the proportion of people that move into a new home from inside of the local authority, and these estimates have been made for each local authority.

At a larger scale, the appraisal of overall housing policy to deliver homes would require more complex modelling of population movements against some counterfactual.

Sensitivity analysis

50. Overarching guidance on how to approach sensitivity analysis is available in the HM Treasury Green Book, DLUHC's Appraisal Guidance and Defra ENCA. Generally, the purpose is to quantify the influence that key evidence and assumptions have on the type, quantity and economic value of impacts, and the implications for the appraisal result (i.e. which option is identified as the preferred one).

51. Within the scope of appraising environmental impacts of new housing developments, key sensitivities to consider are:

- The specification of alternative options (e.g. design/content or delivery).
- Assumptions made about the counterfactual.
- The affected population of various outcomes (i.e. spatial scale of affects and the aggregation of benefits/costs).
- The magnitude, direction, timing, and spatial nature of environmental outcomes.
- Quantitative estimates of impacts (e.g. carbon sequestration rates).

- Value of outcomes (e.g. best estimates, confidence intervals including high or low estimates, or adjustment factors).

- Uncertainties and gaps in supporting data (e.g. socio-economic characteristics of affected population).

- Discount rate and time horizon for calculation of present value.

52. Optimism bias and risk are not formerly addressed in this guidance and ENHAT, as it is expected that they will be incorporated in the appraisal process through the application of techniques recommended by the HM Treasury Green Book and the DLUHC Appraisal Guide.

53. ENHAT includes several sensitivity tests as default outputs to aid the interpretation of results across most impact areas (see Section 7-9). These sensitivity tests aid the user in identifying which parameters for valuing environmental impacts may be most material to the identification of the preferred option. This information needs to be combined with the wider economic appraisal results to understand overall which parameters are key and should be subject to sensitivity testing.

54. In some cases, it will be necessary to carry out supplementary sensitivity analysis, which may be beyond the default outputs of ENHAT. Beyond examining how a range of values (e.g. “low“, “medium“, “high“) might influence the appraisal results, further strategies for sensitivity testing include assigning probability weights to intervention outcomes – especially where minimum (e.g. low) and maximum (high) extremes are particularly unlikely outcomes.

55. Alternatively, the calculation of switching and threshold values could be considered. These can help indicate the level of uncertainty that can be accommodated in a given appraisal for the valuation of an impact or set of impacts, including non-monetised effects. The basic premise is to establish how wrong the estimated impact must be for the recommendation to change – in other words for the net present value (NPV) estimate to switch from positive to negative or vice versa. As highlighted above, this requires combining the environmental impact values for options with the wider economic appraisal results.

56. An outcome from sensitivity testing could be a recommendation that risks and uncertainties around outcomes are more closely examined – e.g. through physical modelling – in order to increase confidence in monetary value estimates for impacts.

Part 2: Environmental Impacts of New Housing Development Appraisal Tool (ENHAT)

6. Overview

This section introduces the Environmental Impacts of New Housing Development Appraisal Tool (ENHAT), providing a summary of its development, structure and content, and the basic requirements for its use.

- **ENHAT provides a practical framework to bring together the factors contributing to the overall environmental impact of new housing developments.** It is intended to provide a credible and proportionate way for appraisal practitioners, who are not specialists in non-market (environmental) valuation, to include these impacts in economic appraisals.
- The tool supports the established procedure for selecting the preferred intervention option at OBC stage by testing and assessing the environmental impacts of a shortlisted set of options.
- It has been developed based on a programme of research carried out by Homes England to identify and value the environmental impacts of new housing developments. This included literature review, desk-based analyses of datasets and primary valuation research studies that produced and compiled the evidence base and methods needed to appraise these impacts.
- **The tool is designed to work with a standard set of information inputs for a new housing development intervention that are expected to be readily available to appraisal practitioners at the OBC stage.** The calculations are for the most part an automated process performed by the tool once the required information about the intervention options is inputted by the user.
- The approach, methods, evidence and calculations used by ENHAT to value impacts are described in Sections 7-9, following the high-level environmental impact logic chain described in Section 4.

Introducing ENHAT

57. **ENHAT should be the starting point for the appraisal of environmental impacts of most new housing development interventions** by Homes England. The tool has been designed to readily support appraisal practitioners to identify, quantify and value the environmental impacts of new housing developments. In summary ENHAT brings together a series of methods and approaches that utilise existing evidence to compare and value the environmental impacts of different intervention options for new housing developments from the land take, construction and occupation phases. The outputs from ENHAT are monetary value estimates for environmental impacts. These should be included in the overall economic appraisal for the intervention.

58. **It** is expected that ENHAT will primarily be used at the OBC stage, where quantification and valuation of environmental impacts could influence how options are shaped. These options and their environmental impacts can then be taken into the wider economic appraisal to eventually inform the assessment of the VfM of the preferred intervention option. This expectation is consistent with the process that is described in the HM Treasury Green Book and DHULC appraisal guidance.

59. Figure 6.1 illustrates the basic structure and content of ENHAT and Table 6.1 provides a list of outcome areas that are covered within ENHAT and the guidance.

Figure 6.1: ENHAT structure and flow chart. (The tabs within ENHAT are given in parentheses).

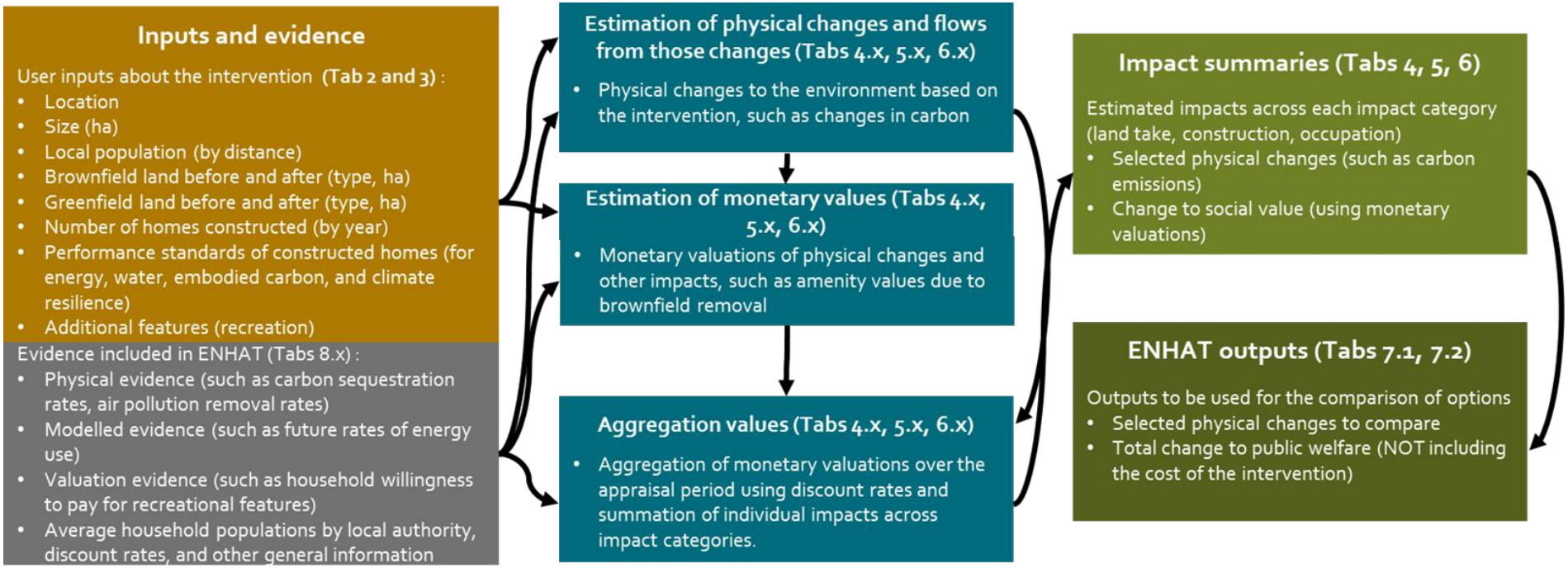


Table 6.1 - Outcomes of new housing development, descriptions, who those outcomes affect, and their coverage in this guidance and ENHAT or other available guidance (note that this table covers two pages).

Environmental outcome	Stage of intervention	Description	Private or public	Affected population	Included in ENHAT	Included in DLUHC AG/LVU	Included in other guidance
Amenity/disamenity	Land take	Change in the amenity experienced on or near a site due to changes in greenfield or brownfield land	Public and private	Local	✓	LVU/placemaking	Defra ENCA
Recreation	Land take	Change in the recreational value on or near a site due to changes in greenfield or brownfield land as well as features provided	Public and private	Local	✓	LVU/placemaking	Defra ENCA
Air pollutant removal/emissions	Land take	Change in air pollutant removal provided by vegetation present on a site	Public	Varies[a]	✓	✗	Defra ENCA
Carbon sequestration/emissions	Land take	Change in the carbon sequestration provided by vegetation present on a site	Public	Global	✓	✗	Defra ENCA
Habitat provision/loss	Land take	Change in the habitat provision by a site due to change in greenfield land	Public	Varies[b]	✓	✗	Defra ENCA
Blue green infrastructure provision (bundled)[f]	Land take	The group of environmental outcomes resulting from blue-green infrastructure present on a site, such as air pollutant removal, carbon sequestration, and amenity	Public and private	Local and land-owner/occupant	✓	✗	CIRIA BEST
Water storage/flood regulation	Land take	Change in the regulation of water flow from vegetation present on a site	Public and private	Catchement	✗	✗	Defra ENCA
Temperature regulation	Land take	Change in the regulation of temperature from vegetation present on a site	Public	Local	✗	✗	Defra ENCA
Heritage	Land take	Change in the value of heritage, either due to a change near or on a heritage site	Public	Varies[c]	Depends on the scale[j]	✗	Valuing culture and heritage capital (DCMS, 2021)
Contamination removal	Land take	Change in contamination present on a site	Public and private	Local	Depends on the scale[j]	✗	Land Contamination: Technical guidance (EA)
Timber production	Land take	Change in the timber production on a site due to change in greenfield land	Private	Land owner	✗	✓[g]	Defra ENCA
Agricultural production	Land take	Change in the agricultural production on a site due to change in greenfield land	Private	Land owner	✗	✓[g]	Defra ENCA
Embodied carbon	Construction	The embodied carbon from construction of new homes	Public	Global	✓	✗	Various – such as Greater London Authority (2022)[i]
Amenity/disamenity	Construction	Change in amenity from noise, visual disturbances, etc. that occurs during construction	Public	Local	✗	✗	✗
Waste (bundled)[f]	Construction	The group of environmental outcomes resulting from the transportation, treatment, and disposal of construction waste	Public	Regional	✗	✗	✗

Environmental outcome	Stage of intervention	Description	Private or public	Affected population	Included in ENHAT	Included in DLUHC AG/LVU	Included in other guidance
Transportation (bundled) [f]	Construction	The group of environmental outcomes relating to household transportation (such as local congestion and air pollution)	Public	Local	✗	✗	Transport analysis guidance (DfT, 2022)
Energy use (bundled) [f]	Occupation	The group of environmental outcomes relating to energy use from the occupation of new homes (such as air pollution and carbon emissions)	Public	Varies[d]	✓	✗	✗
Water use (bundled) [f]	Occupation	The group of environmental outcomes relating to water use from the occupation of new homes (such as over-abstraction and carbon emissions)	Public	Varies[e]	✓	✗	✗
Climate change adaptation	Occupation	Costs associated with adapting to future rises in temperature due to climate change	Private	Land-owner/occupant	✓	✗	✗
Transportation (bundled) [f]	Occupation	The group of environmental outcomes relating to household transportation (such as local congestion and air pollution)	Public	Local	✗	✗	Transport analysis guidance (DfT, 2022)
Waste (bundled) [f]	Occupation	The group of environmental outcomes resulting from the transportation, treatment, and disposal of household waste (such as air pollution and land take occurring at disposal sites)	Public	Regional	✗	✗	✗

Notes: *(a) air pollutants can travel various distances based on their concentration and type. Generally, air pollution removal is regional in effect.*
(b) the social impact of changes to habitat provision can vary based on the types of species that will be affected. Outcomes that affect endangered or rare species will have a wider impact.
(c) the social impact of changes to heritage will vary based on the rarity and value of the heritage site in question.
(d) the social impact of energy use will be global for carbon emissions, and local or regional for air pollution. However, the affected population is also a result of where the energy is originally produced.
(e) the social impact of water use will be global for carbon emissions, and regional for other outcomes like habitat degradation due to over abstraction.
(f) some environmental outcomes, such as energy use, are representative of a set of outcomes that create an environmental impact. See the description for further details.
(g) Timber and agricultural production, being a private benefit, should be included in land-value uplift calculations (which account for decrease in private production on land).
(h) sources for other guidance: Land contamination (EA, 2022) - https://www.gov.uk/government/collections/land-contamination-technical-guidance; Valuing culture and heritage capital (DCMS, 2021) - https://www.gov.uk/government/publications/valuing-culture-and-heritage-capital-a-framework-towards-decision-making/valuing-culture-and-heritage-capital-a-framework-towards-informing-decision-making; Transport analysis guidance (DfT, 2022) - https://www.gov.uk/guidance/transport-analysis-guidance-tag; ENCA (Defra, 2023) - https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca; B£ST (Ciria, 2019) - https://www.susdrain.org/files/resources/BeST/w047b_bst_guidance_release_5_v0b_issued.pdf.
(i) London Plan Guidance Whole Life-Cycle Carbon Assessments available at: https://www.london.gov.uk/sites/default/files/lpg_-_wlca_guidance.pdf
(j) Valuations from eftec (2022) may capture contamination and heritage values if the impact is relatively small. Major changes to heritage or contamination – such as national important sites – will require bespoke assessment.

Development

60. The methods and approaches that are included in ENHAT follow from the stages of research carried out for Homes England that preceded the development of this guidance document (see Appendix 2). This included a literature review to collate relevant evidence – including from the Defra ENCA databooks – along with the development of the initial framework for the guidance, including the practical classification of environmental impacts (land take, construction, and occupation). Based on a gap analysis and scoping exercise, a series of studies were commissioned by Homes England to enhance the evidence base and provide the core content of ENHAT. This included both primary valuation research and desk-based analyses of existing datasets to provide insights and evidence tailored to Homes England's needs for the economic appraisal of new housing developments.

61. The principal research studies were:

- **Brownfield redevelopment values:** Appraisal values for the removal of brownfield land from a location (land take impacts). These values capture the avoided disamenity (eyesore, contribution to deprivation, anti-social behaviour) due to redeveloping brownfield sites into new or remodelled homes.

- **Embodied carbon:** Indicative estimates of embodied carbon – based on whole-lifecycle carbon – for a typology of home types and construction methods, along with estimates of the additional costs for implementing home types of higher standards (construction impacts).

- **Improved performance standards:** Estimates for energy use, water use, and surface water management techniques (sustainable drainage systems and/or blue green infrastructure) for constructing homes and residential developments to different performance standards (occupation impacts).

- **Climate change resilience:** Estimates of capital and operational costs for adapting to a changed future climate for different house types and different residential development options.

- **Population adjustment factors:** Estimates for both the expected number of occupants for new homes, as well as how many of those occupants are likely to be additional, estimated by local authority.

62. Standalone reports detailing the research aims, methodologies, analysis and results of these studies are available alongside this guidance in the background research report. The brownfield redevelopment values report has been published separately as part of Homes England's measuring social value research series. The practical tools produced by these studies have been integrated into ENHAT to ensure consistency of application.

Getting started

63. ENHAT is designed to work with a standard set of information inputs for a new housing development intervention that are expected to be readily available to appraisal practitioners at the OBC stage (Box 6.1). The **user guide (tab 1)** section included in the tool provides step-by-step instructions for using ENHAT and summarising (reporting) the monetary value estimates for environmental impacts that it produces.

Box 6.1 ENHAT user inputs.

User inputs are split between: (i) general inputs (information about the site); and (ii) option inputs (information about the counterfactual or an intervention):

- **General information.** These are details that remain the same between intervention options, such as:
  - Project name.
  - Site location and associated information such as the water company area.
  - Local population density.
  - Existing greenfield (habitats) on the site.
  - Existing brownfield on and nearby to the site.

- **Option (counterfactual or intervention) information.** These are details that are specific to the counterfactual and intervention options being appraised, including:
  - The number of units (homes) and their type.
  - Timing of delivery of those homes.
  - Performance standards of the homes.
  - Changes to green space on the site.
  - Changes to brownfield on the site.
  - Any additional features delivered as a part of the development.

Technical summary

64. Sections 7-9 of this guidance summarise the technical content of ENHAT, in terms of the logic chains that underpin the approaches and methods that are applied to value individual (or bundled impacts), along with the evidence that is used to do this. A consistent format is used to explain the approach for impact, covering:

- **Method:** How the final change in social value is estimated (e.g. production of goods and services, costs savings, reduced damage costs, reduced health treatment costs, health and wellbeing values, recreation and amenity benefits) and the (assumed) beneficiary population.

- **Information requirements for using ENHAT:** Detailing which user inputs are applied to value the impact.

- **Key evidence sources:** The principal source studies and data sources that are used to value the input.

- **Assumptions and notes:** Relevant notes to aid the interpretation of results, including sources of uncertainty, the extent to which the evidence and values applied represent the "full impact", along with limitations and potential gaps.

- **Discount rate:** Applied to the 60-year appraisal period as the standard social time preference rate (STPR) set out in the HM Treasury Green Book: 3.5% for years 1-30 and 3% for years 31-60. For environmental outcomes that have human health impacts, the HM Treasury Green Book supplementary guidance health discount factors are applied: 1.5% for years 1-30 and 1.286% for years 31-60.[18]

- **Key sensitives:** Relevant notes identifying key parameters for sensitivity testing.

[18] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/936262/Discount_Factors.xlsx

65. Accompanying commentary for each impact area provides further guidance for interpreting the evidence used and its application in ENHAT.

66. Note that the technical summaries for each impact category in this guidance do not report the specific values and parameter estimates that are applied in ENHAT. The summaries do, though, provide the basic calculations and formulas that are used to quantify and value impacts. A mix of unit values and functional relationships are used – hence in some cases there is no single value that is applied to monetise a specific environmental impact of a new housing development. Over time, values and evidence sources may be updated or refreshed. Tabs 8.1 onwards in ENHAT show the key evidence sources applied (including the date of publication and suggested timescales for review).

Illustrative examples demonstrating the use of ENHAT

67. Two illustrative examples are used throughout Sections 7-9 to demonstrate the use of ENHAT and methods applied for each impact area. One example is illustrative of a brownfield site development, the other characterises a greenfield site development. Table 6.2 describes the overall profile of the two illustrative examples, which draw on real world interventions by Homes England[19].

Table 6.2: Illustrative examples used throughout sections 7-9.

Example	Example A: Brownfield illustrative example	Example B: Greenfield illustrative example
Description	A small brownfield redevelopment. The proposed intervention includes several environmental features, including solar panels and rainwater collection.	A medium to large greenfield development, with some brownfield. The proposed intervention includes a number of local amenity features as part of the development, including sports pitches, cycle paths, and children's play areas.
Location	North East	West Midlands
Timing	Intervention completed in 2027; counterfactual leads to redevelopment in 2033.	Intervention completed in 2035; the counterfactual is no change to the site over the next 60 years.
Overall size in hectares (ha)	0.82 ha	35.2 ha
Initial greenfield area (ha)	0 ha	30 ha, mainly agricultural land.
Final greenfield area (ha)	0 ha	14 ha, mix of public open space and wildlife habitats.
Initial brownfield area (ha)	0.82 ha of industrial (buildings will need to be removed.	5.2 ha, including colliery spoil mounds (mining waste) and old industrial sites.
Number and type of homes	76, mixture of 1-4 bed homes in apartment blocks.	675, mixture of 1-5 bedroom homes, in a mixture of flats, semi-detached, and detached homes.

68. Summaries of the two examples are provided in Box 6.2 and Box 6.3. Throughout this guidance these worked examples focus on environmental outcomes and their impact on social value, and are a partial account of the entire impact to social value of an intervention. Therefore, the impact estimated here needs to be combined

[19] Note that the examples have been adapted for the purposes of this guidance and demonstrating the use of ENHAT. Therefore, the results reported for the illustrative examples should not be interpreted as representative of the HE interventions on which they are based.

with other values from the DLUHC Appraisal Guide, such as LVU and the cost of delivery, to get a full view of the option(s) being appraised.

69. Overall, the guidance and ENHAT are intended to provide a pragmatic set of methods and values to be used alongside the DLUHC Appraisal Guide and outputs from other Homes England research. ENHAT results rely on the inputs of the practitioner, the current understanding of environmental impacts from new housing, and evidence sources that are available. The coverage of the guidance and ENHAT is, though, partial. In some instances, it will not be sufficient and bespoke analysis will be required; for example, unique impacts or complex interventions (e.g. major land contamination). The evidence sources and methods covered in this guidance and ENHAT should also be reviewed periodically. Indications of when updates should occur are included throughout the guidance.

Box 6.2: Illustrative example – brownfield development.

Example A: This example is based on a development that will take place on a small brownfield site. The site is less than 1 hectare and will be developed into 76 homes with around 150 total occupants. The intervention option will deliver homes with high performance standards for energy and water use and include community features as part of the development. The overall public expenditure for the intervention option is expected to be around £2 million. It is expected that without Homes England intervention development would still take place on the site around 10 years later and that those homes would be developed to a lower standard. ENHAT is used to assess two options:

- **An option "without" intervention (counterfactual).** The environmental outcomes due to later development to a lower standard on the site.
- **An option "with" intervention.** The environmental outcomes arising from earlier Homes England involvement to higher standards on the site.

The performance of both options is assessed relative to a "do nothing" (no change) reference case to show the environmental impact of new housing development, "with" and "without" intervention from Homes England. The "with" intervention option can be compared to the "without" intervention option in order to determine the (net) environmental impact of Home England's intervention. This is performed by comparing the "with" and "without" results provided by ENHAT in a separate options comparison workbook.

The table below shows the impact to social value from environmental outcomes for this example. All outcomes/impacts are assessed over a 60-year time horizon. ENHAT also estimates selected private and delivery costs, where those costs represent an increase beyond "standard" methods of construction. As this intervention contains no greenfield land as a part of the site, some of the methods in ENHAT were not used.

Example A: ENHAT summary outputs for environmental outcomes

(notes: positive values indicate benefits; negative values indicate costs; small rounding differences)

Category of environmental impact	**Difference in environmental outcomes due to the intervention option over the option without intervention**
Impacts from land take	£2.17 million (£2.86 million minus £0.69 million)
Impacts from construction	-£0.03 million (-£0.25 million minus -£0.22 million)
Impacts from occupation	£0.08 million (£0.34 million minus £0.24 million)
Net environmental cost/benefit (discounted)	***£2.23 million (£2.94 million minus £0.71 million)***

Example A: ENHAT summary outputs for selected private costs[20] where those costs represent an increase beyond "standard" methods of construction

(notes: positive values indicate benefits; negative values indicate costs)

	Difference in private costs for delivering selected aspects due to the intervention option over the option without intervention
Construction methods to reduce embodied carbon	-£0.44 million (-£1.84 million minus -£1.40 million)
Measures taken for climate change adaptation	-£0.06 million (-£0.26 million minus -£0.20 million)

This example illustrates a few key trends in this guidance:

- There are potentially large social benefits to redeveloping brownfield sites and removing brownfield disamenity (seen in the land take outcome), especially where public features are created.
- The number of homes near to the brownfield site has a large influence on how much positive environmental impact an intervention can create, due to the large impact amenity has on social value.

Box 6.3: Illustrative example – mixed (greenfield and brownfield) development.

Example B: This example is for a development that will take place on a large site that is currently enclosed agricultural land (30 ha) with some brownfield (5.2 ha). The intervention will deliver approximately 675 homes with around 1,700 total occupants and provide 14 ha of nature habitat and public greenspace and recreation features. In the counterfactual the site will remain as enclosed agricultural land, and the existing brownfield will not be remediated (no change to the site).

This example uses the full range of ENHAT methods and data. It also provides a comparison where the option "without" intervention (the counterfactual) is a "do nothing" (no change) reference case.

Example B: ENHAT summary outputs for environmental outcomes

(notes: positive values indicate benefits; negative values indicate costs)

Category of environmental impact	**Difference in environmental outcomes due to the intervention option over the option without intervention**
Impacts from land take	£3.15 million (£3.15 million minus £0)
Impacts from construction	-£3.19 million (-£3.19 million minus £0)
Impacts from occupation	£2.43 million (£2.43 million minus £0)
Net environmental cost/benefit (discounted)	***£2.38 million (£2.38 million minus £0)***

[20] Some estimates of private costs were produced in the development of this guidance and have been included in ENHAT. These estimates should be treated with caution and project specific estimates based on the current market would be preferable. Further detail can be found in the background report. It should also be noted that the private costs presented in these tables cannot simply be compared to the environmental impact estimates to reach a conclusion on value for money. These must be fed into a broader economic appraisal that includes, e.g. public sector costs and estimates of LVU. The environmental standards included in each option may impact on these broader elements of the appraisal (e.g. building to a higher standard may impact on Gross Development Values).

Example B: ENHAT summary outputs for selected private costs[21] where those costs represent an increase beyond "standard" methods of construction

(notes: positive values indicate benefits; negative values indicate costs)

	<u>Difference</u> in private costs for delivering selected aspects due to the intervention option over the option without intervention
Construction methods to reduce embodied carbon	£0 (no action is taken to reduce embodied carbon)
Measures taken for climate change adaptation	-£2.76 million (-2.76 million minus £0)

When viewed alongside example A, the difference in results highlight other key trends in this guidance:

- The environmental outcomes of construction are negative – driven by embodied carbon. This negative impact is "unavoidable" (if homes are to be built) as all current construction techniques have associated carbon emissions.
- The environmental outcomes from the occupation of new homes – such as water use, energy use, and embodied carbon can have a positive social impact where the intervention decreases use due to the design standard used.
- Social impacts estimated through ENHAT are material to the appraisal of options and could be a major influence on both the preferred option and on the VfM assessment of options.

[21] Some estimates of private costs were produced in the development of this guidance and have been included in ENHAT. These estimates should be treated with caution and project specific estimates based on the current market would be preferable. Further detail can be found in the background report. It should also be noted that the private costs presented in these tables cannot simply be compared to the environmental impact estimates to reach a conclusion on value for money. These must be fed into a broader economic appraisal that includes, e.g. public sector costs and estimates of LVU. The environmental standards included in each option may impact on these broader elements of the appraisal (e.g. building to a higher standard may impact on Gross Development Values).

Navigation

70. The sub-sections for each impact category and type are intended to be accessible reference sources for users of ENHAT and a wider audience that wishes to understand the specific methodology used in each case (for instance in the case of appraising environmental impacts outside of ENHAT). The table of contents for Part 2 below links to the individual sections:

7. Environmental Impacts of Land Take

This section covers the environmental impacts of land take:

- **Land take impacts occur as a result of the change in land use due to an intervention**. For example, this could be agricultural land being converted into homes, or a disused industrial site being converted into homes. The impacts of land take depend on the current characteristics of the site as well as the characteristics of the site post-development/intervention.

- This guidance considers land take in two broad categories – land take occurring on greenfield sites, and land take occurring on brownfield sites. The outcomes that occur due to these two types of land take are considered separately because the logic chains for each are expected to be different, as well as the overall direction and magnitude of impacts. The methods applied are consistent across both types of land take, but the evidence sources differ.

- The impacts for which evidence and methods are included in ENHAT are:
  - Changes to **local amenity, recreation, heritage (only for minor changes), and contamination (only for minor changes).**[22]
  - Changes to **air pollutant removal.**
  - Changes to **carbon sequestration from the land** (i.e. not from occupancy or construction).
  - Changes to **habitat provision.**
  - Bundled services from changes to **blue-green infrastructure (BGI).**

- The impacts that are also considered in this guidance, but not quantified in ENHAT are:
  - Changes to local temperature regulation.
  - Changes to flood regulation.
  - Changes to timber production.
  - Changes to agricultural production.
  - Changes to contamination (major).
  - Changes to heritage (major).

- Land take impacts are assessed as permanent. For example, a change to local amenity will impact the nearby household for as long as that change persists. Note though that the valuation of land take impacts is particularly sensitive to the information available for the current site, as well as the assumptions used to specify the counterfactual scenario.

71. Land take[23] broadly has two forms – greenfield land take and brownfield land take (Figure 7.1; Table 7.1). Greenfield sites are sites that are previously undeveloped and will often include agricultural land. Brownfield sites are previously developed sites that are underutilised or not currently utilised at all.[24]

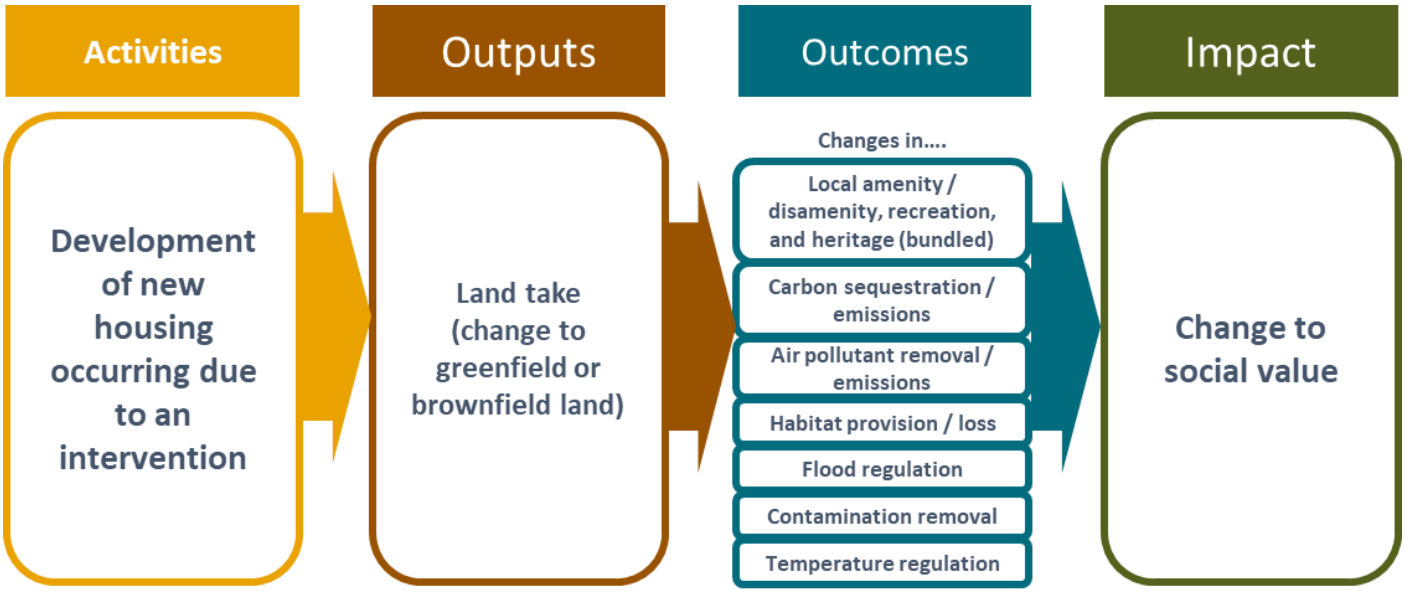
72. Greenfield land take, in general, is expected to produce an overall (net) negative environmental outcome. Greenfield sites in their pre-development state tend to provide environmental amenity to local populations, as well as (flows of) ecosystem services such as habitat provision that benefits wildlife and carbon sequestration

[22] Major changes to heritage or contamination should be assessed using separate guidance. See the section "Local environmental amenity".
[23] Land take is defined in this guidance as the change in land-use due to an intervention.
[24] Note that while commonly referred to in urban context, brownfield can be found in urban or rural areas.

that benefits the wider population. Developing on greenfield sites can result in the removal of this amenity and reductions in ecosystem service provision.

73. Brownfield land take, in contrast, is expected to produce an overall (net) positive environmental outcome. Brownfield sites are, by definition, disused and are in most cases likely to be a source of disamenity for an area. Developing on brownfield sites can therefore result in the removal of this disamenity and its detrimental effect on the quality of the environment for local populations.

Figure 7.1: Environmental impact logic chain for land take.



74. Some consequential land take impacts, such as changes to agricultural yields or timber production resulting from development of greenfield sites, have significant (or even complete) overlaps with the calculation of LVU (see Section 5). Table 7.1 describes the potential for overlaps with LVU by impact, as well as the expected outcome for both brownfield and greenfield applications.

Table 7.1: Expected outcomes in terms of changes to social value by land take.

Land take outcomes	Potential overlap with LVU	Expected brownfield development impact [25]	Expected greenfield development impact
Local amenity/disamenity	Significant for new residents; None for the existing local population	Positive	Variable
Recreation	Significant for new residents; None for the existing local population	None or positive	Variable
Air pollutant emissions/removal	None	None or positive	Negative
Carbon emissions/sequestration	None	None or Positive	Negative
Habitat provision[26]	None	Impacts likely immaterial	Negative
Blue green infrastructure (BGI) provision (bundled)	Significant for new residents; None for the existing local population	Positive	Positive
Flood regulation	None	None or positive	Variable
Local temperature regulation	Significant for new residents; None for the existing local population	None or positive	Negative
Heritage	Significant for new residents; None for the existing local population	Variable	None or negative
Contamination removal	Significant for new residents; None for the existing local population	None or Positive	None, or impacts likely immaterial
Timber	Significant (private value pre-development)	N/A	N/A
Food (crops and livestock)	Significant (private value pre-development)	N/A	N/A

Assumptions regarding land take

75. The default calculations in ENHAT assume that provision of ecosystem services occurs at the full value upon the "creation" of an area of habitat. Sensitivity testing can be used to determine the influence of this assumption on the overall results by changing the "delivery" date for habitats that require time to develop (e.g. delaying the delivery of forest by 10 years in the inputs). ENHAT also does not estimate any private or social costs from the creation or removal of habitats beyond the ecosystem services explicitly covered in the tool. Private costs (e.g. the cost to the developer to create an area of habitat) are assumed to be calculated elsewhere in the appraisal process, and some social costs (e.g. carbon emissions that might occur due to landscaping) are not included due to a lack of available information.

[25] 'Positive' indicates that the intervention will likely result in improvements to the land take outcomes, while 'negative' indicates that the redevelopment will likely result in degradation to the land take outcome.

[26] Habitat provision here refers to the provision of greenspace that improves local wild species presence (local biodiversity).

Box 7.0: Land take – illustrative examples summary.

The method used in ENHAT for each outcome area are discussed in the following sections. As an introduction to the potential magnitude of the impacts from land take, a summary of the two illustrative examples (A and B) are provided here (see Section 6; Table 6.2 for the intervention profiles).

Example A: Brownfield example, land take impacts

(notes: positive values indicate benefits; negative values indicate costs)

Category of environmental impact	**Difference in environmental outcomes due to the intervention option over the option without intervention**
Local environmental amenity due to brownfield	£0.26 million (£0.94 million minus £0.68 million)
Local environmental amenity due to greenfield	£0 (no change in the intervention or the counterfactual)
Local environmental amenity due to specific features	£1.88 million (£1.88 million minus £0 million)
Air pollutant removal	£0 (no change in the intervention or the counterfactual)
Carbon sequestration (from habitats)	£0 (no change in the intervention or the counterfactual)
Habitat provision	£0 (no change in the intervention or the counterfactual)
BGI bundled outcomes	£0.03 million (£0.04 million minus £0.01 million)
Net environmental cost/benefit from land take	***£2.17 million (£2.86 million minus £0.69 million)***

Example B: Greenfield example, land take impacts

(notes: positive values indicate benefits; negative values indicate costs; all counterfactual values are £0 as no change occurs).

Category of environmental impact	**Difference in environmental outcomes due to the intervention option over the option without intervention**
Local environmental amenity due to brownfield	£1.73 million (£1.73 million minus £0)
Local environmental amenity due to greenfield	-£1.29 million (-£1.29 million minus £0)
Local environmental amenity due to specific features	£1.20 million (£1.20 million minus £0)
Air pollutant removal	£0.20 million (£0.20 million minus £0)
Carbon sequestration (from habitats)	£0.44 million (£0.44 million minus £0)
Habitat provision	£0.01 million (£0.01 million minus £0)
BGI bundled outcomes	£0.85 million (£0.85 million minus £0)
Net environmental cost/benefit from land take	***£3.15 million (£3.15 million minus £0)***

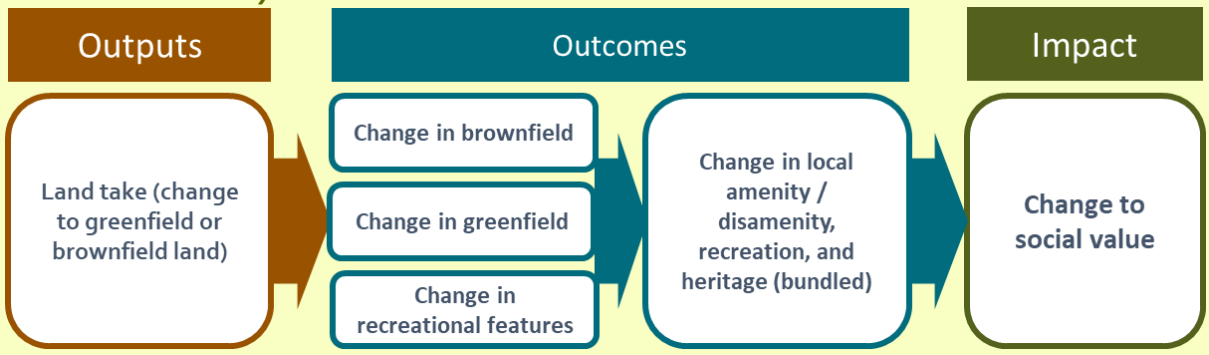
In Example A, the site is an existing brownfield site that is not expected to be developed for several years, and the public benefits from the counterfactual scenario are minimal. The intervention, however, provides public benefits from additional local amenity (both from the provision of additional features and from the earlier removal of the brownfield) and the inclusion of BGI in the intervention.

In Example B, the existing site provides public benefits in the form of local amenity due to existing greenspace. This is indicated by the negative value for (the loss of) greenspace in the intervention. However, the intervention also

increases local amenity by removing brownfield and providing additional features for the local community. This includes more varied provision of ecosystem services, with the transition from agricultural land to woodland and grassland (providing local biodiversity, carbon sequestration, and air pollutant removal benefits). The inclusion of BGI in the intervention also provides a range of additional public benefits. As no change occurs on the site under the counterfactual scenario, the impact values are all reported as £0.

Local environmental amenity

Local environmental amenity – Overview



ENHAT method: Changes to local amenity and recreation value are assessed on a per household basis, based on the (assumed) affected population – households a certain distance from the site. Values may be further differentiated by the distance of households to the intervention to account for distance decay effects. The suggested method is to value the per household amenity benefit/disbenefit based on distance, and then aggregate by distance bands over the affected population.

Information requirements for using ENHAT:

- Location and surrounding population density of the site (the affected population).
- Hectares of greenfield by type and quality (if any part of the site is greenfield).
- Hectares of brownfield (if any), as well as previous site usage and current condition.
- Extent of other brownfield land local to the site (if any part of the site is brownfield).
- Changes to recreational features/facilities (by type and number of feature/facilities).

Key evidence sources and supporting data (see ENHAT tab 8.1 for full references):

- Brownfield development values (eftec and SQW, 2022) – for sites that remove brownfield disamenity, as well as for estimates of recreation feature value (brownfield or greenfield developments).
- Household WTP for greenfield amenity (Gibbons et al, 2014).

Assumptions and other notes:

- It can be difficult to unbundle the general "amenity" of the local environment from recreation uses and values, particularly for changes to greenfield sites. Given the likely overlap, separate amenity/aesthetic values are not included in ENHAT. It is assumed that these are captured within recreation values. However, some types of sites (such as sites that are very visible on busy commuting routes) may impact the amenity of an area beyond just recreation. These values will not be captured via ENHAT and the wider valuation evidence is limited in this regard.
- Heritage impacts are also not valued separately – in part due to the potential overlap with recreation and brownfield amenity values, but also due to the limited nature of the valuation evidence in this area and its suitability for use in generalised terms. If an intervention is expected to have a significant impact on heritage features or the historic environment in a place, bespoke analysis should be considered.

Discount rate: 3.5% for years 1-30, 3% for years 31-60 (HM Treasury Green Book STPR).

Key sensitives: Estimated affected population used, per household values used, counterfactual used.

76. This section focuses on the changes to social value that result from changes to local environmental amenity due to land take. The outcomes that are covered in this section include recreation, local amenity, and local heritage.

77. These outcomes are treated as bundled in ENHAT as there is a risk of double counting and overlap if impacts are valued separately across the same beneficiary population. For example, improvements to recreational facilities or access are likely to improve the local amenity for all residents in the area, by offering more choice of sites to visit/use, or by providing a better experience at a site. Similarly, changes to local heritage features – e.g. conserving historic buildings as part of brownfield development – results in a similar change to social value in terms of improving the quality of a place for all. Since amenity and heritage features can be motivations for recreational use of sites – i.e. why a person regularly visits or uses a site – it can be difficult to disentangle effects and treat them as independent and additive outcomes in an economic appraisal.[27]

78. All housing development interventions are expected to change local environmental amenity, and the set of outcomes is sensitive to the specifics of the intervention – even on the same site. A key factor in appraising these impacts is to determine the beneficiary population and spatial area or distance over which values should be aggregated. Changes to local environmental amenity are unique in this guidance as they are the only outcomes that are sensitive to the amount of interaction households have with the site – the level of interaction is estimated using distance bands.

79. Note that within the beneficiary population, a household's distance to the site boundary may not reflect distance to a specific output or outcome. Take, for example, a very large site with a proposed intervention that will result in changes to both greenfield and brownfield land. If the brownfield land on that site were localised to one area – say for example an edge of the site – then the per household impact would be different for those households that are near to the brownfield area versus those that are on the other side of the overall site. Therefore, in some instance, what constitutes "local households" may need to be estimated on the basis of distance to the impacted area, as opposed to simple distance to the overall site.

ENHAT method for quantifying impacts of changes to local environmental amenity

80. The ENHAT approach to valuing impacts and aggregation differs according to whether a brownfield, greenfield, or mixed (including both greenfield and brownfield) development is being assessed (Table 7.2)

Table 7.2: Approach for valuing local environmental amenity impact.

Type of development	Affected population assumption and benefit evidence
Brownfield land only	Amenity values for the removal of brownfield disamenity (eftec and SQW, 2022) applied to households within a 2-mile (3.2km) radius of the brownfield land that is re-developed. This distance is based on the recommendations of eftec and SQW (2022).
Brownfield land with additional development features (e.g. recreation facilities)	Amenity values applied to households within a 2-mile (3.2km) radius of the brownfield land that is developed. Values for added features applied to households within a 1-mile (1.6 kilometre) radius of the added feature(s). Evidence from eftec and SQW (2022).
Greenfield land only	Per household amenity or disamenity values applied based on the ENCA Service Data book (ENCA, 2021; Gibbons, 2014) to each household within 1km (0.6mi) of the greenfield. Note that the habitats with estimated amenity values are freshwater (rivers,

[27] The Outdoor Recreation Valuation Tool (ORVal, 2023; available at: https://www.leep.exeter.ac.uk/orval/) provides another method to estimate recreational values for greenspace. This is a recreation demand model that would enable specific estimates of visitation rates and social benefits for a site, which is featured in the HM Treasury Green Book (2022). ORVal could be used as a sensitivity to estimate amenity benefits, versus the bundled approach used in ENHAT.

	lakes, and ponds), forest, and enclosed farmland. All other types were found to be insignificant in terms of amenity (Gibbons, 2014).
Brownfield land and greenfield land	Amenity values for the removal of brownfield disamenity (eftec and SQW, 2022) applied to households within a 2-mile (3.2km) radius of the brownfield land that is re-developed. This distance radius is based on the recommendations of eftec and SQW (2022). Per household amenity or disamenity values applied based on the ENCA Service Data book (ENCA, 2021; Gibbons, 2014) to each household within 1km of the greenfield. Note that the habitats with estimated amenity values are freshwater (rivers, lakes, and ponds), woodland, and enclosed farmland. All other types were found to be insignificant in terms of amenity (Gibbons, 2014).
Brownfield land, greenfield land, and recreational features	Brownfield development values (eftec and SQW, 2022) applied to households within a 2-mile (3.2km) radius of the brownfield land that is developed. Amenity or disamenity values applied based on the ENCA Service Data book (ENCA, 2021; Gibbons, 2014). Additional recreation feature values (eftec and SQW, 2022) applied to households within a 1 mile radius of the added recreational feature.

Note: the mixture of use of miles and kilometres are due to the differing sources of evidence (Gibbons,2014 uses km; eftec and SQW, 2022 uses miles). Miles are the default measure used in ENHAT.

Brownfield amenity

81. For brownfield sites, the ENHAT method estimates the annual social value for the removal of brownfield disamenity:

$$Annual\ social\ value\ due\ to\ changes\ in\ brownfield\ (disamenity\ removal)\ = \\ brownfield\ removal\ value\ (£\ per\ household\ per\ year) * number\ of\ households\ affected$$

where: $brownfield\ removal\ value = f(distance\ to\ site\ in\ miles, \\ site\ size\ in\ hectares, site\ condition)$

82. The steps required to implement the formula above using ENHAT are:

Step 1 – The user inputs the amount and condition of that brownfield land (i.e. structures will be remodelled/refurbished, will be removed/demolished, already removed/demolished) and the previous use of that site (residential, commercial, or industrial).

Step 2 – The user inputs an estimate of the amount of brownfield land near the site (either by 2-mile radius, 4-mile radius, or local authority area depending on the density of development near the site). Note that ENHAT has a default estimate for brownfield land in the local authority area that is applied if intervention-specific data is not available (e.g. data that might be available through local authority brownfield registers and GIS data).

Step 3 – The user inputs the amount of brownfield land that will be removed in hectares per year.

Step 4 – ENHAT applies the per household brownfield disamenity removal value from the lookup tables developed in the brownfield development research (eftec and SQW, 2022).

Step 5 – ENHAT estimates the affected population as the number of local households by distance bands from the intervention site, based on the (average) household density for the local authority area. Note that the user can modify these estimates if better data is available – for example through GIS analysis.

Step 6 – ENHAT aggregates the per household disamenity removal values over the estimate of the affected population by distance to estimate the total annual impact value.

Step 7 – ENHAT takes the annual value, calculates a 10-year present value, and then amortises the figure in an equivalent annual value that can be used to estimate benefits over a longer time horizon. This value is further modified by the percentage of brownfield removed each year in question, and these annual benefits are then discounted and aggregated over the appraisal period.[28]

Greenfield amenity

83. For greenfield, the ENHAT method estimates the annual social value for local greenspace:

$$Annual\ social\ value\ due\ to\ change\ in\ greenspace = households\ affected * amenity\ value\ for\ each\ household$$

where: $amenity\ value\ for\ each\ household = f(household\ preferences, distance\ to\ change, available\ substitutes)$

84. Several studies included in ENCA Service Databook (2021) provide estimates of the amenity or disamenity values to households based on local greenfield. In particular, Gibbons (2014) provides estimated amenity benefits values for enclosed farmland, woodland, and freshwater environments.[29]

85. The individual steps required to implement the formula above using ENHAT are:

Step 1 – The user inputs the number of households within 1km of the greenfield site, or uses the estimate provided in ENHAT based on average housing density.

Step 2 – The user inputs the initial greenfield on the site and the change in greenfield on the site over time by habitat type.

Step 3 – ENHAT aggregates the per household value over the estimate of the affected population to estimate the total annual impact value.

Step 4 – ENHAT discounts the annual impact and aggregates the sum over the appraisal period.

Additional feature amenity

86. For both brownfield and greenfield, the ENHAT method also estimates the annual social value for added recreation features:

$$Annual\ social\ value\ due\ to\ change\ in\ recreation\ features = additional\ feature\ value\ (£\ per\ household\ per\ year) * number\ of\ households\ affected$$

87. The individual steps required to implement the formula above using ENHAT are:

[28] The original research (eftec and SQW, 2022) used a 10-year time horizon for benefits aggregation. This means that those per household annual values estimated via eftec and SQW (2022) must be translated into equivalent annual value for use over the longer 60-year appraisal period. While the user could also take the direct values over 10-years, this is not compatible with interventions that occur over longer time horizons.

[29] The values from Gibbons (2014) are price differentials in home prices. These figures are annualised over the appraisal period.

Step 1 – The user inputs the recreational features that will be added. ENHAT identifies which of those features has the greatest value using the lookup table results from eftec and SQW (2022). ENHAT only uses the feature with the highest value, regardless of when features are delivered.

Step 2 – ENHAT estimates the affected population as the number of local households by distance bands from the intervention site, based on the (average) household density for the local authority area. Note that the user can modify these estimates if better data is available – for example through GIS analysis.

Step 3 – ENHAT aggregates the per household value over the estimate of the affected population to estimate the total annual impact value.

Step 4 – ENHAT takes the annual value, calculates a 10-year present value, and then amortises the figure in an equivalent annual value that can be used to estimate benefits over a longer time horizon. These benefits are discounted and aggregated over the appraisal period.

Box 7.1: Local environmental amenity (including recreation and heritage) – illustrative examples and discussion.

Example A: Brownfield illustrative example

In the intervention option, the brownfield is redeveloped over three years from 2025 to 2027, and hardscaped area is added as a part of the development. Two calculations are made in ENHAT. First, the benefits from brownfield disamenity removal are estimated. This is done by estimating benefits over distance bands, summing those benefits by year, and then discounting and aggregating.

ENHAT estimates of the amenity benefit of brownfield disamenity removal:

Distance band	Households	Disamenity removal benefit (£/hh/yr)	Annual amortised value (£ millions/yr)	**Total discounted value (60 years, £ millions)**
0 to 0.5 miles	2,000	£17.96	£0.01	£0.28
0.5 to 1 miles	2,000	£11.51	£0.01	£0.18
1-2 miles	10,000	£5.89	£0.02	£0.47
Total	**14,000**	**N/A**	**£0.04**	**£0.94 (rounding)**

In the counterfactual, it is assumed that the brownfield is removed in 2035 (10 years later, resulting in a PV of £0.68 million. The total discounted social benefit from the brownfield removal under the intervention is therefore £0.26 million (£0.94 in the intervention - £0.68 million in the counterfactual) over the 60-year appraisal period.

Second, the benefits from the delivery of additional features are estimated using a similar method by summing per household benefits over beneficiaries in different distance bands.

ENHAT estimates of the amenity benefit of additional features:

Distance band	Households	Feature benefit (£/hh/yr)	Annual amortised value (£ millions/yr)	**Total non-discounted value (60 years, £ millions)**
0 to 0.5 miles	2,000	£56.82	£0.04	£0.94
0.5 to 1 miles	2,000	£56.82	£0.04	£0.94
Total	**4,000**	**N/A**	**£0.07 (rounding)**	**£1.88**

The discounted total value for additional features is £1.88 million, and no additional features are expected to be delivered in the counterfactual. Therefore, the estimated local environmental amenity value for Option A over the counterfactual is around £2 million in present value terms over 60 years.

Change in amenity in Example A:

Category of environmental impact	**Difference in environmental outcomes due to the intervention option over the option without intervention**
Local environmental amenity due to brownfield	£0.26 million (£0.94 million minus £0.68 million)
Local environmental amenity due to greenfield	£0 (no change in the intervention or the counterfactual)
Local environmental amenity due to specific features	£1.88 million (£1.88 million minus £0 million)
Total change in amenity	***£2.14 million (£2.82 million minus £0.68 million)***

Key sensitivities are the per household values used and the number of households affected. For example, using the values from the high estimates within ENHAT, the estimate for the PV of the amenity impact to social value from the intervention becomes £3.74 million, the counterfactual becomes £1.02 million, and the difference is £2.72 million.

Example B: Greenfield illustrative example

In this example, the brownfield land to be redeveloped is significantly larger (5.2 hectares) than in Example A, but also has a lower surrounding population density, and therefore impacts fewer households in aggregate (10,000). The brownfield also does not contain any standing structures (condition of 'already removed'), and therefore has less impact relative to other brownfield conditions.

For the greenfield amenity estimates, the distance bands that are used to estimate household values are smaller – this is due to the evidence used (Gibbons et al., 2014). At a distance band of 1km from the site, the estimated number of households affected is estimated to be 1,300.

In the counterfactual, there is no development on the site (30 ha of enclosed farmland for 60 years). In the intervention, development begins in 2024 and removes all existing habitat (30 ha). 9ha of broadleaved woodland and 5 ha of semi-natural grassland are “created” in 2033. The annualised value (£/ha/hh) for the habitats in question are:

- Enclosed farmland: £6/ha/hh (for households within 1 km).
- Broadleaved woodland: £21/ha/hh (for households within 1 km).
- Semi-natural grassland: £6/ha/hh (for households within 1 km); assumes semi-natural grasslands provides at least as much amenity as enclosed farmland.

ENHAT estimates of the amenity benefit/disbenefit of changes to greenfield:

Habitat type	Amenity value (Gibbons et al., 2014; annualised value from ENHAT)	Change in land area	Change in social value (£/yr)	**Total discounted value (60 years)**
Broadleaf woodland (rural)	£21/hh/ha/yr * 1300 households	+9 hectares	£0.24 million/year	**-£1.29 million**
Semi-natural grassland	£6/hh/ha/yr * 1300 households	+5 hectares	£0.04 million/year	
Enclosed farmland	£6/hh/ha/yr * 1300 households	-30 hectares	-£0.25 million/year	
Total change in social value from greenfield amenity due to greenfield changes in the intervention				**-£1.29 million**

In Example B, brownfield is also removed and additional features delivered. See Example A above for an example of how those benefits are estimated. As there is no change under the counterfactual, the changes from the intervention result in an increase in local amenity of around £1.29 million. It is important to note that the current amenity provided by the site is also substantial for local households indicating this land has social value in its current form (the estimated flow of benefits removed by removing the farmland at the start of construction is around £250,000 per year, seen in the table above).

However, the intervention can also create social value, through the provision of recreational features and the removal of the brownfield disamenity, which outweighs the current greenfield amenity provided by the site.

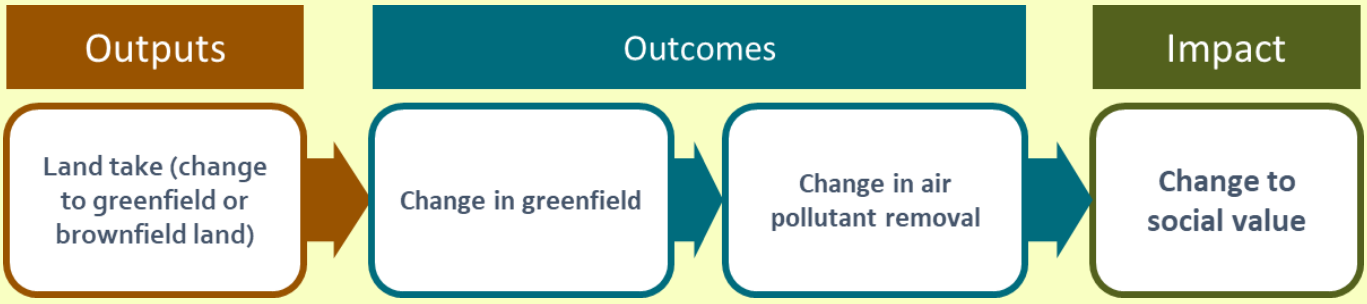
Change in amenity in Example B:

Category of environmental impact	**Difference in environmental outcomes due to the intervention option over the option without intervention**
Local environmental amenity due to brownfield	£1.73 million (£1.73 million minus £0)
Local environmental amenity due to greenfield	-£1.29 million (-£1.29 million minus £0)
Local environmental amenity due to specific features	£1.20 million (£1.20 million minus £0)
Total change in amenity	***£1.64 million (£1.64 million minus £0)***

Key sensitivities are the per household values used and the number of households affected. For example, the high estimate in ENHAT is £2.39 million, while the low estimate is £1.01 million.

Air pollutant removal by vegetation

Air pollutant removal – Overview



ENHAT method: Changes to air pollutant removal by vegetation are quantified on a per hectare basis by greenspace type (e.g. woodland, parkland and heath). Existing evidence is applied that estimates the change in the annual removal of air pollutants based on the greenspace changes (and sometimes the location). The change in social value is then valued according to existing guidance (Defra ENCA, 2023).

Information requirements for using ENHAT:

- Site location (local authority or region).
- Changes to hectares of greenspace by type and quality.

Key evidence sources and supporting data (see ENHAT tab 8.1 for full references):

- Air pollution removal for NOx, SO2, VOCs, PM2.5, and PM10 by habitat type combined with avoided life years lost, avoided hospital admissions, or avoided deaths due to that pollutant removal (Jones et al, 2017; CEH and eftec, 2019; ONS, 2020; Defra ENCA, 2021).
- Air pollutant removal for NH3 by habitat type combined with damage costs in terms of on-farm mitigation methods (Defra ENCA, 2021).

Assumptions and other notes:

- The air pollution removal rates are based on average rates for habitats and assumed air pollutant concentrations.
- The net change is calculated based on damage costs, including life years lost, hospital admissions, and deaths, and these values are likely to change over time.
- Full benefits/costs are assumed to occur from when the habitat is created/removed.

Discount rate: 1.5% for year 1-30 and 1.286% for years 31-60 (HM Treasury Green Book health values).[30]

Key sensitives: Air pollutant removal rates used, counterfactual used, local population density and population characteristics, timing of air pollutant removal rates.

88. This section focuses on the changes to social value that result from changes to air pollution removal due to vegetation and changes in the amount of greenspace. Note that this outcome is separate from changes in air

[30] Health discount rates (1.5% with a declining profile after 30 years) are recommended for "… risk to life values". Defra guidance on air quality impacts specifically recommend the use of the 1.5% declining discount rate in this case. www.gov.uk/government/publications/assess-the-impact-of-air-quality/air-quality-appraisal-damage-cost-guidance

pollution removal rates that are due to changes in blue-green infrastructure, which are considered to be an additional effect if included in an intervention.

89. ENHAT includes five air pollutants: PM2.5 and PM10, SO2, NOx, and VOCs (which affect ozone – O3). According to Defra guidance (Defra, 2023), these five pollutants have impact pathways that link to increased mortality and morbidity health impacts.[31] There is also evidence that can link changes in the environment – such as habitat provision – to changes in the concentration of these pollutants. Changes to air pollution, being mainly a health impact, are not expected to overlap with any other set of values, and therefore can be considered in isolation.

90. ENHAT assumes that the full social value of the change occurs upon creation of the habitat. As with the other ecosystem services estimated in ENHAT, sensitivity testing can be used to determine the influence of this assumption on the overall values, by changing the "delivery" date for habitats that require time to develop (e.g. delaying the delivery of forest by 10 years in the inputs).

ENHAT method for quantifying impacts of changes to air pollutant removal

91. For any intervention that results in a change to greenspace, the overall formula to estimate the annual social value due to air pollutant removal from that greenspace is:

$$\begin{aligned} &Annual\ social\ value\ of\ change\ in\ air\ pollutant\ removal \\ &\quad = change\ in\ amount\ of\ habitat\ present\ (hectares) \\ &\quad * \ air\ pollutant\ removal\ rate\ for\ that\ habitat\ (tonnes\ per\ hectare\ per\ year) \\ &\quad * damage\ cost\ value\ for\ that\ pollutant\ (£\ per\ tonne) \end{aligned}$$

92. The individual steps to implement the equation above using ENHAT are:

    Step 1 – The user inputs the amount of greenspace that is impacted (e.g., created or removed) by type(s) of habitat in hectares, as well as whether the site is urban, semi-urban, or rural.

    Step 2 – ENHAT multiplies the air pollution removal values for each habitat by the change in area of that habitat (the health value from a hectare of habitat is estimated in Jones et al, 2017).

    Step 3 – ENHAT sums and discounts the annual impact and aggregates over the appraisal period.

[31] https://www.gov.uk/government/publications/assess-the-impact-of-air-quality/air-quality-appraisal-impact-pathways-approach

Box 7.2: Air pollutant removal – illustrative examples and discussion.

Example A: Brownfield illustrative example

There is no substantial greenfield that would be created or modified as a part of this intervention or the counterfactual, and therefore there is no social value for air pollutant removal as a part of this site.

Example B: Greenfield illustrative example

The Defra ENCA services databook (2023) provides estimates for the value of air pollutant removal for key habitats (from ONS (2022) update to Jones et al, 2017).

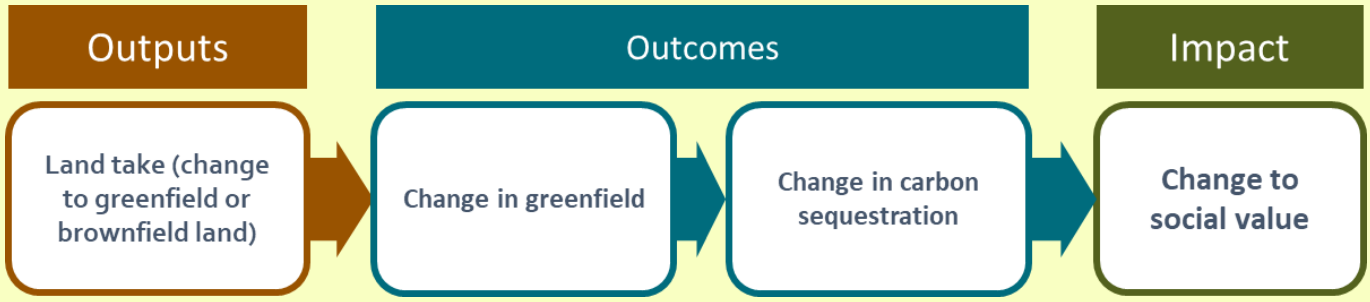
ENHAT estimates of the social value impact of air pollutant removal:

Change in habitat in intervention	Indicative air pollutant removal value (from ONS (2022) update to Jones et al, 2017)	Change in land area	Change in social value (£/yr)	**Total discounted value (60 years)**
Broadleaf woodland (rural)	£453/ha/yr	+9 hectares	£4,075/year	£0.24 million
Semi-natural grassland	£680/ha/yr	+5 hectares	£3,399/year	
Enclosed farmland	£30/ha/yr	-30 hectares	-£900/year	-£0.04 million
<u>Difference</u> in air pollutant removal due to the intervention option over no change to the site				***£0.20 million***

When compared with the amenity value for habitats, it is evident that the air pollutant removal values are modest, but they are still material. The value is also highly reliant upon the type of habitat (e.g. urban woodland has an estimated indicative per hectare value of almost 40 times that of enclosed farmland). If the benefits for the woodland are not realised until later (due to the time it takes woodland to grow, then the benefits would be less, but still positive. A delay of 10 years for the woodland ("delivered" by 2043/44) reduces the PV by £0.03 million (to a benefit from air pollutant removal of £0.17 million).

Carbon sequestration

Carbon sequestration – Overview



ENHAT method: Changes to greenspace are quantified on a per hectare basis by greenspace type (e.g. woodland, parkland and heath). Existing evidence is applied that estimates the changes in annual carbon sequestration based on the change in greenspace (by type) and the location. The change in social value on an annual basis can then be estimated based on these changes in carbon sequestration using DESNZ carbon values.

Information requirements for using ENHAT:

- Changes to hectares of greenspace by type and quality.

Key evidence sources and supporting data (see ENHAT tab 8.1 for full references):

- Carbon sequestration rates for various habitats (Natural England, 2021).
- Carbon values (non-traded only) (DESNZ, 2021).

Assumptions and other notes:

- Habitats continue to provide carbon sequestration over the entire appraisal period.
- Lost habitat only creates a net loss to carbon sequestration rate, and not an immediate increase in emissions from the habitat removal.
- The full carbon sequestration rate for each habitat is assumed to occur from when the habitat is created/removed (i.e. there is no 'lag' for habitats to reach the maximum sequestration rate).

Discount rate: 3.5% for years 1-30, 3% for years 31-60 (HM Treasury Green Book STPR).

Key sensitives: Carbon sequestration rates used for habitats, DESNZ value used (low, central, or high), counterfactual used.

93. This section focuses on the changes to social value that result from changes to carbon sequestration due to greenfield land take. Note that this outcome is separate from changes in carbon sequestration that are due to changes in blue-green infrastructure (see later in this section), which is estimated as an additional effect (if included in an intervention).

94. Changes to carbon sequestration, being a global impact, are not expected to overlap with any other set of values.

95. ENHAT assumes that the full sequestration rate occurs upon creation of the habitat. As with the other ecosystem services estimated in ENHAT, sensitivity testing can be used to determine the influence of this

assumption on the overall values, by changing the "delivery" date for habitats that require time to develop (for example, delaying the delivery of forest by 10 years in the inputs).

ENHAT method for quantifying impacts of changes to carbon sequestration

96. The overall formula to estimate the annual social value due to carbon sequestration is:

$$\begin{aligned} &Annual\ social\ value\ impact\ of\ change\ to\ carbon\ sequestration \\ &\quad = change\ in\ amount\ of\ habitat\ by\ type\ (hectares) \\ &\quad * \ carbon\ sequestration\ rate\ for\ that\ habitat\ (tonnes\ per\ hectare\ per\ year) \\ &\quad * carbon\ value\ (£\ per\ tonne) \end{aligned}$$

97. The individual steps to implement the equation above using ENHAT are:

Step 1 – The user inputs the amount of greenspace that is changing by type(s) of habitat in hectares.

Step 2 – ENHAT applies the annual carbon sequestration rate for the habitat(s) that are changing in area.

Step 3 – ENHAT sums the change in carbon sequestration due to the habitat changes.

Step 4 – ENHAT multiplies the annual change in carbon sequestration rate by the DESNZ carbon non-traded values.

Step 5 – ENHAT discounts the annual impact and aggregates the sum over the appraisal period.

Box 7.3: Carbon sequestration – illustrative examples and discussion.

Example A: Brownfield illustrative example

There is no substantial greenfield that would be created or modified as a part of this intervention or the counterfactual, and therefore there is no social value for carbon sequestration as a part of this site.

Example B: Greenfield illustrative example

The carbon sequestration rates of various habitats are provided within the ENCA services databook (2023).

ENHAT estimates of the social value impact of carbon sequestration:

Habitat	Carbon sequestration rate	Change in land area	Annual carbon sequestration	**Total discounted value (60 years)**
Broadleaf woodland (rural)	6.70 tonnes CO_2e/ha/yr	+9 hectares	62.3 tonnes CO_2e/ha/yr	£0.47 million[1]
Semi-natural grassland	0.40 tonnes CO_2e/ha/yr	+5 hectares		
Enclosed farmland	0.11 tonnes CO_2e/ha/yr	-30 hectares	3.2 tonnes CO_2e/ha/yr	-£0.03 million[1]
Difference in carbon sequestration due to the intervention option over no change to the site				***£0.44 million***

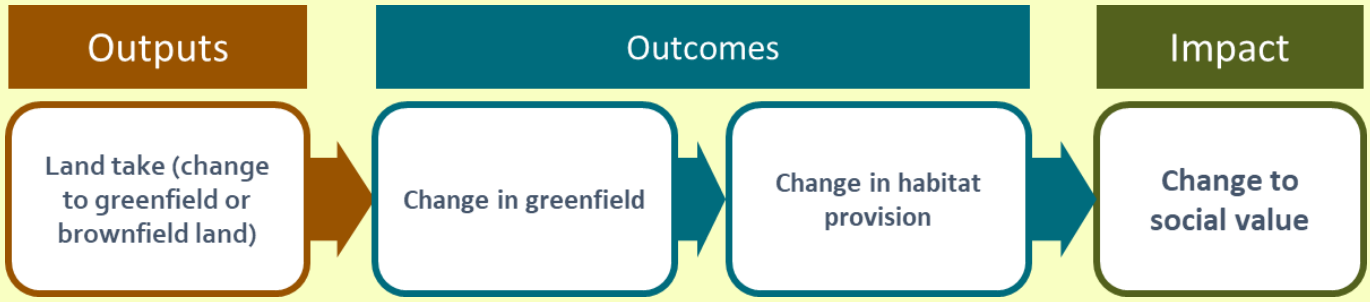
Note 1: The multiplication of the annual carbon sequestration rate by the carbon value is skipped in the above table, as the carbon value changes over time.

The carbon sequestration values in these cases are similar to those of the air pollutant removal values. Again, when compared with the amenity value for habitats, it is evident that these values are modest, but they are still material to the overall appraisal on the intervention case.

Using the same sensitivity test on the time until the full ecosystem service is realised as outlined in Box 7.2 (a delay of 10 years) gives a similar result – the overall benefits are less (PV of £0.32 million), but still material and positive overall.

Habitat provision

Habitat provision (biodiversity) – Overview



ENHAT method: Changes to greenspace are quantified on a per hectare basis by greenspace type (e.g. woodland, parkland and heath). Existing evidence is then applied that estimates the change in the value of habitat provision based on the change in greenspace (by type) and the location.

Information requirements for using ENHAT:

- Change to habitats by type and area (hectares).

Key evidence sources and supporting data (see ENHAT tab 8.1 for full references):

- Habitat provision values for various habitats (Christie et al, 2011).

Assumptions and other notes:

- Habitats that are included in an intervention provide the whole benefit value, regardless of their age and quality.
- There is a risk of double counting with recreation and amenity, as well as many of the ecosystem services such as air pollutant removal and carbon sequestration, which are covered elsewhere in this guidance. The approach in ENHAT aims to limit this risk by applying what can be interpreted as a non-use value for habitat provision.
- The full habitat value for each habitat is assumed to occur from when the habitat is created/removed (i.e. there is no 'lag' for habitats to reach the maximum provision value).

Discount rate: 3.5% for years 1-30, 3% for years 31-60 (HM Treasury Green Book STPR).

Key sensitives: Habitat provision values used, counterfactual used.

98. This section looks at the impact of greenfield site developments on habitat provision (wildlife and plants), and the associated changes in social value. Note that as amenity from greenfield is covered elsewhere in this guidance, the value estimated is intended to only reflect non-use[32] values (such as altruism and existence value) for biodiversity conservation. See "Side Note: Valuing Biodiversity" for a discussion of the various values of biodiversity and how they fit within this guidance.

[32] Non-use value derives from the knowledge that the natural environment is maintained. It can be based on three different motives: (a) bequest values, where individuals value knowing that future generations will have access to natural environment (just as they have benefited from inheriting from previous generations, such as ancient woodland); (b) altruistic values, where individuals value the enjoyment of natural environment by others in the current generation (such as beaches in a distant part of the country); and (c) existence values, where individuals value the existence of habitats or species for themselves irrespective of any actual or planned use of it now or in the future (Defra ENCA, p17).

99. Note that the approach included in ENHAT is separate to the provision that will be required as part of the Environment Act 2021 "biodiversity gain objective" that new developments will need to deliver. It is based on estimating the value of habitat provision according to evidence on economic preferences as part of a VfM calculation, rather than the measurement of net gain through habitat intactness as per the (non-monetary) "Biodiversity Metric".[33] As of February 2024, development must deliver a biodiversity net gain (BNG) of 10%, either in the form of offsets or by supplying habitat on site.[34] The benefits and costs of any interventions affected biodiversity that are made on site should still be counted through ENHAT.

Side note: Valuing biodiversity

Care should be taken with respect to valuing impacts on biodiversity as there is a risk of double-counting. Biodiversity generates economic value when it contributes to social value. Such contributions can take two basic forms:

- Direct contribution: some aspect of biodiversity is the (final) good/service that an individual benefits from, such as wild species conservation.
- Indirect contribution: some aspect of biodiversity is an intermediate service that contributes to the production of a (final) good/service that an individual benefits from, such as timber – which in principle at least, would be reflected in LVU calculations.

The indirect contribution includes the fundamental role of biodiversity in ecosystem functioning and processes that underpin ecosystem service provision. This includes processes such as biomass production, soil organic carbon storage, and pollination. These underpinning processes are often classified as 'supporting services' or 'intermediate services'. The economic value of biodiversity in this regard is embedded within values for the final benefits from ecosystem service provision – or at least the value for the current flow of final benefit (see below).

The direct contribution is relatively straightforward to conceptualise if biodiversity is characterised in terms of habitats or charismatic species. People benefit in a variety of ways, including through nature-based recreation and the appreciation of natural environment and scenic views (e.g. use values), as well as through non-use motivations – either a pure existence value, and/or because they feel better off knowing that others benefit, now or in the future (altruistic and bequest motives).

Including the value of the direct contribution of biodiversity alongside values for other final ecosystem benefits does not result in double-counting. The risk of double-counting arises in an appraisal if values are also included for intermediate and supporting services that are dependent on aspects of biodiversity – for example a value for pollination (supporting service) alongside the value of crop production (final good).

In practice the bigger risk for appraisal is that only a partial account of the importance of biodiversity is possible. There are critical gaps in scientific and economic evidence available for appraisals concerning the value of biodiversity as a stock that confers resilience in ecosystems to disturbances and shocks and is therefore fundamental to sustaining flows of benefits into the future. This also requires an assessment beyond the marginal changes brought about by a single intervention to understand cumulative effects – i.e. national level assessments that set bounds for acceptable impacts on biodiversity.

[33] See: https://www.gov.uk/guidance/biodiversity-metric-calculate-the-biodiversity-net-gain-of-a-project-or-development
[34] See: https://www.gov.uk/government/collections/biodiversity-net-gain

ENHAT method for quantifying impacts of changes to habitat provision

100. The overall formula to estimate the social value from habitat provision is:

$$\begin{aligned} &Annual\ social\ value\ impact\ of changes\ to\ habitat\ provision \\ &\quad = change\ in\ amount\ of\ habitat\ by\ type\ (hectares) \\ &\quad * \ biodiversity\ vales\ (non\ use\ value)\ for\ that\ habitat\ (£\ per\ hectare\ per\ year) \end{aligned}$$

101. The individual steps to implement the equation using ENHAT are:

Step 1 – The user inputs the amount of greenspace that currently exists and the expected changes by type(s) of habitat in hectares.

Step 2 – ENHAT applies the biodiversity values for the change in habitat(s) by year from Defra ENCA (2023).

Step 3 – ENHAT sums the changes in benefit values across all of the habitats by year.

Step 4 – ENHAT discounts the annual impact and aggregates the sum over the appraisal period.

Box 7.4: Habitat provision – illustrative examples and discussion.

Example A: Brownfield illustrative example

There is no substantial greenfield that would be created or modified as a part of this intervention or the counterfactual, and therefore there is no social value for habitat provision as a part of this site.

Example B: Greenfield illustrative example

The evidence on the value of habitat provision is limited, but values are provided within the Defra ENCA services databook (2021) for a few key habitats.

ENHAT estimates of the social value impact of habitat provision:

Habitat	Habitat provision value	Change in land area	Change in annual habitat provision	**Total discounted value (60 years)**
Broadleaf woodland (rural)	£96/ha/yr	+9 hectares	£918/yr	£0.01 million
Semi-natural grassland	£11/ha/yr	+5 hectares		
Enclosed farmland	£5/ha/yr	-30 hectares	£160/yr	£0.00 million
Difference in habitat provision due to the intervention option over no change to the site				***£0.01 million***

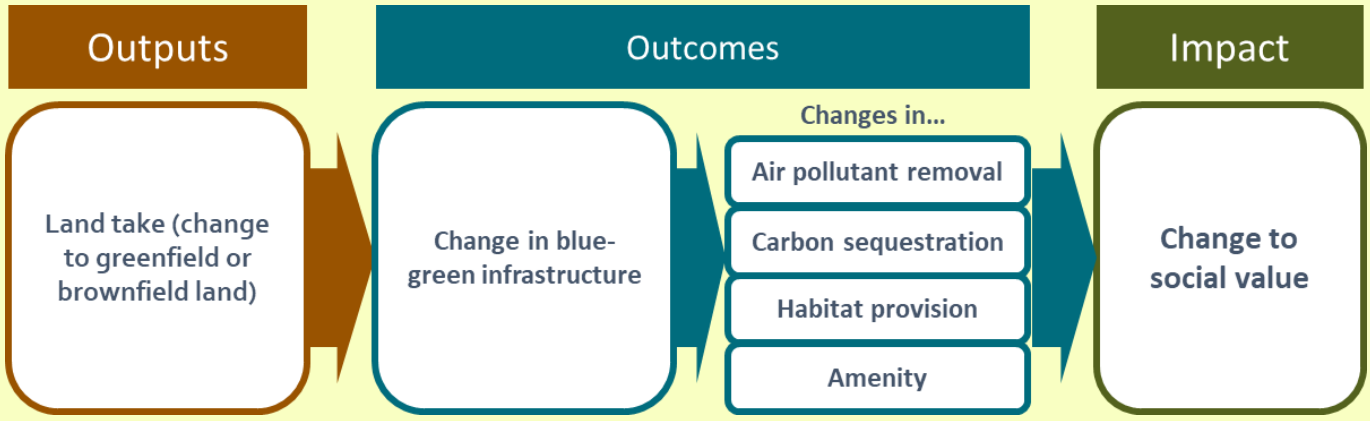
Habitat provision values are observed to be small in comparison with carbon sequestration, local amenity, and air pollutant removal services from habitats. The per hectare values used here are sourced from Christie et al. (2011) and this evidence should be reviewed and updated if possible in the coming years. Other research on habitat provision (such as Browning et al., 2024[35]) indicates that the national level values for habitat provision and species recovery actions are substantial, and therefore the per hectare values used here are likely to underestimate the social value of those habitats.

As the value of habitat provision is very small, sensitivity testing around the timing of delivery has a minimal impact on the overall interpretation of the change in habitat provision.

[35] Browning, E., Christie, M., Czajkowski, M., Chalak, A., Drummond, R., Hanley, N., ... & Provins, A. (2024). Valuing the economic benefits of species recovery programmes. People and Nature, 6(2), 894-905. https://besjournals.onlinelibrary.wiley.com/doi/full/10.1002/pan3.10626

Enhanced options for blue-green infrastructure

Blue-green infrastructure (combined outcomes valuation) – Overview



ENHAT method: As a part of this project, eftec and SQW (2022) developed a lookup table that can be used at the OBC stage to estimate the environmental impacts of various sizes and qualities of BGI that might be used as a part of a new housing development, including through the provision of sustainable urban drainage systems (SuDS). This look-up table was informed by the guidance provided by CIRIA (B£ST)[36], to ensure alignment between ENHAT and other appraisal methods. Note that the CIRIA guidance and B£ST tool are not used directly at any point in this guidance, but there is alignment between evidence sources and general methods.

Information requirements for using ENHAT:

- Location of intervention.
- Site size in hectares.
- Approximate percentage of the developments surface area that will be dedicated to BGI.
- Approximate quality of that BGI using categories provided in ENHAT.

Key evidence sources and supporting data (see ENHAT tab 8.1 for full references):

- Integrated assessment of BGI (eftec and SQW, 2022), which is informed by the ENCA services databook (2021) and CIRIA (B£ST) to ensure a level of consistency with the evidence that could be used in stand-alone assessments of BGI in the sector. While the integrated assessment is considered adequate and fit for purpose in the OBC stage of appraisal, the full assessment provided in the B£ST tool may be more appropriate where extensive BGI is used and at later stages of the appraisal process.

Assumptions and other notes:

- It is assumed that there is no overlap between changes to habitats and BGI implementation. This assumption requires that the appraisal practitioner differentiates between the two and does not double count. Regardless, there is a risk of double counting between this set of benefits, and the carbon sequestration and habitat provision methods also outlined in the guidance.

Discount rate: 3.5% for years 1-30, 3% for years 31-60 (HM Treasury Green Book STPR).

Key Sensitivities: The accuracy of the description of the BGI to be implemented, underlying values for ecosystem service provision, counterfactual used.

[36] See: Benefits EStimation Tool (B£ST) – valuing the benefits of blue-green infrastructure. Available from: https://www.susdrain.org/resources/best.html

102. Blue green infrastructure (BGI) refers to natural features (such as plants, trees, swales, natural drainage systems, etc) within an area, usually purposely placed such that they provide ecosystem services and amenity. Sustainable urban drainage systems (SuDS) are a subset of BGI. The expected outcomes from including BGI as part of a housing intervention are:

- Increased air pollution removal.
- Increase habitat provision.
- Improved carbon sequestration.
- Improved local amenity and recreation opportunities.
- Improved surface flooding regulation (not estimated in ENHAT).

103. eftec and SQW (2022) developed a look-up table that can be used to include the combined value of different levels of BGI. This is integrated into ENHAT.

ENHAT method for quantifying impacts of changes to blue-green infrastructure

104. For any intervention that includes BGI, the overall formula to estimate the social value of that BGI is:

$$Annual\ social\ value\ impact\ of\ change\ to\ BGI\ provision = size\ of\ the\ site\ (ha) * benefit\ vales\ for\ BGI\ (£/ha/yr\ )$$

Where: $Benefit\ values\ for\ BGI\ (£/ha/yr\ ) = f(quality\ of\ BGI, number\ of\ households\ affected)$

105. The individual steps to implement the equation using ENHAT are:

Step 1 – The user estimates the amount of land being developed (in hectares, not including any land that is counted as greenfield habitat) and the standard of BGI using the categories provided in ENHAT.

Step 2 – ENHAT applies the value for the specific standard and amount of BGI to the number of households to get an annual benefit value.

Step 3 – ENHAT discounts the annual impact and aggregates the sum over the appraisal period.

Box 7.5: Blue-green infrastructure – illustrative examples and discussion.

Example A: Brownfield illustrative example

In the intervention, blue-green infrastructure (BGI) is implemented over the entirety of the development with a standard of "B", which represents a high density of street trees and around 10% of the total development area being used for BGI (such as bioswales).

ENHAT estimates of the social value impact of BGI provision (Example A):

Physical change	BGI element	Estimated annual benefit	Total annual benefit	**Total discounted value (60 years)**
41 small trees 29 medium trees 0.08 hectares of habitat	Air pollutant removal	£550/year	£1,275/year (differences due to rounding)	**£0.04 million**
	Carbon sequestration	£425/year		
	Habitat provision	£6/year		
	Additional amenity	£300/year		

However, this is not the total benefit of the intervention, as the counterfactual is also expected to deliver BGI, but at a lower level (estimated by ENHAT as a PV of £0.01 million). Therefore, the benefit of the change BGI under the intervention is £0.03 million (£0.04 - £0.01 million).

Example B: Greenfield illustrative example

This site is much larger than the brownfield example, and the development is much less dense. The intervention will be housing development occurring over 19 hectares and a standard of "C" – a "best" implementation – for BGI (with 15% of the residential development area being BGI of good quality).

ENHAT estimates of the social value impact of BGI provision (Example B):

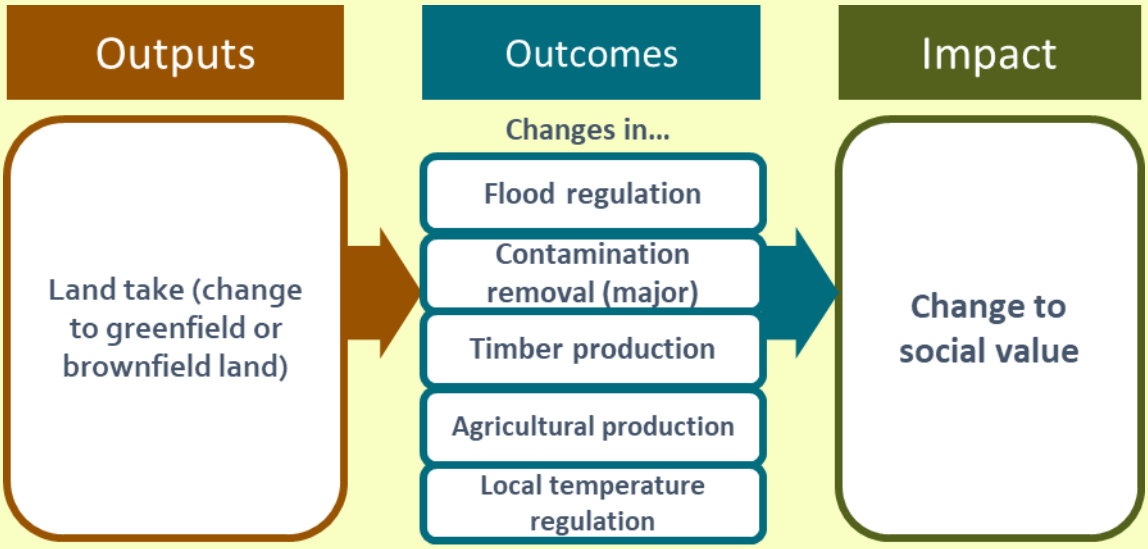
Physical change	BGI element	Estimated annual benefit	Total annual benefit	**Total discounted value (60 years)**
1020 small trees 850 medium trees 2.55 hectares of habitat	Air pollutant removal	£15,000/year	£28,400/year	**£0.85 million**
	Carbon sequestration	£12,000/year		
	Habitat provision	£200/year		
	Additional amenity	£1,200/year		

In this case, the counterfactual does not deliver any BGI, and therefore the total PV of the change in BGI delivered by the intervention is £0.85 million.

The difference between these two examples illustrates the difference in the potential scale of impact of BGI as a public benefit. BGI may also provide private benefits – in the form of LVU – which are not estimated here but should be considered (at least) in qualitative terms.

Other impacts due to land take

Other impacts due to land take – Overview



There are several additional impacts from land take that are identified, but not quantified, in this guidance:

- **Flood regulation:** Changes to greenfield can impact water storage from vegetation, which in turn can have an impact on local flood regulation or surface water management. In consultation with Homes England, it was determined that the minimum guidance set-out by the Environment Agency and their flood risk assessments should result in limited differentiation between short-list options at the OBC stage. Notwithstanding, Defra ENCA (2023) does reference evidence that could be used to appraise water storage benefits by greenfield sites, but the currently available valuations are subject to some conceptual limitations and therefore not included within ENHAT at this stage.[37]

- **Contamination removal (major):** Interventions that will result in major contamination removal should be accompanied by bespoke valuations and appraisal which are outside of the scope of this guidance. Several resources are available from the Environment Agency that describe processes to assess and manage contamination risk.[38] The Environment Agency Land Contamination Risk Management (LCRM[39]) includes guidance on options appraisal. The guidance indicates that these assessments may only be carried out by qualified persons – those with qualifications and/or professional experience in contaminated land management.

- **Timber production:** Timber production is a private benefit, and as such should be included in LVU. The quantification of the impact can be accomplished using market values for timber and estimated production rates for the land.

[37] The two pieces of evidence currently available are Broadmeadow et al (2023); available at: https://cdn.forestresearch.gov.uk/2019/02/final_report_valuing_flood_regulation_services_051218.pdf and Fitch et al (2023); available at randd.defra.gov.uk/ProjectDetails?ProjectId=20501. Both reports contain several caveats relating to the monetary evidence and the specification of the counterfactual, which limit their applicability to application in an economic appraisal setting.
[38] https://www.gov.uk/government/collections/land-contamination-technical-guidance
[39] https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm

- **Agricultural production:** Agricultural production is a private benefit, and as such should be included in LVU. The quantification of the impact can be accomplished using market values for agricultural outputs and estimated production rates for the land.

- **Local temperature regulation:** An accurate appraisal for land-take impacts due to changes in local temperature regulation requires detailed modelling local to the site, as the impacts vary widely based on site-specific characteristics, other local greenspace or urban centres, and the local climate of the site. Impacts estimated could be based on the avoided costs from climate control that would be necessary in the absence of temperature regulation benefits from greenspace. eftec et al (2018) estimates an average value of temperature regulation services of £5,580 per hectare for woodland in London, but the estimate for Greater Manchester is much lower at £312 per hectare of woodland.

These impact areas should be periodically revisited to ensure alignment with the MHCLG guidance, Environment Agency guidance, as well as any additional evidence that may support the development of specific methods for these impact areas.

8. Environmental Impacts of Construction

This section covers the environmental impacts of the construction phase of a new housing development:

- Construction impacts occur due to the resources used during construction, construction activities (e.g. emissions), as well as the temporary disruption impacts. For example, construction will cause some forms of local disamenity and disruption – such as noise pollution and congestion. Construction may also result in temporary or permanent reductions to habitat provision, depending on its physical footprint during the construction phase. Finally, construction uses resources and energy, and will therefore create impacts such as carbon emissions.

- The impacts for which evidence and methods are included in ENHAT are:
  - **Embodied carbon emissions.**

- The impacts that are also considered in this guidance, but are not quantified in ENHAT are:
  - **Broader resource use and waste.**
  - **Local disamenity (including congestion, light, and noise).**
  - **Air pollution.**
  - **Habitat provision.**

- These impacts are not quantified as the local disamenity and air pollution caused by construction can be: (i) difficult to estimate, especially at the OBC stage; and (ii) potentially an area where Homes England will not have much influence, outside of requiring that already established good practice guidance be followed on their interventions (e.g. "considerate constructors" principles).

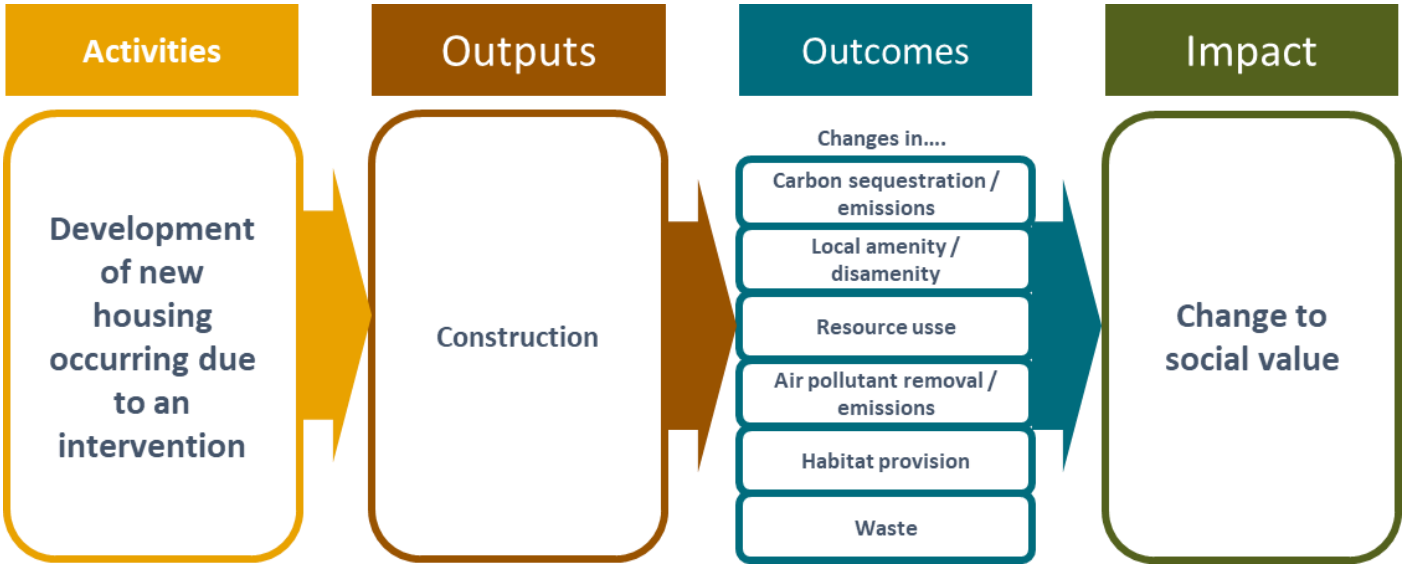
- **Valuation of construction impacts are sensitive to the scope considered.** For example, whole life carbon assessments have several well-established stages, which includes end of life (emissions that occur due to demolition, or refurbishment). The current evidence for the full scope of impacts is rarely available, and in most cases Homes England would also have little influence over certain aspects of the intervention (such as what infrastructure) is constructed on a site. The scope considered for the individual impact areas are explored more thoroughly in those sub-sections.

- **Resource use impacts are limited to carbon assessments.** There are other environmental impacts from resource use (mining impacts, timber impacts, etc), but these are not considered in this guidance as the evidence on these links is not developed adequately to be used in appraisal at this stage. Currently carbon emissions are the only impact assessed from resource use.

106. Construction that results from housing development interventions will result in several outcomes that temporarily reduce local environmental amenity and quality, as well as use resources and cause emissions that can have local, regional or global impact. Impacts from construction is unavoidable, as construction is an inherently disruptive and resource using process. However, certain design and implementation decisions can be made to attempt to reduce those impacts, such as using designs that are less carbon intensive.

107. Figure 8.1 shows the high-level logic chain for construction on greenfield and brownfield sites combined. It is not expected that there will be any systematic difference between greenfield and brownfield interventions in terms of construction impacts.

Figure 8.1: Environmental impact logic chain for construction.



108. Many construction outcomes and their impacts are not currently well evidenced primarily in terms of the data available on the intensity or quantity of "typical" impacts during construction. Homes England is also likely to have limited influence over some outcomes, as they will be determined by factors such as travel distances for construction materials (e.g. transport emissions), the layout of local road network (e.g. congestion), or the construction duration (e.g. number of homes plus other considerations).

109. Table 8.1 summarises the approximate level of influence Homes England is expected to have, data availability, evidence quality, as well as the overlap with other sections of this guidance and the length and direction of impact. Based on this assessment, only embodied carbon emissions are currently included in ENHAT. The other impact areas are considered more broadly in this guidance, but specific methods and evidence source(s) are not provided.

Table 8.1: Construction outcomes.

Construction outcome	Homes England influence	Availability of data at OBC	Quality of valuation evidence	Overlap with other sections	Expected length of impact	Expected direction of impact
Local disamenity (including congestion, light, and noise)	Minimal	Minimal	Poor	None	During construction	Negative
Resource use and waste	Moderate	Moderate	Moderate	Carbon emissions	Measured at time of use/disposal	Negative
Embodied carbon emissions	Moderate	Moderate	Good	None	Measured at time of emission	Negative
Air pollution	Minimal	Minimal	Good	None	During construction	Negative
Habitat provision	Moderate	Moderate	Minimal	Overlap with land-take	During construction	Negative

Box 8.0: Construction – illustrative examples summary.

Two outcomes are assessed by ENHAT for the construction phase – the social impact of the carbon emissions, and the private costs of any measures taken to reduce those emissions. Details of the ENHAT estimates for each are discussed in the following sections. As an introduction to the potential magnitude of the impacts from construction, a summary of the two illustrative examples (A and B) are provided here (see Section 6; Table 6.2 for the intervention profiles).

Example A: Brownfield example, construction impacts

(notes: positive values indicate benefits; negative values indicate costs)

Category of environmental impact	**Difference in environmental outcomes due to the intervention option over the option without intervention**
Embodied carbon (social impact of emissions)	-£0.03 million (-£0.25 million minus -£0.22 million)

Example A: Brownfield example, selected private and delivery costs[40] construction impacts

(notes: positive values indicate benefits; negative values indicate costs)

	Difference in private costs for delivering selected aspects due to the intervention option over the option without intervention
Improved construction methods to reduce embodied carbon	-£0.44 million (-£1.84 million minus -£1.40 million)

Example B: Greenfield example, construction impacts

(notes: positive values indicate benefits; negative values indicate costs)

Category of environmental impact	**Difference in environmental outcomes due to the intervention option over the option without intervention**
Embodied carbon (social impact of emissions)	-£3.19 million (-£3.19 million minus -£0)

Example B: Greenfield example, selected private and delivery costs[41] construction impacts

(notes: positive values indicate benefits; negative values indicate costs)

	Difference in private costs for delivering selected aspects due to the intervention option over the option without intervention
Improved construction methods to reduce embodied carbon	£0

As shown in Example A, the cost of construction techniques that reduce embodied carbon over current standard practice (-£1.84 million for 76 homes) are comparatively high versus the value of the reduced carbon emissions (-£0.25 million). However, if that construction were to become cheaper, or carbon emissions more costly, then this

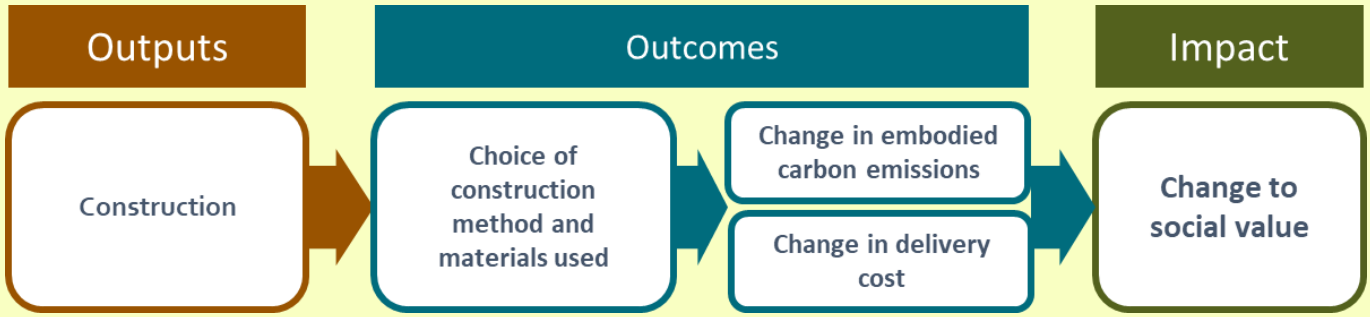
[40] Some estimates of private costs were produced in the development of this guidance and have been included in ENHAT. These estimates should be treated with caution and project specific estimates based on the current market would be preferable. Further detail can be found in the background report. It should also be noted that the private costs presented in these tables cannot simply be compared to the environmental impact estimates to reach a conclusion on value for money. These must be fed into a broader economic appraisal that includes, e.g. public sector costs and estimates of LVU. The environmental standards included in each option may impact on these broader elements of the appraisal (e.g. building to a higher standard may impact on Gross Development Values).

[41] Some estimates of private costs were produced in the development of this guidance and have been included in ENHAT. These estimates should be treated with caution and project specific estimates based on the current market would be preferable. Further detail can be found in the background report. It should also be noted that the private costs presented in these tables cannot simply be compared to the environmental impact estimates to reach a conclusion on value for money. These must be fed into a broader economic appraisal that includes, e.g. public sector costs and estimates of LVU. The environmental standards included in each option may impact on these broader elements of the appraisal (e.g. building to a higher standard may impact on Gross Development Values).

balance could change. As shown in Example B, the total embodied carbon for housing interventions using current methods represents a substantial environmental impact (-£3.19 million).

Embodied carbon emissions

Embodied carbon emissions – Overview



ENHAT method: Embodied carbon emissions are assessed on a per tonne emitted basis, using the Department for Energy Security & Net Zero (DESNZ) carbon values (non-traded minus traded values). Estimates for the carbon emissions from an intervention are based on the Daedalus Environmental and SQW embodied carbon tool (2022). This tool estimates embodied carbon based on a typology of homes as well as a set of construction standards. Private costs are also estimated from Daedalus Environmental and SQW (ibid).

Information requirements for using ENHAT:

- Location of intervention.
- Number and type of homes constructed by year.
- Construction standard used for those homes by year.

Key evidence sources and supporting data (see ENHAT tab 8.1 for full references):

- Daedalus Environmental and SQW embodied carbon tool (2022).
- DESNZ carbon values (traded and non-traded values).

Assumptions and other notes:

- Embodied carbon emissions are those emissions that arise from the construction of homes. There are other (likely) carbon emission sources in a housing intervention, such as occupational carbon emissions, which are also considered separately (see Section 9). However, carbon emissions from transport and the construction of infrastructure are omitted from this guidance. This is due to a lack of available data for those types of emissions at the OBC stage.
- This section includes an estimate of the increase in cost for improved interventions, expressed as the capital expenditure (CAPEX) for a specific home type at a specific construction standard. These estimates are built into the Daedalus Environmental and SQW embodied carbon tool (2022) and were included as it was considered unlikely that information on the costs of various construction methods would be readily available otherwise. These cost data can then be used to support development appraisals.
- Some of the environmental costs of carbon emissions are already captured in private costs through the traded carbon values – therefore the carbon values used to value the social impact are the non-traded minus the traded values (DESNZ, 2023).

Discount rate: 3.5% for years 1-30, 3% for years 31-60 (HM Treasury Green Book STPR).

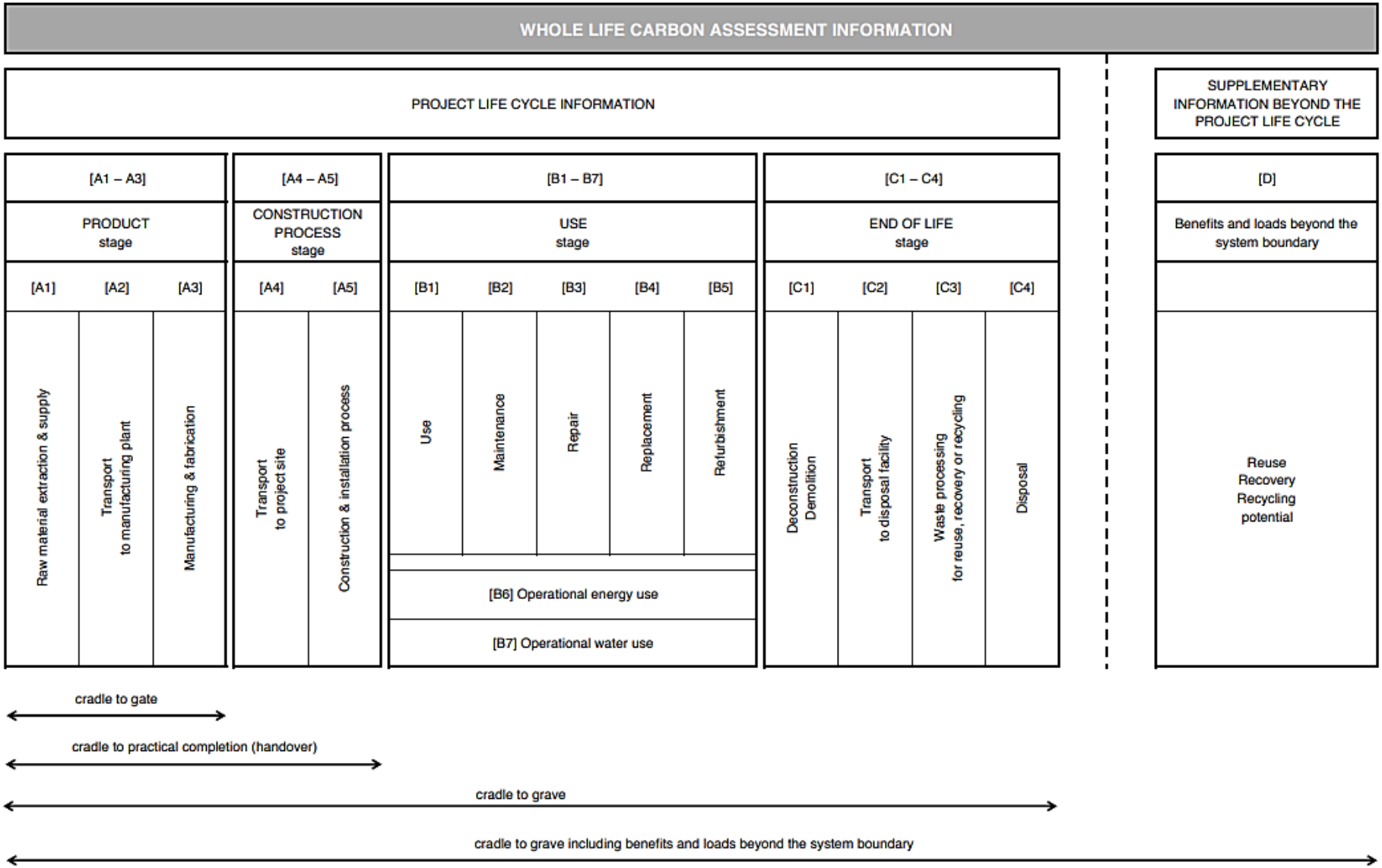
Key sensitivities: The carbon values used (central versus high versus low carbon values), length of appraisal considered, counterfactual used.

110. Embodied carbon – the carbon emissions created in the production of something – is an outcome of a construction process. The construction of homes results in carbon emissions throughout the process of material extraction, manufacture, transport, and final assembly and construction. A generalised view of the stages of a whole life carbon assessment is provided in Figure 8.2.

111. ENHAT uses the embodied carbon tool (Daedalus Environmental and SQW, 2022) to estimate and value embodied carbon in a new housing development. The tool covers the "cradle to practical completion" stages (A1-A5) represented in Figure 8.2, but to a partial degree. Table 8.2 shows several distinct sources of carbon emissions throughout the construction process, and whether or not those sources are captured in ENHAT and whether they might be assessed using another potential method. Note that the use stages (B1-B7) of the whole life carbon assessment are addressed elsewhere in the guidance (see Section 9, energy use), and the end of life is currently not addressed.

112. There are methods available to quantify the carbon emissions from other stages of new housing development, but these methods either require significantly more data than will typically be available at the OBC stage and/or would be too difficult to accurately estimate on a systematic basis at this point in time. Research is being conducted into this area however, and new methods may become available in the future.

Figure 8.2: Generalised whole life carbon assessment (source: RICS whole life carbon assessment, 2018, pg. 12).[42]



[42] Available at https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/building-surveying-standards/whole-life-carbon-assessment-for-the-built-environment

Table 8.2: Sources of carbon emissions from construction and how they are used in ENHAT.

Source of emissions	ENHAT method	Potential method(s)
Site preparation: Resources, energy, and transportation to prepare the site.	None – site preparation is likely to be similar across options (and therefore won't materially impact intervention comparisons).	Step 1: Quantify the vehicle travel by distance and the energy used on site for preparation. Step 2: Determine the average emissions per mile travelled and KWH of energy used. Step 3: Multiply the quantities from Step 1 by the rates from Step 2 to get total carbon emissions. Step 4: Use the Department for Energy Security & Net Zero carbon values to value those carbon emissions.
Site infrastructure development: Resources, energy, and transportation to create site infrastructure.	None – infrastructure development (roads, waterpipes, etc) is likely to be similar across options (and therefore won't materially impact intervention comparisons).	Step 1: Quantify the vehicle travel by distance, the energy used on site, and the embodied carbon of the materials used in the infrastructure development. Step 2: Determine the average emissions per mile travelled and KWH of energy used. Step 3: Multiply the quantities from Step 1 by the rates from Step 2 and add the embodied carbon from Step 1 to get total carbon emissions. Step 4: Use the Department for Energy Security& Net Zero carbon values to value those carbon emissions.
Home construction: Product stage and construction processes - Resources and energy used to construct homes.	Yes.	See method below.
Home construction: Transport - Transport of people and resources to the site.	None – transport was determined to be too variable to estimate on a systematic basis (Daedalus Environmental and SQW, 2022).	Step 1: Quantify the vehicle travel by distance. Step 2: Determine the average emissions per mile travelled (both direct and indirect).[a] Step 3: Multiply the quantities from Step 1 by the rates from Step 2 to get total carbon emissions. Step 4: Use the Department for Energy Security & Net Zero carbon values to value those carbon emissions.
Home construction: End of life - Deconstruction or demolition, transport and disposal.	None – Homes England will have little to no influence over the end-of-life stage (Daedalus Environmental and SQW, 2022)[b].	Step 1: Quantify the vehicle travel by distance, the energy used on site, and the carbon impact of disposal used in the deconstruction. Step 2: Determine the average emissions per mile travelled and KWH of energy used. Step 3: Multiply the quantities from Step 1 by the rates from Step 2 and add the embodied carbon from disposal to get total carbon emissions. Step 4: Use the Department for Energy Security& Net Zero carbon values to value those carbon emissions.

Notes: *(a) Department for Transportation method and definition of direct and indirect emissions can be found here: https://www.gov.uk/government/publications/transport-energy-and-environment-statistics-notes-and-definitions/journey-emissions-comparisons-methodology-and-guidance*

(b) Overall, it is expected that homes created in interventions will have a life longer that 60-years, and therefore end-of-life falls outside of the appraisal period. The appraiser should consider what happens outside the appraisal period and determine if that should be factored into the case.

ENHAT method for quantifying impacts of embodied carbon emissions

113. The overall formula for estimating the social value due to the embodied carbon of new home construction in the intervention is done in two parts – the environmental impact and the private costs:

$$Annual\ social\ value\ impact\ of\ change\ to\ embodied\ carbon\ emissions = embodied\ emissions\ (tonnes) * carbon\ value + change\ in\ delivery\ cost$$

Where: $embodied\ emissions\ (tonnes) = number\ of\ homes\ constructed\ (by\ home\ type\ and\ building\ standard) * embodied\ carbon\ from\ construction\ for\ each\ home\ (tonnes\ per\ home)$

$Change\ in\ delivery\ cost\ (Private\ costs\ of\ embodied\ carbon\ emission\ standard\ applied) = change\ in\ capital\ expenditure\ for\ reaching\ standard\ (difference\ from\ "standard\ construction")$

114. The individual steps required to implement the formula using ENHAT are:

Step 1 – The user identifies the location of the intervention.

Step 2 – The user inputs number of homes constructed in each year by type and the building standard that will be used.

Step 3 – ENHAT applies the Daedalus and SQW embodied carbon tool (2022) and lookup for embodied carbon per home in tonnes.

Step 4 – ENHAT sums across the embodied carbon per home multiplied by the non-traded carbon value minus the traded carbon value for that year.

Step 5 – ENHAT estimates the Capex unit cost per home delivered (Daedalus and SQW embodied carbon tool,2022), and sums across all homes delivered by year.

Step 6 – ENHAT reports the Capex costs and the embodied carbon costs separately.

Box 8.1: Embodied carbon from construction – illustrative examples and discussion.

Example A: Brownfield illustrative example

In the intervention option, 76 homes will be delivered to a reduced embodied carbon standard.

ENHAT estimates of the social value impact of embodied carbon:

Step 1 and 2: Specify the location, the total homes delivered and standard used, and the year the homes are delivered	**Step 3:** Estimate the total embodied carbon for the homes delivered	**Step 4a:** Apply the additional social cost (non-traded minus traded) of carbon in the year of delivery	***Step 4b:*** *Aggregate and discount the value of the social cost of embodied carbon*
76 homes delivered to a reduced embodied carbon standard in the North East region. Homes delivered in 2026/27	1,509 tonnes CO_2e	£175/tonne CO_2e	***-£0.25 million***

In the counterfactual, an reduced embodied carbon standard is also used. These homes are constructed later, so after accounting for the carbon value and discounting, the cost of the emissions estimated by ENHAT as -£0.22 million, giving a total change under the intervention of -£0.03 million (a marginal difference).

The change in the delivery cost of those homes to reach the reduced embodied carbon standard is also calculated by ENHAT.

ENHAT estimates of the additional delivery cost[43] for reaching a higher embodied carbon standard:

Step 1 and 2: Specify the location, the total homes delivered and standard used, and the year the homes are delivered	**Step 5a:** Estimate the additional cost per home delivered	**Step 5b:** Aggregate the additional delivery cost	***Step 5c:*** *Discount the delivery cost*
76 homes delivered to a reduced embodied carbon standard in the North East region. Homes delivered in 2026/27	£17,000 to £51,000 depending on the size of the home	-£1.97 million for all homes	*-£1.84 million*

As the counterfactual is also expected to be delivered under a reduced embodied carbon standard (due to local authority planning requirements, for example), the discounted delivery cost is also estimated by ENHAT (-£1.40 million). Therefore, the change under the intervention is an additional present value for the delivery cost of -£0.44 million.

As detailed in Daedalus and SQW (2022), the current costs to deliver to a reduced embodied carbon outweigh the potential benefits. However, as different construction techniques become available and common within the UK, these costs may shift.

[43] Some estimates of private costs were produced in the development of this guidance and have been included in ENHAT. These estimates should be treated with caution and project specific estimates based on the current market would be preferable. Further detail can be found in the background report. It should also be noted that the private costs presented in these tables cannot simply be compared to the environmental impact estimates to reach a conclusion on value for money. These must be fed into a broader economic appraisal that includes, e.g. public sector costs and estimates of LVU. The environmental standards included in each option may impact on these broader elements of the appraisal (e.g. building to a higher standard may impact on Gross Development Values).

Example B: Greenfield illustrative example

In the intervention, 675 homes are delivered using the "baseline" standard for embodied carbon performance. In the counterfactual, no construction occurs. Therefore, the only figure estimated in ENHAT is the cost of embodied carbon.

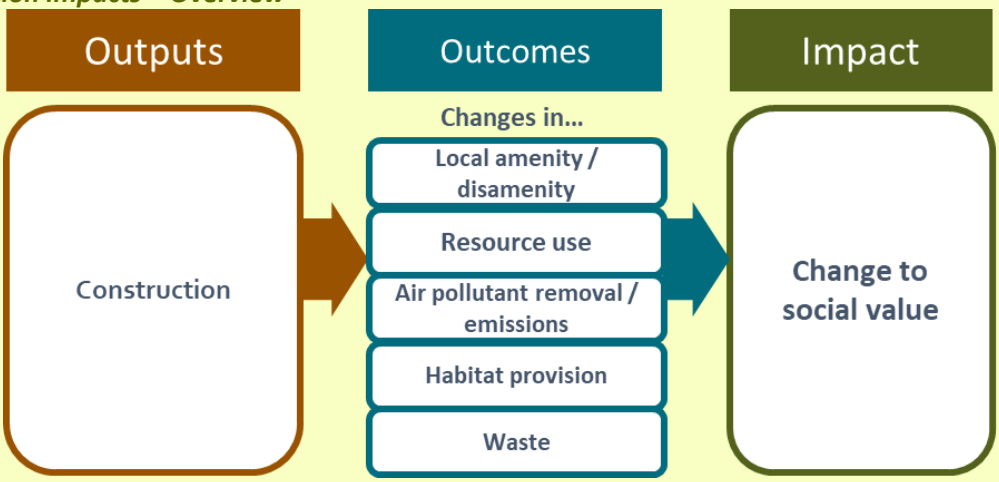
ENHAT estimates of the social value impact of embodied carbon:

Step 1 and 2: Specify the location, the total homes delivered and standard used, and the year the homes are delivered	**Step 3:** Estimate the total embodied carbon for the homes delivered	**Step 4a:** Apply the additional social cost (non-traded minus traded) of carbon in the year of delivery	***Step 4b:*** *Aggregate and discount the value of the social cost of embodied carbon*
675 homes delivered to the baseline standard in the West Midlands. Delivered from 2027/28 to 2034/35.	20,466	£184 to £202/tonne, depending on the year	-£3.19 million

There is no additional delivery cost in this example, as the intervention uses the "baseline" building standard. There is, however, a large amount of embodied carbon emissions which has an estimated social impact of around £4,726 per home delivered (based on the non-traded minus traded carbon values).

Other construction impacts

Other construction impacts – Overview



There are several additional impacts from construction that are identified, but not quantified and valued in ENHAT. They are:

Local amenity/disamenity: New homes could have substantial local amenity impacts during construction, including: congestion; restriction of access; noise and light pollution; and visual disamenity.

Congestion is currently covered under the DfT TAG[44]. For the other impacts, it is unlikely that there will be sufficient evidence to quantify these impacts at the OBC stage in a consistent manner. It is also unlikely that Homes England will have a substantial impact on these areas. It is expected that industry good practice (such as considerate constructor guidance) would be used to minimise these impacts in practice.

Resource use: There are other impacts from resource use outside of carbon emissions, such as environmental impacts from mining, manufacturing, or timber harvesting that is required to supply the development of new homes. Currently, however, carbon is the primary concern for most government policy, and the existing data on environmental impacts from resource use would require additional scoping and evidence review to be used in a consistent way in appraisal.

Air pollution: Site activities and transport of materials will generate air pollutant emissions. A large body of evidence exists on emissions factors for pollutants such as NOx and PM2.5 which could be applied along with existing guidance on damage costs from air pollution. This requires quantification of physical inputs (e.g. vehicle kms, operating hours) which is not expected to be possible at the OBC stage and, may, vary substantially according to location (e.g. distance materials have to travel to a site). Whilst data may be insufficient to estimate and value these impacts, it is expected that industry good practice (e.g. considerate constructor guidance) would be used to minimise these impacts in practice.

Habitat provision: Construction may result in loss of vegetation and habitat. This impact is addressed in land take impacts (Section 7) where "temporary" changes can be profiled in ENHAT to a sufficient degree to reflect the construction phase.

Waste: Waste may be measurable but is not yet included in this guidance. This should be revisited in future versions.

[44] https://www.gov.uk/guidance/transport-analysis-guidance-tag

9. Environmental Impacts of Occupation

This section covers the environmental impacts of the occupation phase of a new housing development:

- Occupation impacts occur due to the resource and energy use, waste generation, and transportation use from people living in the new homes. These impacts are expected to be long term, lasting for the duration of the properties' lives.

- **Occupation impacts for any given home are dependent on the specific behaviours of the occupants of those homes.** In most cases, there are reasonable expectations and assumptions for (average) behaviours that can be used to estimate the aggregate impacts across a whole intervention. ENHAT is based on a "fittings" method for estimating energy and water use, which accounts for the types of fittings used in the home to predict resource usage based on average rates of use.

- The impacts where evidence is available, and a method is included in ENHAT are:
  - **Energy use**.
  - **Water use**.
  - **Climate change resilience**.

- The impacts that are also considered in this guidance, but not are quantified in ENHAT are:
  - **Local congestion and associated impacts**.

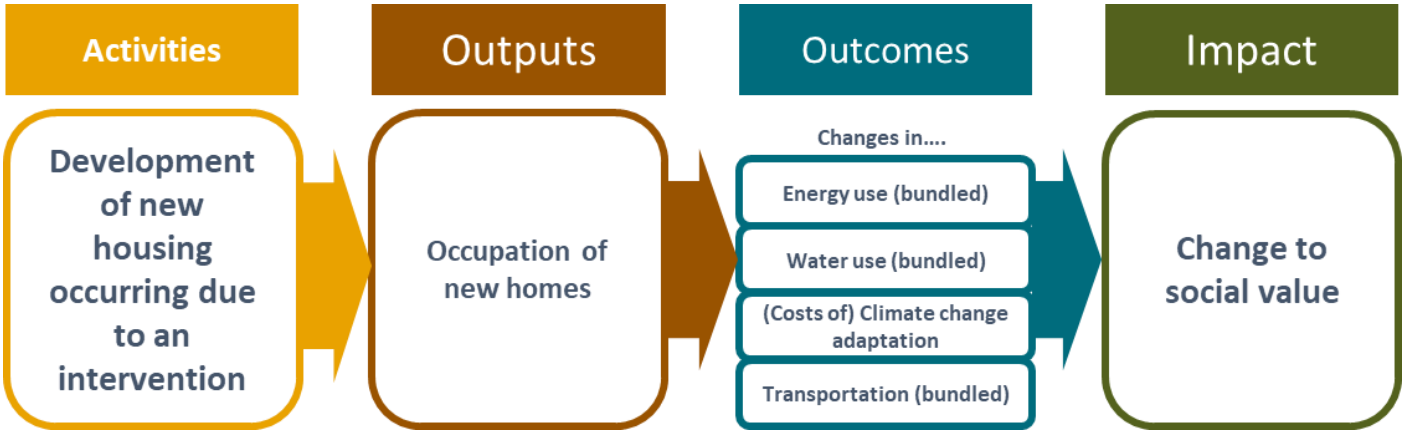
- **Climate change resilience is unique in this guidance.** The impact of designing homes to have better climate change resilience will only impact the occupant of those homes. It is included in this guidance as overall the resilience of homes to climate change can have significant impacts to social value – which is reasonable to expect will become more prominent in the medium to long-term – and it is also unlikely to be priced into costs or benefits elsewhere in the appraisal process (such as in LVU).

- **Occupation impacts may be reduced in one location and increased on the intervention site due to occupants of new homes moving from their previous residences.** This means that the net effect should be considered. The overall impact against the counterfactual is estimated using current average impacts from people in their homes and the population adjustment estimates (SQW, 2023). In ENHAT, energy and water use impacts are specifically calculated by taking the impact of *the change in overall energy and water use* as well as *the change in the impact of that use* (such as more or less water being used in an area of serious water stress), based on the energy and water standards used and any movement of population from one local authority to another.

115. The occupation of new homes created by housing development interventions will result in several long-term outcomes that can impact environmental quality for a range of areas (local, regional, and global). To some degree the impact of these outcomes is unavoidable, but these impacts can be reduced through the use of improved performance standards for homes.

116. Figure 9.1 shows the high-level logic chain for the occupation of new homes, both on brownfield and greenfield interventions. Just as in construction, it is not expected that there will be any systematic difference in the occupation impacts from greenfield and brownfield interventions.

Figure 9.1: Impact path map for occupation.



117. Transportation impacts from the occupation of homes – if determined to be a material concern – can be estimated using the DfT TAG[45]. Table 9.1 summarises the approximate level of influence Homes England is expected to have, data availability, evidence quality, as well as the overlap with other sections of this guidance, area of impact, and the direction of impact.

Table 9.1: Occupation outcomes.

Occupation outcome	Homes England influence	Availability of data at OBC	Quality of valuation evidence	Overlap with other sections/guidance	Area of impact	Expected direction of impact
Energy use (bundled)	High	Good	Good	None	Global	Variable
Water use (bundled)	High	Good	Good	None	Regional	Variable
Transportation or congestion (bundled)	Moderate	Minimal	Good	DfT TAG	Local	Variable
Climate change adaptation costs	High	High	Moderate	None	Resident	Variable

[45] https://www.gov.uk/guidance/transport-analysis-guidance-tag

Box 9.0: Occupation – illustrative examples summary.

The details of the ENHAT estimates for each outcome area are discussed in the following sections. As an introduction to the potential magnitude of the impacts from occupation, a summary of the two illustrative examples (A and B) are provided here (see Section 6; Table 6.2 for the intervention profiles).

Example A: Brownfield example, occupation impacts
(notes: positive values indicate benefits; negative values indicate costs; small rounding differences)

Category of environmental impact	**Difference in environmental outcomes due to the intervention option over the counterfactual**
Energy use	£0.01 million (£0.15 million minus £0.15 million) *(difference due to rounding)*
Water use	£0.09 million (£0.19 million minus £0.10 million)
Net environmental cost/benefit from the occupation of homes	£0.10 million (£0.34 million minus £0.25 million) *(difference due to rounding)*

Example A: Brownfield example, selected private and delivery costs[46] occupation impacts
(notes: positive values indicate benefits; negative values indicate costs)

	Difference in private costs for delivering selected aspects due to the intervention option over the option without intervention
Actions taken for climate change adaptation, private costs	-£0.06 million (-£0.26 million minus -£0.20 million)

Example B: Greenfield example, occupation impacts
(notes: positive values indicate benefits; negative values indicate costs)

Category of environmental impact	**Difference in environmental outcomes due to the intervention option over the option without intervention**
Energy use	£1.67 million (£1.67 million minus £0)
Water use	£0.76 million (£0.76 million minus £0)
Net environmental cost/benefit from the occupation of homes	£2.43 million (£2.43 million minus £0)

Example B: Greenfield example, selected private and delivery costs[47] occupation impacts
(notes: positive values indicate benefits; negative values indicate costs)

	Difference in private costs for delivering selected aspects due to the intervention option over the option without intervention
Actions taken for climate change adaptation, private costs	-£2.76 million (-£2.76 million minus £0)

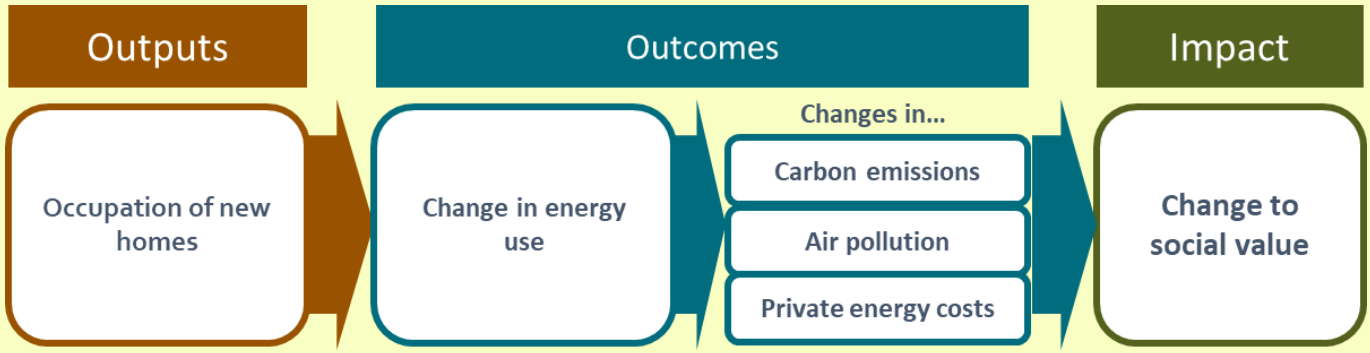
[46] Some estimates of private costs were produced in the development of this guidance and have been included in ENHAT. These estimates should be treated with caution and project specific estimates based on the current market would be preferable. Further detail can be found in the background report. It should also be noted that the private costs presented in these tables cannot simply be compared to the environmental impact estimates to reach a conclusion on value for money. These must be fed into a broader economic appraisal that includes, e.g. public sector costs and estimates of LVU. The environmental standards included in each option may impact on these broader elements of the appraisal (e.g. building to a higher standard may impact on Gross Development Values).

[47] Some estimates of private costs were produced in the development of this guidance and have been included in ENHAT. These estimates should be treated with caution and project specific estimates based on the current market would be preferable. Further detail can be found in the background report. It should also be noted that the private costs presented in these tables cannot simply be compared to the environmental impact estimates to reach a conclusion on value for money. These must be fed into a broader economic appraisal that includes, e.g. public sector costs and estimates of LVU. The environmental standards included in each option may impact on these broader elements of the appraisal (e.g. building to a higher standard may impact on Gross Development Values).

These examples demonstrate that by building to higher performance standard, energy and water use can be reduced over people's current usage in their homes, resulting in positive impact on social value. However, these results may hide changes in where resources are used. E.g. water use in a local area may increase due to development. These local impacts should be considered alongside the ENHAT results, such as in areas of serious water stress.

Energy use (bundled)

Energy use – Overview



ENHAT method: The number of homes delivered by type and the energy performance standard of those homes is input by the use (on a delivery per year basis). Energy consumed is then estimated using the Daedalus Environmental and SQW GHG Calculator tool (2022; updated), which includes the regulated (space heating, domestic hot water, lights, pumps and fans) and unregulated (appliances and cooking) energy demand. The *per person* energy people use in their current homes is subtracted off (unregulated energy + hot water heating) to calculate the net (additional) impact of the new homes. The estimated additional energy use by energy type (electricity versus gas) is combined with the carbon profile of grid energy sources over time to estimate the annual carbon emissions and air pollution due to the occupied homes. The annual emissions (tonnes) and air pollution are then multiplied by the DESNZ carbon values (non-traded values minus traded values) and the health cost of the pollution to determine the impact to social value.

Information requirements for using ENHAT:

- Number and type of homes built per year.
- Energy performance standard of those homes.
- Number of people expected to live in those homes.

Key evidence sources and supporting data (see ENHAT tab 8.1 for full references):

- SQW and Daedalus Environmental Green House Gas tool (2022).
- SQW population adjustment factors (2023).
- DESNZ carbon values (traded and non-traded) and air quality impact values (updated 2023).

Assumptions and other notes:

- The energy composition of the grid (e.g. renewable energy, natural gas, etc) is assumed to become less carbon intensive over time.
- Some of the costs of carbon emissions are already captured in private costs through traded carbon values – therefore the values applied for the social impact are: (i) the non-traded minus the traded values for electricity; and (ii) the non-traded values for natural gas (DESNZ, 2023).
- The homes that people move out of are assumed to have gas water heaters, as around 80% of current homes are heated this way. See ENHAT tab 8.10 for more detailed assumptions on current energy use.

Discount rate: 3.5% for years 1-30, 3% for years 31-60 (HM Treasury Green Book STPR).

Key sensitivities: DESNZ carbon values, air pollutant values, assumed energy mix of grid, counterfactual used.

118. ENHAT calculates and values carbon emissions from energy use in homes based on the expected energy demand of that home and the estimated energy mix that will supply it, as well as valuing other air pollutant emissions that may occur from energy use (air pollutant emissions values are provided as a single value for NOx, SO2, NH3, VOC, and PM2.5 emissions per kWh based on the energy type, estimated by DESNZ (2023)). ENHAT uses the calculations developed by SQW and Daedalus Environmental (2022; updated) to estimate energy use, air pollution and carbon emission impacts for various home types based on a set of performance standards from those homes. These estimates and the home types are available in ENHAT. The performance standards used in ENHAT are:

- **A1 -** Baseline, compliance with Approved Document Part L Volume 1, 2022: This includes a heating system based on the use of natural gas with photovoltaic panels included.

- **A2 -** Compliance with Approved Document Part L Volume 1, 2022: This includes a heating system based on the use air source heat pumps for the provision of space heating and hot water.

- **FHS -** Compliance with the expected emissions requirements of the Future Homes Standard: This includes a heating system based on the use of air source heat pumps for the provision of space heating and hot water, plus photovoltaic panels.

- **OZC -** Operationally Zero Carbon: As per the FHS performance standard, but with additional photovoltaic to reduce calculated emissions to zero. Note that this is an intentionally simplistic approach for a practical appraisal (see further discussion below).

119. The four standards are expected to represent the majority of the scenarios that will be applicable for developments being brought forward in the near future. A1 and A2 are most familiar to the sector and there is already a transition away from A1 and towards A2 (SQW and Daedalus, 2022), recognising the need to create buildings that do not need future retrofitting and to provide heating systems that are fully future-proof. Option, A1, in fact, will not be a viable option for any home built from 2026. These standards should be revisited frequently to ensure compliance with any new or anticipated standards.

ENHAT method for quantifying carbon emission impacts of energy use from the occupation of new homes

120. The overall formula for estimating the social value (disbenefit) due to the energy use from the occupation of new homes is:

$$\begin{aligned}&Annual\ change\ in\ social\ value\ from\ a\ change\ in\ energy\ use = \\ &annual\ change\ in\ emissions\ in\ tonnes\ from\ gas * DESNZ\ nontraded\ carbon\ value + \\ &annual\ change\ in\ emissions\ in\ tonnes\ from\ electricity * (DESNZ\ nontraded\ carbon\ value - \\ &DESNZ\ traded\ carbon\ value) + change\ in\ air\ pollution\ impacts + change\ in\ private\ energy\ costs\end{aligned}$$

Where: $Change\ in\ emissions\ in\ tonnes =$

$$\begin{aligned}&number\ of\ homes\ constructed\ (by\ home\ type\ and\ building\ standard) * \\ &(modelled\ energy\ use\ for\ that\ home\ type\ per\ year - \\ &energy\ that\ would\ have\ been\ used\ by\ those\ people\ in\ their\ previous\ homes) * \\ &emissions\ per\ energy\ use\ by\ type\ of\ energy\end{aligned}$$

$$\begin{aligned}&Change\ in\ air\ pollution\ impacts = \\ &number\ of\ homes\ constructed\ (by\ home\ type\ and\ building\ standard) * \\ &(modelled\ energy\ use\ for\ that\ home\ type\ per\ year -\end{aligned}$$

$$energy\ that\ would\ have\ been\ used\ by\ those\ people\ in\ their\ previous\ homes) * air\ pollution\ per\ energy\ use\ by\ type\ of\ energy$$

$$Change\ in\ private\ energy\ costs = change\ in\ energy\ use * costs\ of\ energy\ use$$

121. The individual steps required to implement the formula using ENHAT are:

Step 1 – The user provides: (i) an estimate of the number of homes delivered in each financial year by type of home; and (ii) the energy performance standard that will be used for all of the homes delivered in that year.

Step 2 – ENHAT estimates the total energy demand of the new homes and the change in energy use based on assumptions around energy use in existing homes as well as the user inputs (homes and standard used) and the estimates of energy demand from the SQW and Daedalus Environmental Greenhouse Gas Calculator Tool (2022). This is done through a series of sub-steps.

Step 3 – ENHAT estimates the carbon emission by year based on the expected energy demand and grid composition.

Step 4 – ENHAT: (a) multiplies the annual tonnes of carbon emitted from the change in energy use from electricity by the DESNZ non-traded carbon values minus the traded values; (b) multiplies the annual tonnes of carbon emitted from the change in energy use from natural gas by the DESNZ non-traded carbon values; and (c) applies the damage cost values for air pollution (DESNZ, 2023) to the change in energy demand by energy type (electricity and natural gas).

Step 5 – ENHAT discounts the annual impact and aggregates the sum over the appraisal period.

122. The expected change in total energy demand – expressed as the change in private energy costs – is also available in ENHAT. These private values may overlap with LVU and are therefore not included in the summary tabs. See ENHAT Tab 6.1 for more information.

Box 9.1: Energy use – illustrative examples and discussion.

Example A: Brownfield illustrative example

In the intervention option, 76 homes are delivered to the FHS in 2026/27.

ENHAT estimates of the social value impact of energy use (Example A):

Step 1: Specify total homes delivered, energy standard, and expected occupancy	**Step 2a:** Estimate total energy demand per year	**Step 2b:** Estimate total ***change*** in annual energy demand by energy type	**Step 3:** Total change in annual carbon emissions	**Step 4:** Estimate annual social value impact	**Step 5:** Aggregate and discount
76 homes delivered to "FHS" 155 occupants expected	Electricity: 306 MWh Gas: 0 MWh	Electricity: 225 MWh Gas: -120 MWh	21.29 tonnes CO_2e in 2026/27, declining to -21 tonnes CO_2e by 2044/45	Carbon: -£4,000 to +£5,000 per year (depending on the year) Air pollution: around -£300 per year	£0.15 million

In the counterfactual scenario the FHS standard is also used for all new homes, however these are delivered later in 2033/34. The PV of the impacts from energy use in that case are also £0.15 million. Under these scenarios, people moving into new homes are replacing some of the gas used in older homes with electricity use, and carbon emissions from electricity use are lower than from gas (especially as grid energy becomes less carbon intensive in

the future). However, the additional homes do result in more overall energy use, as each home needs to be heated and maintained.

The private energy costs are also calculated in ENHAT, however these may be considered to overlap with LVU. Electricity is (and is expected to continue to be) more expensive that natural gas in the near term, until electricity prices are decoupled from gas. However, the proposed heating systems are several times more efficient in A2, FHS and OZC than in most current homes, which counters this cost per unit impact to some degree. In this case, there is an increase in private energy costs for the new households, which is estimated to be around £310 to £400 per household per year (depending on the year, total PV cost of -£0.61 million).

Example B: Greenfield illustrative example

In the intervention, homes are delivered to the FHS. The existing housing stock is much less energy efficient and uses a combination of electricity and natural gas. Therefore, even though more total floor area must be heated, the benefits for appliances, hot water, and other energy uses that are estimated on a per person basis outweigh the increase from overall heating.

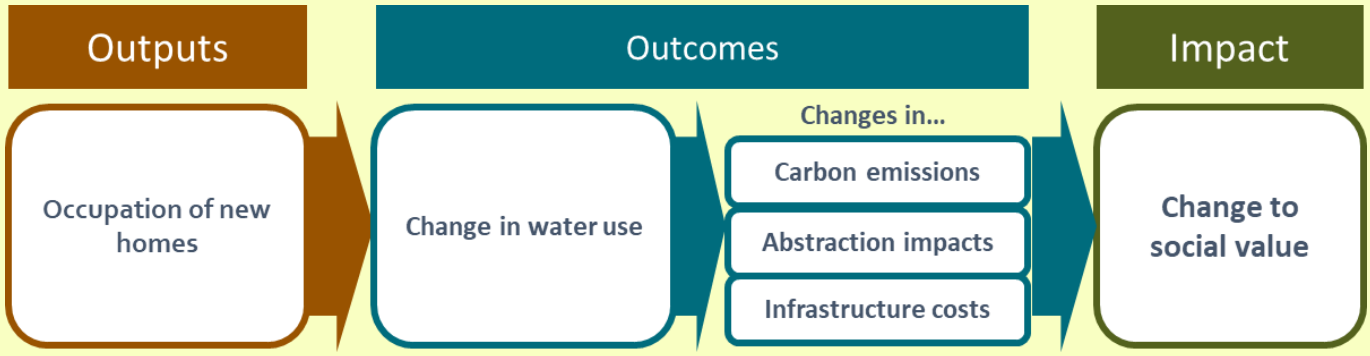
ENHAT estimates of the social value impact of energy use (Example B):

Step 1: Specify total homes delivered, energy standard, and expected occupancy	**Step 2a:** Estimate total energy demand per year	**Step 2b:** Estimate total ***change*** in annual energy demand by energy type	**Step 3:** Total change in annual carbon emissions	**Step 4:** Estimate annual social value impact	**Step 5:** Aggregate and discount
675 homes delivered to "FHS" 1,700 occupants expected	Electricity: 3,300 MWh Gas: 0 MWh	Electricity: 2500 MWh Gas: -1310 MWh	40 tonnes CO_2e/year in 2027/28, declining to -235 tonnes CO_2e/year by 2046/47	Carbon: -£7,000 to +£100,000 per year (depending on the year) Air pollution: around -£10,000 per year	£1.67 million

As the counterfactual is no homes being built on the site, the PV of the social value benefit £1.67 million.

Water use (bundled)

Water use – Overview



ENHAT method: The number of homes delivered by type of dwelling and the water performance standard of those homes is quantified by the user (on a delivery per year basis). Water use per person per home is estimated based on the home standard. This is aggregated over the number of occupied homes to estimate the total water use per year for the intervention option (in litres per year). This use is separated between people moving to the local authority and people moving within the local authority using the population adjustment factor estimates (SQW, 2022), with each being assigned their current water use based on the England average or the local water company average (per household consumption), respectively. Annual water use (in litres) is then multiplied by values that capture carbon emissions, abstraction, and infrastructure costs (eftec and SQW, 2022) to estimate the impact to social value as well as the private cost of new infrastructure development.

Information requirements for using ENHAT:

- Location of the development (local authority and region).
- The water company and water company region (selection from dropdown).
- Number and type of homes built per year.
- Water performance standard of those homes.
- Water performance standard of existing homes in the area.

Key evidence sources and supporting data (see ENHAT tab 8.1 for full references):

- Water use impacts per litre of water (eftec and SQW, 2022).
- Average occupants per home type and population adjustment factors (SQW, 2023).

Assumptions and other notes:

- The water performance standards should reflect most types of development – however the standards can be updated to reflect new types of designs if necessary.
- Current water use in existing homes is taken as the average water consumed and the average impact of that use across England or the local water company.
- Some of the environmental costs of carbon emissions are already captured in private costs through the traded carbon values – therefore the carbon values used to value the social impact are the non-traded minus the traded values (DESNZ, 2023).

Discount rate: 3.5% for years 1-30, 3% for years 31-60 (HM Treasury Green Book STPR).

Key sensitivities: The location of the development and the specific pressures on the water resources in the area, the estimated water use based on the fittings approach, counterfactual used.

123. Water use from people occupying homes can create several different types of environmental impacts, including:

- Environmental impacts from (increased) abstraction, including greater pressure on waterbodies and groundwater sources that can make them more vulnerable to drought, impacting wildlife and habitats dependent on these sources.

- New infrastructure investments – impacts from construction and operation (average incremental social and environmental costs) – required to meet increased demand in an area.

- Increased greenhouse gas emissions from increased water consumption due to (drinking) water treatment, pumping, and sewage treatment.

124. Note that the assumption applied in ENHAT is that water consumption from the occupation of new homes is additional for residents that move to the local authority as well as displaced for residents that move within the LA. While this assumption has minimal effect on comparisons between enhanced intervention options, it may not accurately reflect the VfM overall for an intervention versus the counterfactual. At the margin, this assumption may over-estimate the (negative) environmental impact of a new development in terms of water use[48].

125. ENHAT includes the following performance standards based on eftec and SQW (2022):

- A – minimum standard under part G of the building code, 125 litres per person per day.

- B – enhanced national standard, 110 litres per person per day (the current "optional" standard under part G).

- C – minimum viable standard (that ensures quality of user experience) for a mains only solution, based on efficient fixtures and fittings alone, typically 105 litre per person per day (Current policy 5.15 of the London Plan, for example).

- D – standard with rain or grey water recycling, around 85 litres per person per day.

126. These standards are based on expectations of potential future targets, as well as practical steps that could be taken to reduce water usage.

ENHAT method for quantifying impacts of water use from occupation of new homes

127. The overall formula for estimating the social value (likely a cost) of water use from the occupation of new homes is:

[48] More broadly, though, pressures from changing climate, increased environmental protection regulation, and population growth mean that many areas of England are facing deficits in the supply-demand balance, both in the short and over the longer-term. See for example the National Framework for Water Resources (Environment Agency, 2020). In this context – where changing population is contributing to pressures on water resources and the need for new resource development, including strategic region-wide resources, along with enhanced investment in maintenance of existing infrastructure (e.g. reducing leakage), attributing a net negative impact to a development for water use vs. the counterfactual is judged not to be entirely inappropriate. Reference from - https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources

$$\begin{aligned}&Annual\ change\ in\ social\ value\ of\ water\ use\ from\ the\ occupation\ of\ new\ homes\\&=Annaul\ water\ use\ by\ development*impact\ of\ water\ use\ in\ that\ local\ authority\\&-water\ use\ in\ existing\ homes\ from\ people\ moving\ within\ the\ local\ authority\\&*impact\ of\ water\ use\ in\ the\ development\ LA\\&-water\ use\ in\ existing\ homes\ from\ people\ moving\ from\ elsewhere\\&*average\ impact\ of\ water\ use\ in\ England\end{aligned}$$

Where: $impact\ per\ litre\ of\ water\ use=\ impact\ of\ abstraction\ per\ litre+\ carbon\ emissions\ impact\ per\ litre+infrastructure\ cost\ per\ litre$

128. The individual steps required to implement the formula using ENHAT are:

Step 1 – The user inputs: (i) the number of homes constructed in each year by type; (ii) the water performance standard of those homes (note that the tool only allows one performance standard to be used per year – individual homes cannot be given different standards); the region and water company that serves the site.

Step 2 – ENHAT estimates the new water use per year based on the user inputs (homes and standard used) and the existing water use of the people moving into those homes based on current average water use data and estimates for the number of people moving from inside and outside of the local authority per home of each home type (based on the population adjustment work by SQW, 2023).

Step 3 – ENHAT multiplies the new annual water use in litres by the estimated social value change from each litre of water used (which includes emissions, abstraction, and infrastructure impacts). Emission values are calculated as the non-traded minus traded values (DESNZ, 2021).

Step 4 – ENHAT discounts the annual impact and aggregates the sum over the appraisal period.

Box 9.2: Water use – illustrative examples.

Example A: Brownfield illustrative example

In the intervention option, the highest water efficiency standard is implemented, resulting in social value benefit, as the people moving into the homes are expected to use less water.

ENHAT estimates of the social value impact of water use (Example A):

Step 1: Specify total homes delivered, water standard, and expected occupancy	**Step 2a:** Estimate total water demand per year	**Step 2b:** Estimate total ***change*** in annual water demand	**Step 3a:** Estimate selected physical impacts	**Step 3b:** Estimate annual social value impact	**Step 5:** Aggregate and discount
76 homes delivered to "D" standard 155 occupants expected	4,800 cubic metres/year in new homes 8,700 cubic metres/year in previous homes	Total change in water demand: -3,900 cubic metres/year Total change in local authority: -740 cubic metres/year	Change in carbon emissions due to change in water use: reduction of 1.56 tonnes/year	National benefit of £7,500 to £7,900/year (depending on the year)	£0.19 million

In the counterfactual option, water use also decreases, but as that reduction is smaller (due to the water use standard of "B") and happens later than the intervention the social value impact is also smaller (PV impact of £0.10 million over the appraisal period). Therefore, the PV of the intervention over the counterfactual is £0.09 million (£0.19 million - £0.10 million).

Example B: Greenfield illustrative example

Once all 675 total homes are delivered in the intervention, 1,700 people are expected to move into those homes (of which 1,260 are new to the local authority and 440 are from inside of the local authority).

ENHAT estimates of the social value impact of water use (Example B):

Step 1: Specify total homes delivered, water standard, and expected occupancy	**Step 2a:** Estimate total water demand per year	**Step 2b:** Estimate total ***change*** in annual water demand	**Step 3a:** Estimate selected physical impacts	**Step 3b:** Estimate annual social value impact	**Step 5:** Aggregate and discount
675 homes delivered to "C", 1,700 occupants expected (1,260 new to the LA, 440 from within the LA)	65,000 cubic metres/year in new homes 89,000 cubic metres/year in previous homes	Total change in water demand: -24,000 cubic metres/year Total change in local authority: 43,000 cubic metres/year	Change in carbon emissions due to change in water use: reduction of 10.4 tonnes/year	National benefit of £38,000/year once fully delivered	£0.76 million

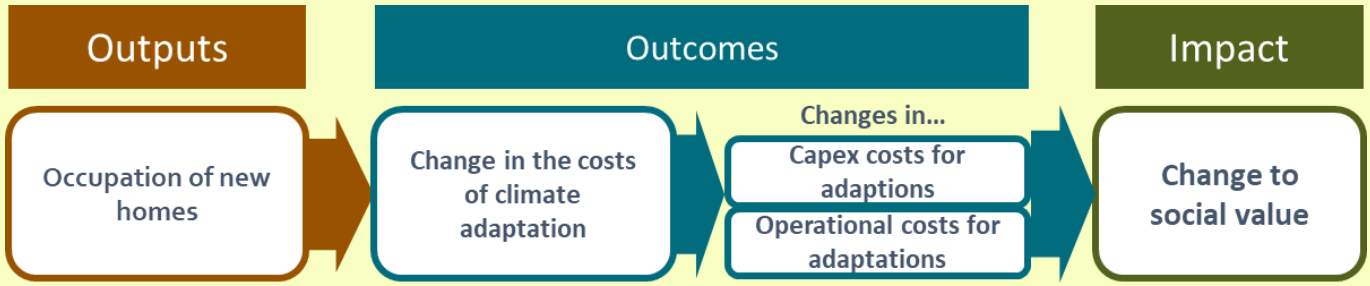
In the counterfactual, no homes are delivered, so there is no change to water use in that case (£0).

Comments on water use impacts

In both examples, delivering homes with higher performance standards for water use is expected to decrease overall water use and provide positive social value from that change when assessed at the national level. However, in Example B, there are negative local impacts. Most of the people moving into new homes in Example B are expected to come from outside of the local authority, and as the site is in an area of serious water stress, this local increase in water use comes with local infrastructure costs and environmental impacts from increased abstraction.

Climate change adaptation

Climate change adaptation – Overview



ENHAT method: Using homes delivered by type of dwelling per year and the climate change resilience performance standard of the homes, the value in terms of future adaptation cost versus the delivery cost at time of construction is measured. This can be used to estimate the cost/benefits of adaption measures during initial construction versus future retrofit.

Information requirements:

- Homes delivered by type of dwelling per year.
- The climate change resilience performance standard of those homes.

Key evidence sources and supporting data (see ENHAT tab 8.1 for full references):

- Daedalus Environmental and SQW (2022).

Assumptions and other notes:

- The climate change resilience performance standards in the Daedalus and SQW (2022) estimates appropriately cover most situations.
- Home value changes due to improved design standards for climate adaptation are not captured in LVU.

Discount rate: 3.5% for years 1-30, 3% for years 31-60 (HM Treasury Green Book STPR).

Key sensitivities: The estimated rate of climate change; the future cost of retrofitting buildings, counterfactual used.

129. It is anticipated that homes will require adaptation to provide suitable indoor conditions based on changes to the climate over time. Homes built today are likely to still be inhabited many decades into the future, and climate modelling suggests that under most carbon scenarios the climatic conditions of England will change over that time period. The adaption of homes to these changing conditions may incur substantial future costs if measures are not taken during initial construction to minimise those costs.

130. Research undertaken by Daedalus Environmental and SQW (2022) uses a set of performance standards for homes and climate data to estimate both the initial capital cost (CAPEX) and the future operational and capital expenditure (OPEX and CAPEX) to maintain appropriate conditions within the home. The estimates can be used in assessing the change in value for the homeowners over time. While these costs are likely to be private, it is unlikely that they will be adequately priced into sale and rental prices and hence captured in current LVU estimates.

131. ENHAT uses the methodology developed by the Chartered Institution of Building Services Engineers (CIBSE) described in their guidance document 'TM59' to assess climate change adaptations – specifically with regard to future overheating risk – made for three performance standard options: a baseline approach and two enhanced options which bring forward solutions to occur during the initial construction to reduce over-heating risk. TM59 is the recognised basis for assessing the primary internal risk from climate change (overheating specifically).

132. The standards used in ENHAT, where 2050 weather files were used for all assessments, are as follows:

- **The baseline standard,** which includes no design/physical solutions to address the future climate adaptation challenge. The underlying evidence shows that in every baseline standard case and location, the building designs will not be compliant with TM59 performance criteria in 2050.

- **The intermediate standard,** which provides some adaptation enhancements, ensures compliance with those 2050 standards but only in a small proportion of (generally northern) locations and across certain house types. It does, however, provide an interim step and general overheating risk reduction compared to the baseline.

- **The enhanced standard,** which includes measures that shows compliance with TM59 performance.

ENHAT method for quantifying impacts of climate change adaptation for new homes

133. The overall formula for estimating the social value of current implementation of climate change adaptation measures and necessary future climate change adaption of a new home is:

$$\begin{aligned} &Change\ in\ social\ value\ due\ to\ climate\ change\ adaptation\ in\ a\ home = \\ &total\ additional\ expenditure\ at\ the\ time\ of\ construction\ of\ the\ home\ based\ on\ building\ standard + \\ &total\ discounted\ opex\ cost\ to\ maintain\ appropriate\ indoor\ conditions\ in\ the\ future \end{aligned}$$

Where:
$total\ additional\ expenditure\ at\ the\ time\ of\ construction\ of\ the\ home\ based\ on\ building\ standard$ is the amount of cost incurred to improve the home against future climate change; and

$total\ discounted\ opex\ cost\ to\ maintain\ appropriate\ indoor\ conditions\ in\ the\ future$ is the discounted annual flow of costs from measures taken to create appropriate indoor conditions, such as the running of air conditioning units as well as any major future expenditures, such as the installation of new air conditioning units, or the adoption of enhanced glazing solutions within the home.

134. The individual steps required to implement the formula using ENHAT are:

Step 1 – The user provides an estimate of the number of homes constructed in each year, by type of home and the climate change adaptation performance standard that will be used for all of the homes in that year. Note that the tool only allows one performance standard to be used per year – individual homes cannot be given different standards.

Step 2 – ENHAT estimates CAPEX and OPEX for the homes delivered, both for the standard delivered and for the counterfactual standard. ENHAT then takes the difference in costs between the delivered standard and counterfactual standard to get the change in cost per home.

Step 3 – ENHAT multiplies the annual values by the number of homes, to get total annual values.

Step 4 – ENHAT discounts the annual impact and aggregates the sum over the appraisal period.

Box 9.3: Climate change resilience – illustrative examples.

Example A: Brownfield illustrative example

The 76 homes delivered in the intervention option are to be delivered to the "intermediate" climate change adaptation standard. This means that some measures (such as window shades and vents) are taken to make the homes habitable in the future under expected climate change conditions. These measures then do not need to be taken in the future.

ENHAT estimates of the social value impact of climate adaptation (Example A):

Step 1: Specify total homes delivered and climate change adaptation standard used	**Step 2a:** Estimate the capex and opex costs for the intervention	**Step 2b:** Estimate the capex and opex costs if no action is taken (standard construction)	**Step 3:** Calculate the change in costs	**Step 4:** Aggregate and discount
76 homes delivered to the "intermediate" standard	Total capex: £10.7 million Total opex: £1.6 million	Total capex: £10.2 million Total opex: £2.0 million	Change in total capex: -£0.49 million Change in total opex: £0.43 million	-£0.26 million

In the counterfactual, homes are also delivered to this higher standard, just at a future date (due to local ordinance, perhaps). This has a PV of -£0.20 million, and so the net cost of the intervention is -£0.06 million (-£0.26 million minus -£0.20 million).

Example B: Greenfield illustrative example

The 675 homes delivered in the intervention use the "intermediate" delivery standard. As there is no homes delivery in the counterfactual, there is also no cost or benefit.

ENHAT estimates of the social value impact of water use (Example B):

Step 1: Specify total homes delivered and climate change adaptation standard used	**Step 2a:** Estimate the capex and opex costs for the intervention	**Step 2b:** Estimate the capex and opex costs if no action is taken (standard construction)	**Step 3:** Calculate the change in costs	**Step 4:** Aggregate and discount
675 homes delivered to the "intermediate" standard	Total capex: £129.19 million Total opex: £16.25 million	Total capex: £123.20 million Total opex: £21.47 million	Change in total capex: -£6.00 million Change in total opex: £5.23 million	-£2.76 million

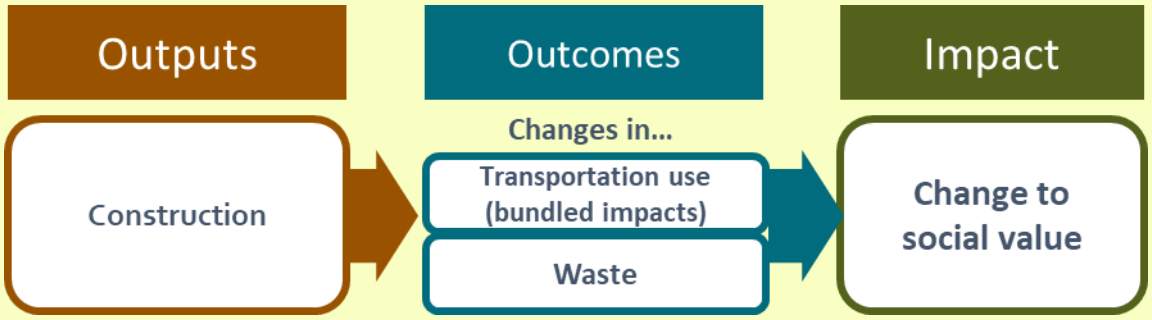
Comments on climate change adaptation measures and impacts

The timing of costs is critical to the assessments above. This is why the PV value is a larger negative value than the total change – upfront costs are discounted less than future savings in addressing changing conditions.

Even though the upfront costs of taking climate change adaptation measures are not offset by the future savings in these examples, some measures included in the intermediate or enhanced standards may also lead to an increase in the overall home value due to potential immediate improvements to indoor climate. This assessment assumes that homeowners will make these changes in the future if they are not made now. If that is not the case, there may be other negative impacts to health and wellbeing due to poor indoor conditions.

Other occupation outcomes

Other occupation outcomes – Overview



There are two additional impacts from the occupation of new homes that are identified, but not quantified and valued in ENHAT. They are:

Transportation: There are several environmental outcomes that can result from changes in local transportation, including congestion, air pollution, and carbon emissions. For guidance on transport, refer to the DfT TAG.[49]

Waste: Waste may be measurable but is not yet included in this guidance. This may be revisited in future versions.

[49] https://www.gov.uk/guidance/transport-analysis-guidance-tag

10. Using and interpreting results

135. The main reporting of results should be consistent with the requirements of the DLUHC Appraisal Guide (2023). The primary results for the appraisal option are shown in the impacts summary (Tab 7 in ENHAT, Figure 10.1 and Figure 10.2). These results show the *change* in social value from environmental outcomes due to the assessed option. To get a net impact – which is the key measure – these results must be compared against those in the counterfactual, which is done by using ENHAT to estimate two options:

- **An option "without" intervention (counterfactual).** The environmental outcomes associated with no Homes England involvement are assessed relative to a "do nothing"/no change reference case. This could, for example, involve building to a lower environmental standard and/or later housing delivery.

- **An option "with" intervention.** The environmental outcomes arising in the case of Homes England involvement can be compared to the "without" intervention option in order to determine the (net) environmental impact of Homes England's intervention.

136. The net impact is then assessed by comparing the "with" and "without" results provided by ENHAT in a separate options comparison workbook (Figure 10.3). Where the "without" case results in no changes to the site over a 60-year time horizon, the change in impacts will be assessed as £0 as there is no ***change*** in social value.

Figure 10.2 – Impact summary for Example A counterfactual, as calculated from ENHAT.

All values are in £ millions and are discounted to the base year	Discounted total (£, Millions)	
Net environmental cost / benefit of option (discounted)	***£***	***2.94***
from Land take	£	2.86
from Construction	-£	0.25
from Occupation	£	0.34
Delivery and private cost for option (beyond "standard" methods of construction, discounted)	***-£***	***2.10***
from Construction	-£	1.84
from Occupation	-£	0.26

Figure 10.1 – Impact summary for Example A intervention case, as calculated from ENHAT

All values are in £ millions and are discounted to the base year	Discounted total (£, Millions)	
Net environmental cost / benefit of option (discounted)	***£***	***0.71***
from Land take	£	0.69
from Construction	-£	0.22
from Occupation	£	0.24
Delivery and private cost for option (beyond "standard" methods of construction, discounted)	***-£***	***1.60***
from Construction	-£	1.40
from Occupation	-£	0.20

Figure 10.3 – Impact comparison for Example A as displayed in the ENHAT comparison sheet. These values are copied out of the ENHAT option summary and placed in the option comparison workbook.

Counterfactual	
Copy the full rows from ENHAT, and past those outputs into the five rows below. Only paste as values (no fo	
Example A: Brownfield illustrative example. - Intervention - Central Estimates	
	Discounted total (£, Millions)
Net environmental cost / benefit of option (discounted)	£ 0.71
Delivery and private cost for option (beyond baseline, discounted)	-£ 1.60

Option 1	
Copy the full rows from ENHAT, and past those outputs into the five rows below. Only paste as values (no fo	
Example A: Brownfield illustrative example. - Intervention - Central Estimates	
	Discounted total (£, Millions)
Net environmental cost / benefit of option (discounted)	£ 2.94
Delivery and private cost for option (beyond baseline, discounted)	-£ 2.10

Difference against counterfactual	
Net environmental impact against reference case	£ 2.23
Delivery and private cost for option against reference case	-£ 0.51

Final considerations

137. Additional key points on ENHAT and the results from appraising the environmental impacts of new housing development using it are:

- **Interpretation**. Supporting commentary should summarise the outputs along with the key assumptions for the analysis. This should provide a transparent account of the calculation of costs and benefits. Any main caveats and uncertainties should be reported at the individual impact level (e.g. related to timing, magnitude, significance, beneficiaries or economic values used), along with relevant sensitivity testing results. This can be done as a supplement to the ENHAT outputs.

- **Non-monetised impacts.** It is important to provide an account of the impacts of options that cannot be quantified and/or monetised in the support commentary for an economic appraisal to provide a rounded view on the expected natural and historic environment impacts of a scheme. Reporting should be based on the screening of impacts to focus on the key omissions from the monetary assessment for options. It should include the physical quantification of the impact (if possible) and an assessment of the significance – both qualitative and scoring/rating (if possible). This could include impacts to local heritage (such as the re-fit of historic buildings) or impacts to the natural environment (such as removing locally important natural sites) that are not sufficiently quantified using existing evidence.

- **Private cost estimates**. Some estimates of private costs were produced in the development of this guidance and have been included in ENHAT. These estimates should be treated with caution and project specific estimates based on the current market would be preferable. Further detail can be found in the background report.

- **Environmental impacts are one portion of the overall appraisal.** LVU, delivery cost, and other aspects of the total appraisal need to be considered to select the preferred option. The environmental standards included in each option may impact on these broader elements of the appraisal (e.g. building to a higher standard may impact on Gross Development Values).

- **Alignment to targets and objectives.** This guidance can also be used to help estimate the alignment of an intervention to other targets and objectives – such as net-zero emissions targets – by considering a full range of impacts.

- **ENHAT results and overall appraisal results.** The results of the appraisal of environment impacts are not themselves indicative of the preferred option and should be combined with the assessment of economic and social impacts. A complete appraisal of all material impacts of an intervention should inform decision making. This information should be further included in the OBC stage options comparison and VfM calculations, per the DLUHC Appraisal Guide.

Sensitivity analysis within ENHAT

138. ENHAT produces central, low, and high estimates of social impacts for most impact areas. The exact method used to produce these varying estimates differs from outcome area to outcome area (see sections 7-9 of this guidance or ENHAT for more details).

139. These estimates are shown in the individual calculation tabs in ENHAT, in the grouped outcome summaries (Figure 10.4), and also in the final impact summaries.

Evidence used in this guidance and within ENHAT

140. This guidance and ENHAT use several sources of evidence which will be updated over time to ensure (i) alignment to other official Government appraisal guidance and (ii) evidence and values being used in appraisal are up to date.

141. ENHAT "Tab 8.1 – Value lookup" provides a list of the data sources and their dates. Generally, it is recommended that evidence that is more than 10 years old be reviewed and updated – specific recommended review and update dates are given in ENHAT.

142. The broader guidance will also be periodically reviewed for alignment to other existing guidance. In particular, this guidance will be reviewed whenever the DLUHC Appraisal Guide is updated to ensure that there are no gaps/overlaps created between this guidance and the overall appraisal guide.

Figure 10.4 – Sensitivity analysis comparison of all impacts for Example A intervention (taken from Tab 7.2).

All values are in £ Millions and are discounted to the base year.	RAG rating (see Tab 1)	Discounted total (£, Millions)
Net environmental cost / benefit of option (discounted)		***£ 2.94***
4.1.1 - Brownfield amenity		£ 0.94
4.1.2 - Greenfield amenity		£ -
4.1.3 - Additional feature amenity		£ 1.88
4.2 - Air pollutant removal (note: uses health discount rate)		£ -
4.3 - Carbon sequestration		£ -
4.4 - Habitat provision		£ -
4.5 - BGI (Blue Green Infrastructure)		£ 0.04
5.1 - Embodied carbon (social impact of emissions)		-£ 0.25
6.1 - Energy use		£ 0.15
6.2 - Water use		£ 0.19
Delivery and private cost for option (beyond baseline, discounted)		***-£ 2.10***
5.1 - Embodied carbon, Delivery cost (CAPEX only)		-£ 1.84
6.3 - Climate adaptation (CAPEX and OPEX)		-£ 0.26

Press the plus/minus to the left to expand/minimise this section

DISCOUNTED RESULTS - LOW ESTIMATES

These values are assessed against a reference case that no changes occur to the site in the next 60 years. For use in appr

All values are in £ Millions and are discounted to the base year.	RAG rating (see Tab 1)	Discounted total (£, Millions)
Net environmental cost / benefit of option (discounted)		***£ 2.04***
4.1.1 - Brownfield amenity		£ 0.49
4.1.2 - Greenfield amenity		£ -
4.1.3 - Additional feature amenity		£ 1.42
4.2 - Air pollutant removal (note: uses health discount rate)		£ -
4.3 - Carbon sequestration		£ -
4.4 - Habitat provision		£ -
4.5 - BGI (Blue Green Infrastructure)		£ 0.01
5.1 - Embodied carbon (social impact of emissions)		-£ 0.09
6.1 - Energy use		£ 0.07
6.2 - Water use		£ 0.12
Delivery and private cost for option (beyond baseline, discounted)		***-£ 1.63***
5.1 - Embodied carbon, Delivery cost (CAPEX only)		-£ 1.38
6.3 - Climate adaptation (CAPEX and OPEX)		-£ 0.25

Press the plus/minus to the left to expand/minimise this section

DISCOUNTED RESULTS - HIGH ESTIMATES

These values are assessed against a reference case that no changes occur to the site in the next 60 years. For use in appr

All values are in £ Millions and are discounted to the base year.	RAG rating (see Tab 1)	Discounted total (£, Millions)
Net environmental cost / benefit of option (discounted)		***£ 3.90***
4.1.1 - Brownfield amenity		£ 1.40
4.1.2 - Greenfield amenity		£ -
4.1.3 - Additional feature amenity		£ 2.34
4.2 - Air pollutant removal (note: uses health discount rate)		£ -
4.3 - Carbon sequestration		£ -
4.4 - Habitat provision		£ -
4.5 - BGI (Blue Green Infrastructure)		£ 0.07
5.1 - Embodied carbon (social impact of emissions)		-£ 0.43
6.1 - Energy use		£ 0.23
6.2 - Water use		£ 0.29
Delivery and private cost for option (beyond baseline, discounted)		***-£ 2.58***
5.1 - Embodied carbon, Delivery cost (CAPEX only)		-£ 2.30
6.3 - Climate adaptation (CAPEX and OPEX)		-£ 0.28

A1. Glossary

Term	Definition
Appraisal	The process of defining objectives, examining options and weighing up the relevant costs, benefits, risks and uncertainties before a decision is made.
Business as usual (BAU)	See counterfactual
Blue-Green Infrastructure (BGI)	Strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services.
Counterfactual	The continuation of current arrangements as if the intervention under consideration were not to happen. This serves as a benchmark to compare alternative interventions.
Cost Benefit Analysis (CBA)	Comparison of present value benefits and costs as part of an economic appraisal.
Discount Rate	The annual percentage rate at which the present value of future monetary values are estimated to decrease over time.
Economic Appraisal	An appraisal technique based on attaching money values to the costs and benefits of actions.
Embodied Carbon	The carbon emissions of the materials and energy used to construct or manufacture something – in this case homes – which includes extraction, transportation, manufacturing, maintenance, replacement, and end-of-life (recycling or disposal).
Environmental Impact Assessment (EIA)	A process set out in European and domestic legislation that must be followed when proposing specific types of work, where the environmental effects of the work are systematically considered and suggestions are made to mitigate any negative impacts.
Externalities	Benefits or costs for others that occur when consuming or producing a good or service, that are not directly involved in the consumption or production.
Full Business Case (FBC)	The completed business case and third stage in the development of a business case for a significant intervention, which identifies the most economically advantageous option following procurement, confirms affordability and puts in place the detailed arrangements for successful delivery.
Habitat	A place where an organism or community of organisms normally live.
Intervention	A proposed, policy, programme or project that is being appraised.
Land Value Uplift (LVU)	The change in the value of the land above its previous use due to development, allowing for production costs.
Net Present (Social) Value	The present value of the total stream of future benefits (to society) from a proposal, intervention, or change minus the present value of the total stream of future costs (to society).
Present Value (PV)	The value of a stream of benefits or costs when discounted to the present time at a prescribed discount rate.
Outline Business Case (OBC)	The 'intermediate' business case and second stage in the development of a project business case, which identifies the option offering best social value.
Sensitivity Analysis	The analysis of how an appraisal will be affected by varying the values of the important variables.
Strategic Outline Case (SOC)	The 'early' first stage in the development of a project business case for a significant project, which makes the case for change and appraises the available long list to produce a short list of options.

Sustainable (urban) Drainage System (SuDS)	Drainage systems that use natural features rather than a network of channel, pipes and sewers to drain surface water and prevent flooding.
Value for Money (VfM)	A balanced judgement about finding the best way to use public resources to deliver policy objectives.
Willingness To Pay (WTP)	The amount an individual is prepared to pay in order to obtain a given improvement in utility. For non-market goods and services like ecosystem services, generally determined through methods such as contingent valuation surveys.

A2. Development of the guidance

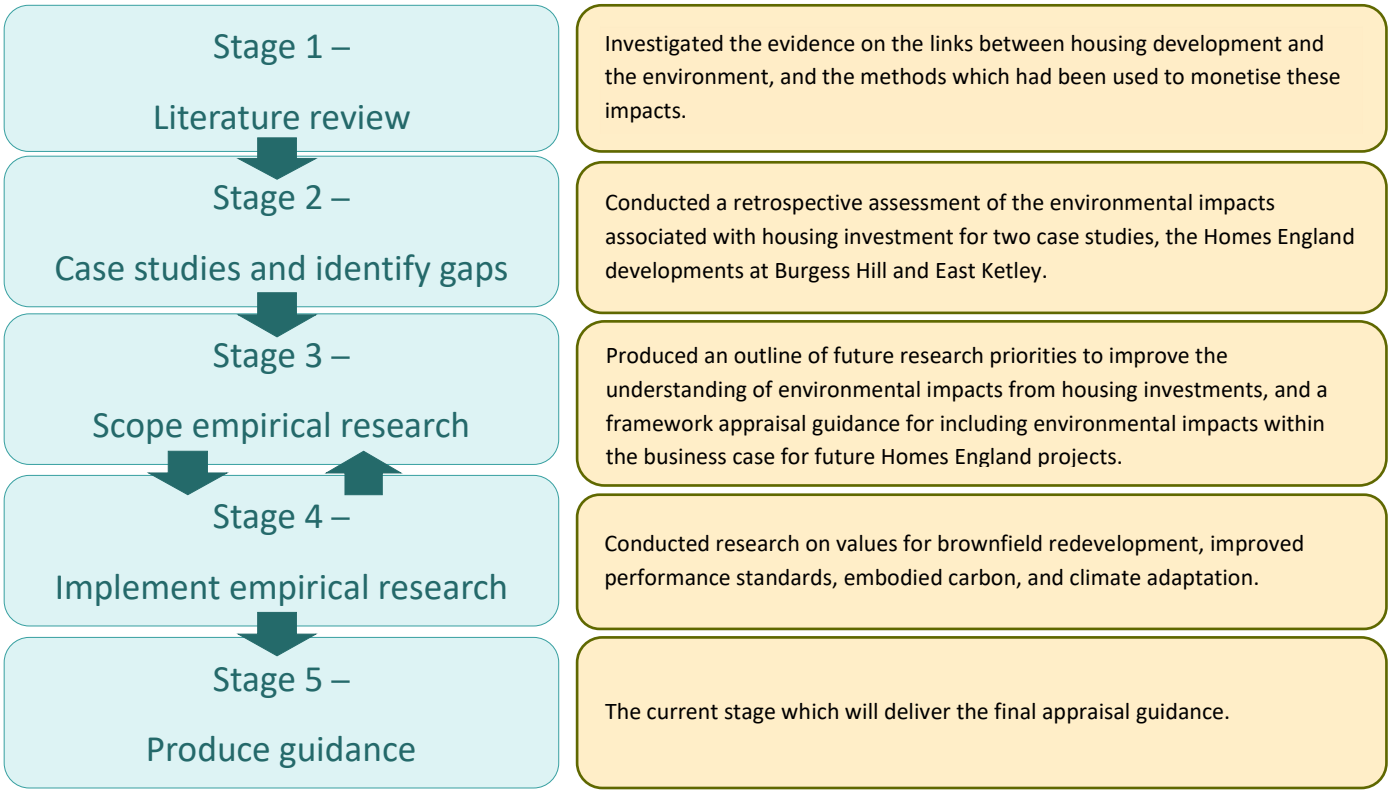
This appendix describes the development of the appraisal guidance.

This guidance was developed using an iterative approach. An initial evidence review identified potential methods for valuation and evidence that might be used to support those methods. Insights from this initial review were applied to two case studies (Burgess Hill and East Ketley), and through this process gaps in the method and evidence were identified. Research that could fill those gaps and improve this guidance was scoped and implemented. Finally, this guidance was produced using the evidence, insights and learnings gathered in previous stages.

This guidance contains both primary and secondary research. Gaps in the current evidence were identified through case studies, and primary research (such as the Brownfield Development Values study) and secondary research (desk based – such as the improve performance standards research) were used to fill some of these gaps.

Homes England and MHCLG have been closely involved throughout the development of this guidance, both to ensure the quality of the outputs and to ensure that this guidance is fit for purpose. Key stakeholders were also consulted at various points throughout the development of the guidance to provide feedback and make sure there is alignment to trends in government policy and strategy.

Figure A2.1: Appraisal guidance development map.



The guidance has been developed through five stages:

- **Stage 1: Literature review of existing evidence and tools –** To understand the evidence on the links between housing development and the environment, and the methods which had been used to monetise these impacts.

- **Stage 2: Two case studies of Homes England's interventions –** As far as data permitted, a retrospective assessment, quantification and/or monetisation of the environmental impacts associated with housing investment for two case studies, the Homes England developments at Burgess Hill and East Ketley.

- **Stage 3: Scope of empirical research report and appraisal guidance document –** A document outlining future research priorities to improve Homes England's understanding of environmental impacts from housing investments, and an appraisal guidance document that gives a framework for including these environmental impacts within the business case for future Homes England interventions.

- **Stage 4: Implement Empirical Research –** To address some of the evidence gaps identified in Stage 3. The specific research undertaken was:
    - **Brownfield redevelopment values –** This research developed a set of appraisal values for the removal of brownfield land from a location. It focused on the avoided disamenity (eyesore, contribution to deprivation, anti-social behaviour) due to redeveloping brownfield sites into new or remodelled residences. Overall, the research found a substantial societal value for removing brownfield disamenity.
    - **Improved performance standards –** This research was conducted to better inform and specify the appraisal of constructing homes with different levels of performance standard for energy use, water use, and surface water management techniques (sustainable drainage systems and/or blue green infrastructure). This research created a performance typology for each area, and then used models to estimate the impacts of homes constructed to those standards.
    - **Embodied carbon –** This research used a typology of homes and a typology of construction methods in order to give a rough estimate of the embodied carbon – based on whole -lifecycle carbon – for home types, and the additional costs for implementing home types of higher standards.
    - **Climate change resilience** – This research estimated the capital and operational cost impact of adapting to a changed climate, for different house types and different residential development options.
    - The full reports developed for each of these research workstreams is available alongside this guidance.

- **Stage 5: Produce final appraisal guidance –** Develop the final appraisal guidance and ENHAT tool.