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Heritage, natural capital and ecosystem services - Historic buildings and their associated boundaries

John Powell, Jeremy Lake, Rob Berry, Peter Gaskell, Paul Courtney, Ken Smith

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Summary

This project explores and tests how the cultural heritage values of buildings and structures can be incorporated into an ecosystem services framework, through considering them as both an integral part of their associated historic spaces and of their wider landscape settings. The project applies a methodology that identifies the ecosystem service outcomes from buildings, expressed in terms of flows of benefits over time, and attributes monetary values that are compatible with the ecosystem services approach. The method focuses on identifying and measuring the flow of ecosystem services over time arising from the current level of 'natural capital' (the stock), in a site or a defined area.

The project team have developed and applied an environmental value accounting model that identifies the benefits and attributes the values associated with historic buildings and structures. The model is based on a 'return-on-investment' accounting framework that integrates historic function, character and significance of buildings (or other structures) with a range of agricultural, environmental, economic, and social functions to analyse the range of values generated. The cultural heritage (historic) value of buildings in the case study areas is assessed through the integration of three scored characteristics (time depth, inter-relationships, legibility). This desk-based identification of the extent to which the historic buildings and structures in an area contribute ecosystem services is aimed at enhancing understanding of the value of the annual flow of benefits generated by cultural heritage.

Individual buildings or structures are not valued directly in this project, the methodology assesses the value of a grouping of buildings within a defined cultural setting. The model utilises a return-on-investment approach to provide a ratio of benefits generated by identified ecosystem services in relation to restoration & maintenance costs. Present values (PV) of the flow of costs and benefits are calculated and compared over a 50-year time horizon (using a standard 3.5% discount rate). Model outputs are generated for three case study areas, Attingham in Shropshire, Sherborne in Gloucestershire, and Upper Booth farm in Edale, Derbyshire.

Total ecosystem service values generated over the 50-year time horizon per m^2 area in the case study areas range from a low of £51.85/m^2 for a single farmstead and barns in Derbyshire up to £168.83/m^2 for a much larger area of buildings on the Attingham estate in Shropshire, receiving much higher visitor numbers, and arguably of greater historic significance. Return on investment ratios (present value comparison of costs and benefits across the 50-year time period) range from 1.82:1 for Edale to 5.07:1 for Attingham.

Strengths of the model lie in its flexibility to explore a range of different building types within different historical and environmental contexts, and ability to analyse values across a range of time frames as well as focus on values of individual outcomes from the four categories of ecosystem services. Current weaknesses of the

model relate to the need for improved quality of data. The current model is based on a pilot project with limited field sampling of building characteristics within the sample sites, particularly in regard to factors such as current function, condition, number of residents, owners, local population and visitors. Improvements could be made to the model through a more detailed sampling approach to explore the likely range of factors affecting magnitude and delivery of benefit streams.

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1 INTRODUCTION

1.1 Background to the project

This project is one of a series of pilot projects that seek to address the need for the heritage sector to better engage with the ecosystem services approach to assess the benefits that cultural heritage can provide to people's sense of place, health, wellbeing and prosperity. Ecosystem services first emerged in the 1980s but its current iteration stems from the Millennium Ecosystem Assessment that was commissioned by the United Nations in 2001 and published in 2005.[1] Subsequently the United Kingdom (UK) Government commissioned its own National Ecosystem Assessment (NEA), the first reports from which were published in 2011,[2] and reports from the most recent phase of work were published in 2014. Natural England's revision of the National Character Areas (NCAs), completed by this date, built upon the results of Historic Characterisation and a range of inter-disciplinary initiatives.[3] While the interaction of human and natural factors is threaded through the Statements of Environmental Opportunity (SEOs), there was much greater uncertainty regarding how to integrate these within the Ecosystem Services text for each NCA Area. This reflects a tendency, seen also in the synthesis and reports drafted for the UK NEA,[4] to place cultural heritage within the cultural services heading and to focus on the so-called 'soft' or intangible heritage (e.g. sense of place or artistic/literary associations).

An obvious impediment to developing an integrated approach is thus created; one that considers how the natural environment results from millennia of human activity and inter-action continuing into the present. In their paper 'Ecosystem Services, Natural Capital and the Historic Environment' Fluck and Holyoak (2017) recognise that the historic environment is currently poorly represented in ecosystem services and natural capital accounting methods, which take little or no account of the role of the historic environment in creating the very fabric of the 'natural' environment. They have suggested options available to the heritage sector for engaging with ecosystem services, ranging from 'doing nothing' to full integration, and the creation of a parallel 'historic environment services' concept, with the pros and cons for each option rehearsed. The paper concludes with a suite of potential responses from Historic England regarding ecosystem services exploring the relationship between natural and cultural capital.

In summary, and whilst ecosystem service approaches are becoming increasingly influential in environmental policy and land management decision, the issue of heritage valuation is insufficiently conceptualised and there is a dearth of empirical research. This project thus addresses a major gap in our understanding of the natural and historic environment, namely the lack of any holistic consideration of

[1] Board, Millennium Assessment. "Millennium ecosystem assessment." Washington, DC: New Island 13, (2005)
[2] Watson *et al.* "UK National Ecosystem Assessment: understanding nature's value to society. Synthesis of key findings." (2011)
[3] Lake and Mayes (2014)
[4] UK National Ecosystem Assessment, (2011) at http://uknea.unep-wcmc.org

the ecosystem services provided by buildings, which are critical to how landscapes and places are experienced and valued. We have at the outset opted for a highly experimental approach that considers buildings as an integral part of their associated spaces and areas: these include gardens and other areas within their historic and present-day boundaries, and which in turn are linked to their historic settings.

This report has thus tested and indeed stretched the limits of how far heritage assets can be described in terms of ecosystem services. Its overall aim is to demonstrate how the monetary and non-monetary values of historic buildings and their associated areas and boundaries can be incorporated into the four categories of ecosystem services. The objectives are to:

- Identify the heritage alongside the natural capital associated with the environmental context of buildings and their associated boundaries.
- Set out in the language of ecosystem services what public and environmental goods and services the heritage assets provide.
- Identify other values that fall outside the ecosystem services framework that can be ascribed to the heritage assets.
- In doing the above develop a methodology that can be used to ensure that heritage can be reflected in a way that is compatible with ecosystem services approaches.
- Provide the heritage and natural environment sectors with case study examples of how this might work for different environmental contexts.

There are clear challenges and opportunities here. On the one hand, the breadth and language of ecosystem services is challenging for heritage professionals who have developed expertise in protecting, assessing and providing advice on specific buildings, monuments and areas. On the other, consideration of buildings and their associated boundaries and spaces within an ecosystem services framework will offer increased opportunities to:

- Consider the benefits offered by them as habitats, in forms of use that are consistent with their intended historic function or that result from the need to adapt them to changing requirements.
- Further demonstrate how they are integral to a 'whole landscape' approach, flowing from the European Landscape Convention's definition of landscape as 'an area, as perceived by people, whose character is the result of natural and/or human factors'.[5]
- Consider how to place people and human values at the core of integrated approaches, building on the *Faro Convention on the Value of Cultural*

[5] Council of Europe (2000), *European Landscape Convention,* Article 1a (https://www.coe.int/en/web/conventions/full-list)

Heritage for Society[6] and the inclusion of communal values in Historic England's *Conservation Principles*.[7]

- Use this understanding as a framework for measuring and demonstrating how historic landscapes and assets contribute to social and economic well-being, building on recent scientific research such as that commissioned by the National Trust.[8]
- Use this understanding to inform the development of thinking by Historic England[9] and others on cultural capital into its relationship with natural capital and how they contribute to ecosystem services as well as each other.

1.2 Report structure

The remainder of this report has been structured in order to enable the reader to understand how the assessment process builds upon understanding of the historic stock of buildings and their boundaries in their landscape context:

- Section 2 provides details of the research methodology and key principles that have guided the approach.
- Section 3 introduces the ecosystem benefits or flows generated from the building stock and the state of research on this and related issues.
- Section 4 introduces the historic stock – its function, date (time depth) and context – in general terms and then for each of the key building types.
- Section 5 builds on this understanding to set out an assessment framework for scoring heritage value and how this has been applied to each of the case study areas.
- Section 6 describes the case study areas selected.
- Section 7 sets out the valuation methodology and how this has been applied to the case study areas.
- Section 8 sets out the conclusions and lessons learned.

[6] 'Cultural heritage is a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. It includes all aspects of the environment resulting from the interaction between people and places through time' as quoted in Council of Europe (2005), *Framework Convention on the Value of Cultural Heritage for Society,* Article 2a

[7] Historic England (2008) *Conservation Principles. Policies and Guidance for the Sustainable Management of the Historic Environment.* (https://historicengland.org.uk/images-books/publications/conservation-principles-sustainable-management-historic-environment/)

[8] see https://www.nationaltrust.org.uk/stories/why-do-places-mean-so-much

[9] See Fluck and Holyoak (2017)

2 METHODOLOGY

2.1 Background to the methodological development

The historic building stock developed over centuries to serve a range of functions, for example as dwellings; to enable the housing, processing and management of farm products and animals; and as places of worship, industry and commerce. These functions have shaped the character of the present-day building stock and the spaces that have developed in intimate association within their 'curtilages', such as gardens and farmyards, and the 'services' or benefits to society and habitats that flow from them. For the purposes of this project these are grouped under the key service flows of the ecosystem services model, namely: supporting, provisioning, regulating, and cultural services. Service flows can then be explored in terms of 'benefit streams' which allows the project team to identify who or what benefits, enabling the attribution of monetary and non-monetary values to each benefit stream. The service 'flows' depend on the current stock of the asset, its condition and the extent to which it continues to support relevant desired functions. Understanding the contribution that buildings make to ecosystem services therefore needs to assess:

- The extent of current research, further to setting out the ecosystem benefits or flows generated from the building stock.
- The historic stock of buildings and their associated boundaries, including consideration of how they express past functions and how they are changing.
- Their historic value, current function and condition in the context of their surrounding areas.
- How the ecosystem service 'flows' arising from the stock can be translated into valued benefits by different stakeholders.

When it comes to understanding the value and extent of ecosystem services provided by historic buildings it is not sufficient to assess specific features in isolation. They need to be assessed within the wider landscape context in which they occur. An isolated field barn for housing dairy cattle and their hay, for example, may provide a very different set of ecosystem services in a former meadow in a limestone dale in Malham or the White Peak than an isolated barn for housing and processing corn, with its yard for cattle, found amongst arable fields in the South Downs. Understanding and capturing that variability is the focus of this project.

2.2 Project stages

Four main stages have been developed to meet the aims and objectives of this project, and the fundamental need to better integrate the historic environment into natural capital and ecosystem services approaches (see Figure 1). The methodology builds on existing techniques for valuing the benefits of market and non-market goods and services, following the completion of a project focused on dry stone walls in the Peak District National Park (Powell *et al*. 2018).

Stage 1:

- Summarises the historic character and function of buildings and their boundaries, as defined in the Historic England Thesaurus of terms,[10] from a natural capital and ecosystems services perspective.
- Relates these to the benefits offered by different types of buildings, their related ecological settings (making a distinction between hard and soft surfaces) and the material used for their construction, for example as habitats for plants and fauna.
- Summarises how past functions have shaped the historic character of buildings and the boundaries enclosing the domestic, recreational and working spaces associated with them.
- Describes their inter-relationships with heritage and natural assets and the environment.

Stage 2:

- Assesses – both strategically and through case studies - how the capital stock contributes 'services' to socio-ecological and economic systems, categorised using the key service flows of buildings with their boundaries using the ecosystem services model (supporting, provisioning, regulating, and cultural), acknowledging that variations in the extent, condition and use of buildings will contribute different and variable amounts of ecosystem service flows in any given area.
- Assesses the potential of Geographic Information System (GIS) data in the case study areas to assess the 'stock' of natural capital and ecosystem service flows.
- Considers other values generated by buildings and their boundaries.

This stage then moves on to the valuation process, testing different scales of application to:

- Assess the value of the benefit streams generated by the 'capital stock' of different building types in differing landscape contexts.
- Apply monetary values to the identified ecosystem service 'benefit streams' arising from them. The size, extent, variability, and duration of benefit streams will be taken into account, along with estimates of beneficiary numbers, across the case study areas.

Stage 3 identifies the values associated with natural capital and ecosystem services in the case study areas.

Stage 4 brings together the different strands of the approach to review and develop a methodology for integrating values of historic buildings (in relation to their boundaries and the spaces enclosed by them) in land management and planning

[10] 17 types from Agriculture and Subsistence to Water Supply

decision making processes. It also considers the reliability and validity of the data utilised, and, through a continual process of evaluation and consideration of the strengths and weaknesses of the approach, provides a methodological approach that can have wider application using the following evaluation criteria:

- Ease of application.
- Level of knowledge and understanding required.
- Range of applicability.
- Reliability and validity of the incorporated valuation techniques.
- Utility to Historic England and other potential users.

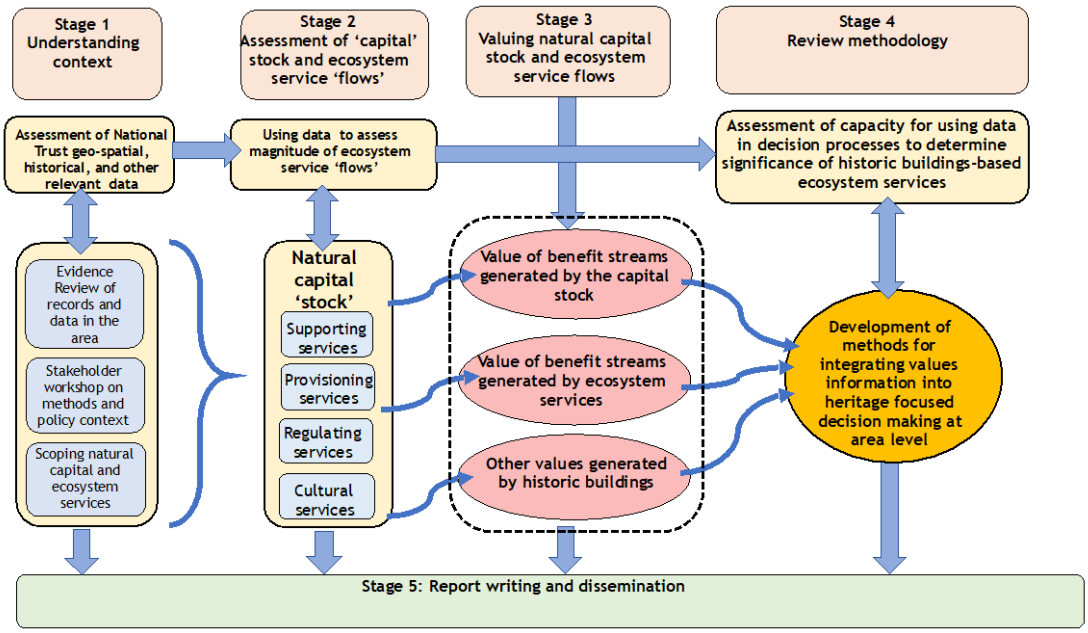

Figure 1: The methodological approach

2.3 Available data

The methodology has considered available data on historic buildings in their urban and rural contexts. A significant issue here is the tension between building-specific data, resulting from different scales of architectural investigation and including the National Heritage List for England (NHLE), and the data that has been developed for landscape, settlement and specific site types that has been increasingly available but would benefit from more in-depth use at a national scale. The UK NEA, for example, acknowledges that buildings and gardens offer habitats and 'play a major part in landscape character and hence the cultural services from farmland', whilst being 'not aware of national data on the numbers, distribution and types of these features.'[11]

In the absence of data, and as an accompaniment to different levels of observation and recording, historic maps – particularly the tithe maps of the 1840s and

[11] *Chapter 7 (Enclosed Land, 7.1.1.6)*

successive Ordnance Survey editions – provide a basic means of dating phases of development from the mid-19th century. Studies of building types have not included assessments of the proportion of the stock that belongs to different periods, including those that pre-date 1850 and are more likely than those of later periods – where increasing discretion is employed - to be eligible for statutory protection through listing. One exception is traditional farmsteads.

2.3.1 Data on buildings

Recording by amateurs and professionals, the latter often as a condition of listed building consent or as a part of geographic and thematic programmes of research, has made a significant contribution to local Historic Environment Records (HERs), the National Trust's Historic Buildings, Sites and Monuments Record (HBSMR) and the Historic England Archive.[12] The input of data on date and building type follows the standards set out in Historic England's Thesaurus of Terms for recording the built and buried heritage to a common standard including for local HERs.[13] The latter display a marked variation in their availability (whether open-source websites using maps or on application) and coverage of non-designated buildings. Vernacular buildings, the subject of study by amateurs and professionals for over a hundred years but increasingly systematic from the 1950s, comprise the majority of those recorded on national and local digital archives: the Vernacular Architecture Group has been pre-eminent in this field, having for example incorporated more than 6,000 entries into its database of cruck buildings[14] and more than 4,200 in its database of tree-ring dating.[15]

Listed buildings comprise the largest single dataset on historic buildings in England, and by far the greatest proportion of buildings included in these national and local archives. There are around 500,000 listed buildings on the NHLE. The Accelerated Resurvey of rural England in the 1980s added over 300,000 items onto the statutory list, published as so-called 'greenbacks'. These were focused on rural parishes, as part of rapid parish-by-parish surveys which were mostly based on external survey and thus the evident date of buildings. These were followed from the mid-1990s by 'blueback' revisions of urban areas, but areas of 'under-listing' – both thematic and by area – and other issues (including a shortage of resources for survey) call for a strategic approach to the assessment of the building stock, and the need for fresh research and assessment to inform more wide-ranging means to address the management of heritage through heritage conservation, planning and land management.[16] The precise number of listed buildings, as opposed to list entries, is not known, as some list entries (for terrace rows for example) may cover multiple properties. Objects or structures fixed or attached to a listed building will

[12] Historic England Archive at https://archive.historicengland.org.uk which also provides links to Images of England (photography of listed buildings) and Pastscape (https://www.pastscape.org.uk)
[13] Historic England (2014) Forum on Information Standards in Heritage (FISH) Thesauri (http://thesaurus.historicengland.org.uk) The Thesaurus also includes Monuments and a class termed 'Unassigned' from aircraft crash sites to yards.
[14] Hosted by the Archaeology Data Service at http://archaeologydataservice.ac.uk/archives/view/vag_cruck/
[15] Hosted by the Archaeology Data Service at http://archaeologydataservice.ac.uk/archives/view/vag_dendro/
[16] Cherry and Chitty (2010). Historic England's Corporate Plan focuses on key areas and national projects (https://historicengland.org.uk/listing/apply-for-listing/listing-priorities/)

be deemed listed, as will structures within the curtilage of the listed building – an issue which has been subject to much litigation, but which can cover several functionally-related buildings within the legal boundary of a principal item such as a mill or farmhouse.[17]

There are also large numbers of unlisted houses and other building types (most numerous of these being farm buildings) dating from the 19th century and earlier which either do not meet listing criteria or whose interest has been concealed beneath later layers of change (see Figure 2). Many buildings which make a positive contribution to local character and distinctiveness are included within conservation areas, of which there are now almost 10,000: most comprise coherent groupings of pre-1918 (and mostly pre-1850) buildings with their historic spaces. Dispersed groupings outside settlements – which primarily include farmsteads and farm buildings - are rarely included, examples including Edale in the Peak District National Park and the Swaledale 'Barns and Walls' conservation area in the Yorkshire Dales National Park.

[17] Providing that the structure pre-dates 1.7.48: Planning (Listed Buildings and Conservation Areas) Act 1990, s.1(5).

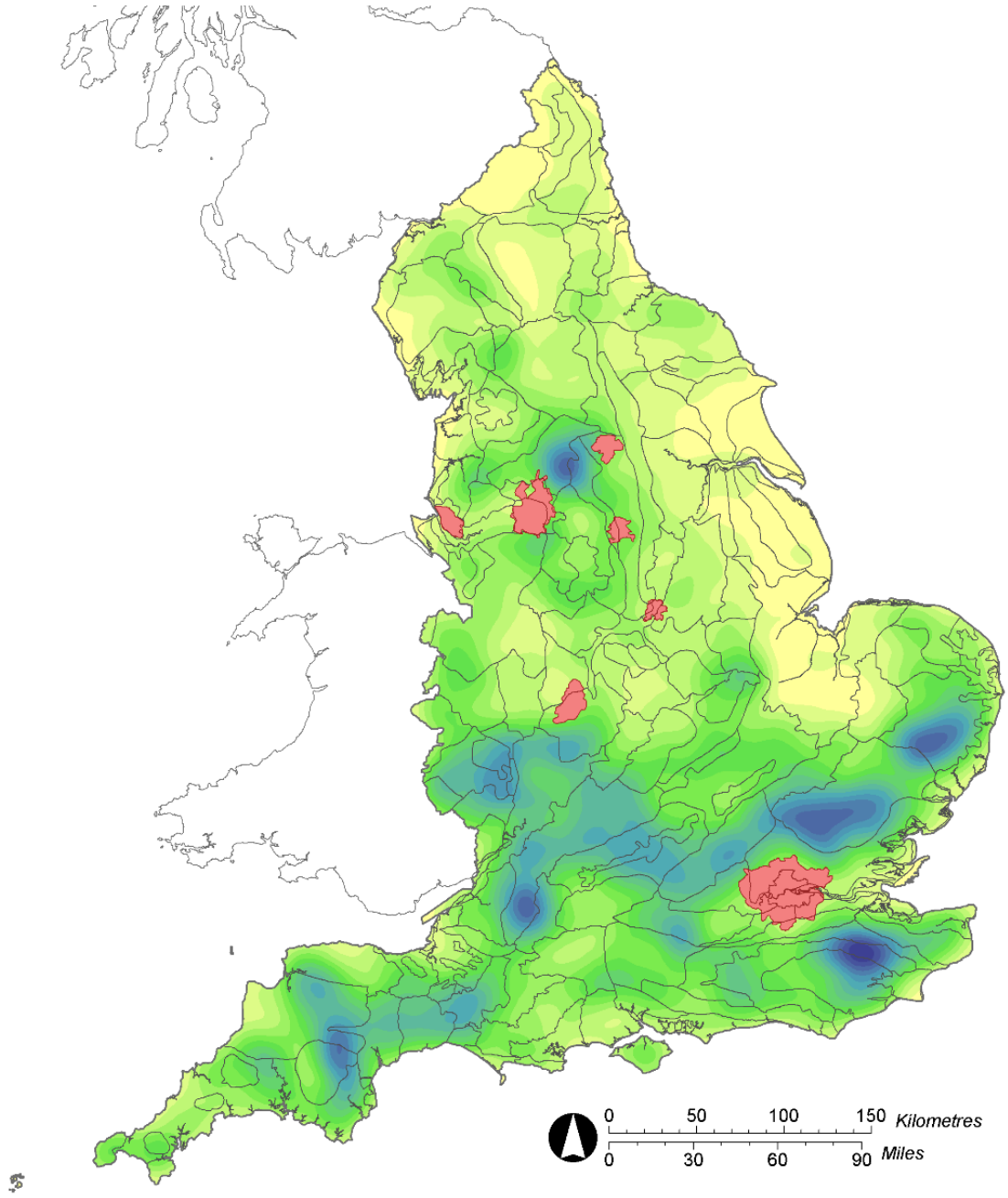

Figure 2: The distribution of listed agricultural buildings, showing the boundaries to the NCAs. The highest densities (in blue) reflect the emergence of prosperous farming economies from the 14th and 15th centuries, and often relate to areas of medieval dispersed settlement and ancient enclosure. Distributions are lowest (in light green and yellow) in areas which experienced profound change in the reworking of landscapes and restructuring of farms from the mid-18th century. They are also low in areas such as the Yorkshire Dales and North Pennines with high survival of traditional farm buildings which are mostly 19th century and do not fulfil listing criteria. (Map courtesy of Historic England).

2.3.2 Historic Characterisation data for landscape and settlement

Historic Characterisation,[18] which has been used to link historic land use to planning for environmental change, comprises:

- Historic Landscape Characterisation (HLC), which at a local level captures the historic character and time-depth of the present landscape – including historic settlement cores, settlement extensions and often the larger elements of dispersed settlement (hamlets and larger farmsteads) as polygons in GIS, and which has recently been synthesized as a national dataset (the National HLC) using 250x250m gridded cells.
- Urban characterisation projects at different scales, which since 2000 have mapped the type (industrial, commercial, residential etc.) and date of areas from smaller towns (mostly through Extensive Urban Survey (EUS)) to major conurbations (through a programme of 'Metropolitan' HLC).
- In-depth settlement characterisation such as Cornwall's Industrial Settlements Initiative.

Variations in the pattern of historic settlement were mapped as part of the *Atlas of Settlement*, by Brian Roberts and Stuart Wrathmell and now digitised as a GIS dataset.[19] Although developed as a tool to relate service provision and other needs to the density and type of settlement, the government's Rural Urban Classification (RUC) – which has used the results of the 2001 and 2011 census returns – displays a strong relationship to this pattern and density of settlement across England (Figure 3).[20] Urban areas are defined as those with more than 10,000 resident population, but of particular interest from an historic perspective – and one that is critical to the settings of buildings – is the close match between the distribution of nucleated and dispersed settlement which has origins in the 8th-11th centuries and has conditioned the patterns of growth of urban as well as rural settlement. The Future of Rural Settlement project, recently completed by Peter Bibby (one of the authors of the RUC), has combined these two datasets and mapped the density and distribution of households using data on household locations from the 1851 census data (which famously marks England's transition from a rural into an urban society, a global first).The basic methodology involved dividing England into 13 million grid squares, or 'cells', each a hectare in size (100m x 100m).[21]

[18] See https://historicengland.org.uk/research/methods/characterisation-2/
[19] Roberts and Wrathmell (2000 and 2002); Lowerre (2011); http://archaeologydataservice.ac.uk/archives/view/atlasrural_he_2015/
[20] Department for Environment, Food and Rural Affairs (2016). Rural Urban Classification at https://www.gov.uk/government/collections/rural-urban-classification
[21] Bibby (2018)

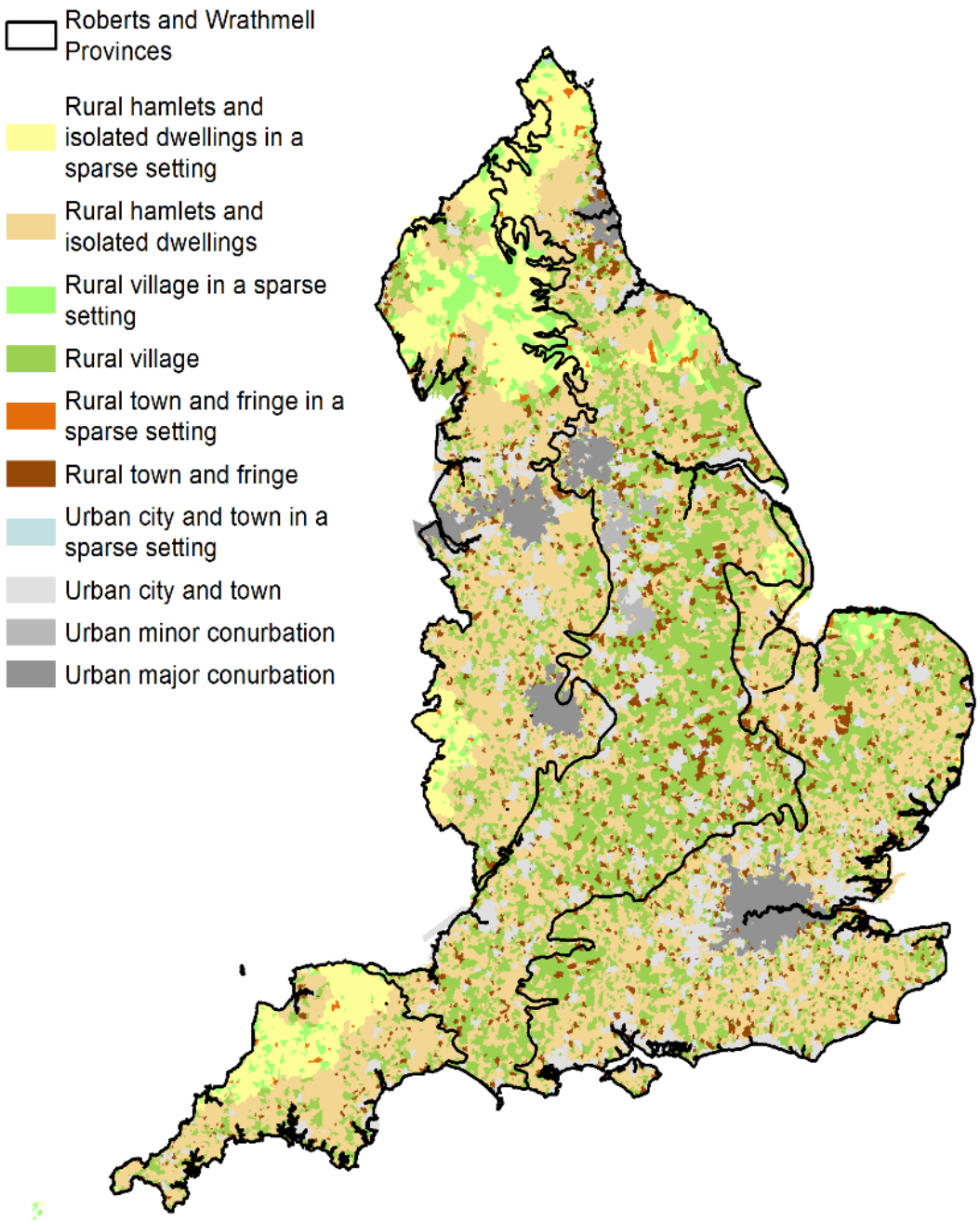

Figure 3: shows the Rural Urban Classification based on the 2011 census output, showing the strong density of villages within the Central Province from the Roberts and Wrathmell Settlement Atlas (2000), flanked by areas dominated by differing densities of dispersed settlement either side. There has been a tendency since the mid-19th century for villages to have developed or expanded to absorb a greater proportion of the housing stock than in dispersed settlement. (Map from Bibby 2018).

2.3.3 Data for site types

Thematic survey of site and building types, focused on those that are least understood and/or most under threat, has similarly developed since the 1990s – at first as the result of liaison between English Heritage and the then Royal Commission for Historic Monuments in England. Examples, too numerous to cite in full in this report, ranged from textile mills and hospitals to 20th century military sites. Approaches to the assessment of military sites broadened from a focus on designation to the development of protection including management plans and consideration of species and habitats.[22] Historic Farmsteads Characterisation, as developed by Historic England with partners in local government and protected landscapes, has demonstrated for the first time a close link between the historic layout and development of farmsteads and patterns of settlement and their associated landscapes of enclosed fields as mapped through the HLC programme.[23] Farm buildings are the most abundant rural building type. The survival of traditional farmsteads pre-dating 1900 has been mapped in several areas including the whole of the West Midlands: here, of 17,000 surviving traditional farmsteads, data obtained from listed building records indicated that a clear majority had no recorded 18th century or earlier dates, but that this varies enormously elsewhere, from 8.4% in the South West Peak to 3.5% in the Cotswolds.[24]

This data has considerable potential to be analysed in relationship to other patterns of use including the benefits that historic buildings in their landscape contexts offer to people and habitats (see Section 3.1). Other work, for example on nonconformist chapels and the assessment of military sites with heritage and natural interest, has similarly underlined the close relationship between buildings, the development of the landscapes around them and also their heritage and natural management issues.[25] In Worcestershire, supported by Historic England, this extended to guidance on the full range of rural building types, their related settings and wildlife habitats, and case studies which built upon the results of Farmstead Mapping to present a mapped analysis of types and dates of buildings in relationship to landscape character and type.[26] Its conclusions are relevant to the need for inter-disciplinary approaches to an issue such as ecosystem services:

- 'Approaches to the study of many rural buildings remains persistently detached from settlement and landscape. This is perpetuated by poor cross sector collaboration, a lack of guidance within regional research frameworks and inconsistent and often very limited datasets associated with non-designated buildings.
- An enduring perception that 'heritage' is solely focused on the protection of the most valued (generally listed) buildings.
- Historic Environment data that is often overwhelming, abstract and difficult to break down.

[22] e.g. Cocroft *et al.* (2011) for a survey of MoD disposals sites in Wiltshire
[23] https://historicengland.org.uk/advice/caring-for-heritage/rural-heritage/farm-buildings/farmstead-characterisation/; Lake and Edwards (2006 and 2007)
[24] Lake and Edwards (2010), 20
[25] Lake *et al.* (2011); Cocroft *et al.* (2011)
[26] Hathaway and Lake (2016 and 2017)

- Building records are predominately associated with Listed Buildings and Conservation Areas, or the results of development control, resulting in an incomplete picture. Although projects such as the Historic Buildings of Worcestershire Project, have done a great deal to enhance records for pre-20th century domestic buildings survey is time- consuming and largely relies on volunteers.'[27]

3 BUILDINGS AND ECOSYSTEM SERVICES

3.1 Relevant action and research

A retrospective look at policy and research, particularly as it has developed over the last 20 years, informs consideration of the relationship between the historic building stock and ecosystem services.

3.1.1 National Policy

It is apparent that most of these fall under the cultural services heading, an obvious example being the increasing emphasis since Planning Policy Guidance Note 7 (1997)[28] placed on recognising and designing for local character and distinctiveness: this demands understanding of traditional and designed buildings in their local and national context. The National Planning Policy Framework (NPPF, revised 2018) now places good design, local character and conservation of the historic environment – defined as resulting from 'the interaction between people and places through time' - at the heart of sustainable development and good planning (paragraphs 184-202, 124-132). It states that the options for change should take into account 'the desirability of new development making a positive contribution to local character and distinctiveness' and 'opportunities to draw on the contribution made by the historic environment to the character of a place' (paragraph 185 c and d). This places an implicit emphasis on traditional architecture in particular and other buildings which make a strong contribution to local character and distinctiveness. Consideration of their contribution to local character, and to supporting and cultural ecosystem services, also demands understanding of the size and ecology of the plots associated with building types within broad classes of building types – for example middle-class suburban villas with native and imported planting to formal and informal gardens, deep front areas with privet hedges and fencing to inter-war suburban housing, small plots with connecting back alleys to 19th and early 20th century working-class terrace housing etc.

3.1.2 The Farrell Review

The *Farrell Review of Architecture and the Built Environment*, led by the distinguished architect Terry Farrell,[29] offers recent consideration of how the

[27] Hathaway and Lake (2017), 50
[28] Planning Policy Guidance 7: The Countryside - Environmental Quality and Economic and Social Development (PPG7) published in February 1997
[29] Farrell Review of Architecture and the Built Environment (2015) (www.farrellreview.co.uk)

benefits of good design, sympathetic to the character of places with distinctive identities, should be integrated into mainstream policy and practice. It significantly states that: 'In order to create the kind of high-quality places we all want, a major cultural change is needed where the focus of everyone involved moves towards the wider context of what is already there and its all-important setting and context. .... Landscape is the primary infrastructure and ordinary everyday buildings are the ones that deserve more attention.' Recent consideration by Historic England of the relationship between the historic environment and wellbeing agendas has included 'Place: belonging' and 'Environment: experiencing' within six topics to inform this agenda.[30]

3.1.3 Heritage Counts

Heritage Counts, the annual audit of England's heritage first produced in 2002, has recently included analysis of the social and economic benefits of heritage, using available data such as visits to heritage sites and the number of listed buildings per head of population. Data used for this work has been largely confined to visits to heritage sites, the value added by listed buildings, conservation areas and urban areas, including the contribution that heritage makes to place branding, property values, returns on investment and the location of businesses.[31]

3.1.4 Farmstead Characterisation

Thus far, Farmsteads Characterisation and a pilot focused on places of worship in Cornwall comprise the only example of analysis that have used understanding of the whole (designated and non-designated) building stock. Matching data from the rapid mapping of traditional farmsteads to business and residential data, in parts of the south east and the West Midlands, has thus revealed patterns of agricultural, commercial and residential use, the proportion of the latter associated with home-based limited liability companies being more than three times higher than in other dwellings regardless of where they are located.[32] Strong local variations have emerged, from buildings in upland landscapes with low capital endowment that are most likely to remain in agricultural use to those which form a highly-valued part of protected landscapes.[33]

3.1.5 Heritage and Wellbeing

Recent work on heritage and well-being has indicated how buildings can be placed within the context of a holistic assessment of health and well-being indicators: much of this builds on the growing field of research on sporting heritage and parks, the use of datasets such as *Taking Part* and *Understanding Society* also

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[30] The others being 'Process; Volunteering', Participation: visiting'. 'Mechanisation: sharing' and 'Healing: therapy' (Reilly *et al.* 2018)
[31] Heritage Counts at https://historicengland.org.uk/research/heritage-counts/ - includes *The Value and Impact of Heritage* 2014 and *Heritage and the Economy* 2018.
[32] Bibby and Brindley (2008); Bibby (2008); Bibby (2010). For the mapping of traditional farmsteads, and analysis of their survival, historic character and use across the West Midlands, see Lake and Smith (2010) at https://content.historicengland.org.uk/images-books/publications/wm-county-summaries/572463/
[33] Gaskell and Owen (2005) for the audit of listed farm buildings; Bibby and Brindley (2007, 2008 and 2010).

highlighting the importance of historic towns.[34] Other work in rural areas, which account for 16% of England's economic output,[35] has demonstrated that agriculture and its built heritage, within this wider context, is vital for community well-being and for attracting domestic and foreign tourists to rural areas including National Parks which have been the subject of a 2013 study ('National Parks, National Assets') for National Parks England.[36] The University of Gloucestershire have also quantified the contribution of pre-2008 agri-environment schemes to local economies in the Lake District and Yorkshire Dales National Parks, and have scoped the potential for determining the social and economic benefits of heritage in the National Parks of England and Wales.[37]

3.1.6 Buildings and Ecosystem Services

A range of research has also drawn attention to the contribution that buildings and their associated boundaries and spaces make to supporting and provisioning services in particular:

- The value of derelict urban land and peri-urban 'edgelands' with industrial and commercial building types as habitats, and their vulnerability to 'brownfield' development.[38]
- The value of industrial sites to ecologies and specialist plant communities – for example calaminarian grasslands with species such as alpine penny-cress and spring sandwort ('leadwort') on lead rakes and hillocks in the Peak District.[39]
- Place-to-place variation in the ecology of managed and unmanaged spaces in urban areas due to the interaction of local soils, the lime offered by crushed building materials and the type and date of the associated building stock.[40]
- The interdependency of buildings and their related ecologies, including how buildings reflect the management of local resources such as woodland and hedgerows.[41]
- The value of gardens as habitats and for local ecologies,[42] awareness of which underpinned the development of 'wild gardens' and hardy perennials associated with post-1850s Domestic Revival housing;[43] developers and local

[34] Fujiwara *et al.* (2014a) *Heritage and Wellbeing*. Report for Historic England. (https://content.historicengland.org.uk/content/heritage-counts/pub/2190644/heritage-and-wellbeing.pdf); Fujiwara *et al.* (2014b) Quantifying and Valuing the Well-being Impacts of Culture and Sport *Department for Culture Media and Sport Research Paper* (https://www.gov.uk/government/publications/quantifying-and-valuing-the-wellbeing-impacts-of-culture-and-sport); Bickerton and Wheatley (2014); Ander *et al.* (2012)
[35] As reported in The *Rural Economy and Land Use Programme* (Relu) led by Newcastle University, published 2013, see http://www.relu.ac.uk/news/Consultations/Growth%20Review.pdf
[36] Cumulus Consultants and ICF GHK (2013) *Valuing England's National Parks*, report for National Parks England (www.nationalparksengland.org.uk)
[37] Summarised in Courtney *et al.* (2008)
[38] Williamson (2013), 179-182; Angold *et al.* (2006)
[39] Barnatt and Penny (2004), 16-19
[40] Gilbert (1989)
[41] Graham (2003). For individual case studies see Moir (1997); Rackham (1972); Kirk (2004)
[42] Smith *et al.* (2006)
[43] Williamson (2013), 171-4; essays in Rotherham and Lambert (2011)

authorities were already integrating hedgerows, woodland and other open spaces into new development in the inter-war period.[44]

- The value of historic churches (and associated churchyards) and traditional buildings – including the carpentry of timber frames and roof spaces - as habitats for birds and bats.[45] Guidance on how to approach the reuse of farm buildings and the sustainable development of farmsteads has also addressed how the immediate landscape setting as well as historic fabric can offer opportunities for conserving and enhancing habitats including connections to surrounding boundaries and the wider landscapes around them.[46]
- The ecological value of brick and stone walls as well as hedges. Segal and Darlington's work has demonstrated that walls of all types can be rich in flora.[47] The Dry Stone Walling Association has published guidance on their value as habitats for flora and fauna.[48]
- Pioneering work in Poland has demonstrated that older buildings are associated with an above-average abundance and variety of birds; this is particularly the case for working farmsteads and even more so for churches – being older, taller and even richer in potential if provided with a bell tower and veteran trees in churchyards.[49]
- The potential of churchyards, chapel yards and burial grounds for species diversity is now being mapped as part of the Beautiful Burial Grounds Project.[50]
- A recent review of the Garden BirdWatch scheme, which collects data on a weekly basis from more than 16,000 sites using volunteers, has demonstrated its potential to detect trends that can be linked to gardens as a proportion of urban environments.[51]
- Some useful recent work on the effectiveness of different types of habitat restoration, including in the context of new development.[52]
- Awareness of the benefits offered by sustainable new-build, and the interdependence of sustainable development and ecologies – from spectacular high-profile projects such as Milan's Bosco Verticale (architect Stefano Boeri) to the developing concepts of 'construction ecology' and 'building ecology' which are focused on the science of new materials and the integration of new design into surrounding landscapes and their related ecologies.[53]

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[44] Williamson (2013), 175-6
[45] Historic England *Bats in Places of Worship* 2016 and *Bats in Traditional Buildings* 2009
[46] Specifically the Farmsteads Assessment Framework and related guidance on adaptive reuse and maintenance https://www.historicengland.org.uk/advice/caring-for-heritage/rural-heritage/farm-buildings/
[47] e.g. Segal (1969); Darlington (1981)
[48] Dry Stone Walling Association of Great Britain (2011)
[49] Rosin *et al.* (2016); Skorka *et al.* (2018)
[50] Managed by the Caring for God's Acre charity, see https://www.caringforgodsacre.org.uk/category/beautiful-burial-ground/
[51] Cannon *et al.* 2005
[52] Sutherland *et al.* 2018
[53] For example Graham 2009, Kibert 2005 and Kibert *et al.* 2003

- Research scoping the spatial integration of geodiversity – which is integral to the character of the built environment - and biodiversity at the landscape scale, including their contribution to landscape character and the delivery of ecosystem services.[54]
- Historic England's Strategic Stone Survey, hosted by the British Geological Survey and now completed for most of England except East Anglia, which has published a database of UK quarries, mines and mineral workings.[55]
- Work by the *Sustainable Traditional Buildings Alliance* which has demonstrated the environmental benefits of conserving and retrofitting traditional buildings and using the principles of traditional construction to guide and inspire the construction industry.[56]

4 DEFINING AND ANALYSING THE HISTORIC STOCK IN ITS CONTEXT

4.1 Introduction

The historic character of buildings and their related spaces in the landscape is a crucial factor in determining the range of services that they and their associated boundaries provide to society, resulting from how land has been settled, farmed and otherwise developed over centuries.

4.2 The building stock

The date and range of the building stock results from:

- Their original and historic function as expressed in the range of building types and their associated spaces and boundaries, reflecting changing ways of domestic and communal life, commerce, industry, worship, education and landownership. Access and the spaces around them can be for work (for farmyards, access to workshops and stores etc.), for the use of the public – streets, greens and footpaths – or be private spaces such as gardens.
- Their date or time-depth, reflecting successive phases of investment, rebuilding and adaptation.
- Their architectural style, reflecting the interplay of national and local influences and distinguishing between traditional (or vernacular) architecture, architecture following established styles (Gothic, Tudor, Georgian, etc.) and modern industrial sheds which display no place-to-place variation.

[54] Bruneau *et al.* 2011
[55] Strategic Stone Survey and Database at http://www.bgs.ac.uk/mineralsuk/buildingStones/StrategicStoneStudy
[56] http://stbauk.org

4.2.1 Definition of historic character

Building types and associated spaces and boundaries
The broad types of buildings, and the boundaries enclosing the types of spaces associated with them, result from their historic functions and the benefits that they have afforded for:

- Housing people and gardens for producing food and enjoyment.
- Housing farm animals and processing crops harvested from the land.
- Processing fish and other products from freshwaters and the sea.
- Housing industrial processes.
- Relaxation and recreation, including parks, gardens and urban spaces, sports and recreation grounds.
- Treating and providing water.
- Facilitating communication, commerce, trade and exchange.
- Education, commemoration and communal interaction.
- Places of worship and burial.
- Treatment of and recuperation from illness, and for promoting well-being.
- Local and national defence including training and infrastructure.

Most of the present building stock accommodates households, whether purpose-built as dwellings of different types or – an increasing phenomenon since the 1970s – adapted from other types of buildings. The housing stock has doubled every 50 years since 1801 and by a factor of 7 since the 1851 census, a key reason for this being the smaller size of households. There are now 23.1 million households in England.[57] Domestic types are dominant in all except some of the sparsely-populated rural areas where agricultural buildings may be more numerous. Estimates for the amount of land taken up by buildings vary, and do not take into account buildings which may exist within the context of enclosed farmland, woodland and unenclosed land such as moorland and heath. The Generalised Land Use Database for England (GLUUD), which uses Ordnance Survey MasterMap and was last updated in 2010,[58] estimated that 7.5% of the land area of England was taken up by Developed Land, with buildings comprising 1.1% of this overall total, whereas the Centre for Ecology and Hydrology offers an estimate of 8.9% for 'Built-up and gardens'.[59] An indication of the dominance of houses is that domestic gardens alone occupy 4.5% of England's land area,[60] and 5.7% of the land area of

[57] English Housing Survey, Headline Report for 2016 to 2017 (Ministry of Housing, Communities and Local Government, https://www.gov.uk/government/statistics/english-housing-survey)
[58] *Generalised Land Use Database* (CLG 2013)
http://data.gov.uk/dataset/land_use_statistics_generalised_land_use_database
[59] Centre for Ecology and Hydrology (2011) *Final Report for LCM2007 – the new UK Land Cover Map, 2011.* Land Cover Map. https://www.ceh.ac.uk
[60] Houses and gardens occupied 4.6% of land area in 1950 (Williamson (2013), 163-4 quoting Dudley Stamp 1950.

the rural environment,[61] although no typological breakdown of house types has been provided. The conversion of redundant urban and rural buildings into housing has made a significant contribution to the housing stock over the last 20 years, and indeed will continue within areas of 'previously-developed land' as defined by GLUUD, in other words brownfield sites that are constantly being redefined and created through redundancy and release onto the market.[62]

4.2.2 Date or time depth

This typological range also reflects change over time, time-depth reflecting successive waves of rebuilding and comprising the fundamental baseline for interpreting and considering the range of benefits offered by landscapes and places (Figure 4).[63] The Institute of Historic Building Conservation, in combining the results of the English Housing Survey and the 2001 House Condition Survey, estimates that, of the existing stock in 2016:

- 2.9% is pre-1850.
- 16.4% is 1850-1918, evenly split equally either side of 1900 – an indication of the strength of the Edwardian housing boom.
- 16.4% is 1919-44.
- 64.3% is post-1945, the highest proportion being 1945-64 (19.7% of the total) and 1965-74 (14.2%).[64]

These statistics also find their reflection in the estimate that buildings offered statutory protection through listing comprise only around 2% of the building stock,[65] the recently-revised Principles for Selection drawing attention to:

- 'before 1700, all buildings that retain a significant proportion of their original fabric are likely to be regarded of special interest;
- from 1700 to 1850, most buildings that retain a significant proportion of their original fabric are likely to be regarded of special interest, though some selection is necessary;
- from 1850 to 1945, because of the greatly increased number of buildings erected and the much larger numbers that have survived, progressively greater selection is necessary;
- careful selection is required for buildings from the period after 1945, another watershed for architecture.'[66]

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[61] As recorded in the 2007 Countryside Survey, most of it in the arable and horticultural broad habitat types and then an increase of 3.9% since 1998. (Countryside Survey (2007), Chapter 9: *Developed Land in Rural Areas*: http://www.countrysidesurvey.org.uk

[62] Bibby and Brindley (2006 and 2007); Bibby (2006)

[63] Fairclough (2003 and 2006a and b) for consideration of time-depth and the issues for achieving a seamless understanding of landscape character that brings together ecological and historical perspectives

[64] English Housing Stock Age, Designing Buildings Wiki, October 2016 (https://www.designingbuildings.co.uk/wiki/English_housing_stock_age)

[65] English Heritage, *Heritage at Risk*, 2010

[66] Department for Culture, Media and Sport (2018) *Principles of Selection for Listed Buildings* (https://www.gov.uk/government/publications/principles-of-selection-for-listing-buildings)

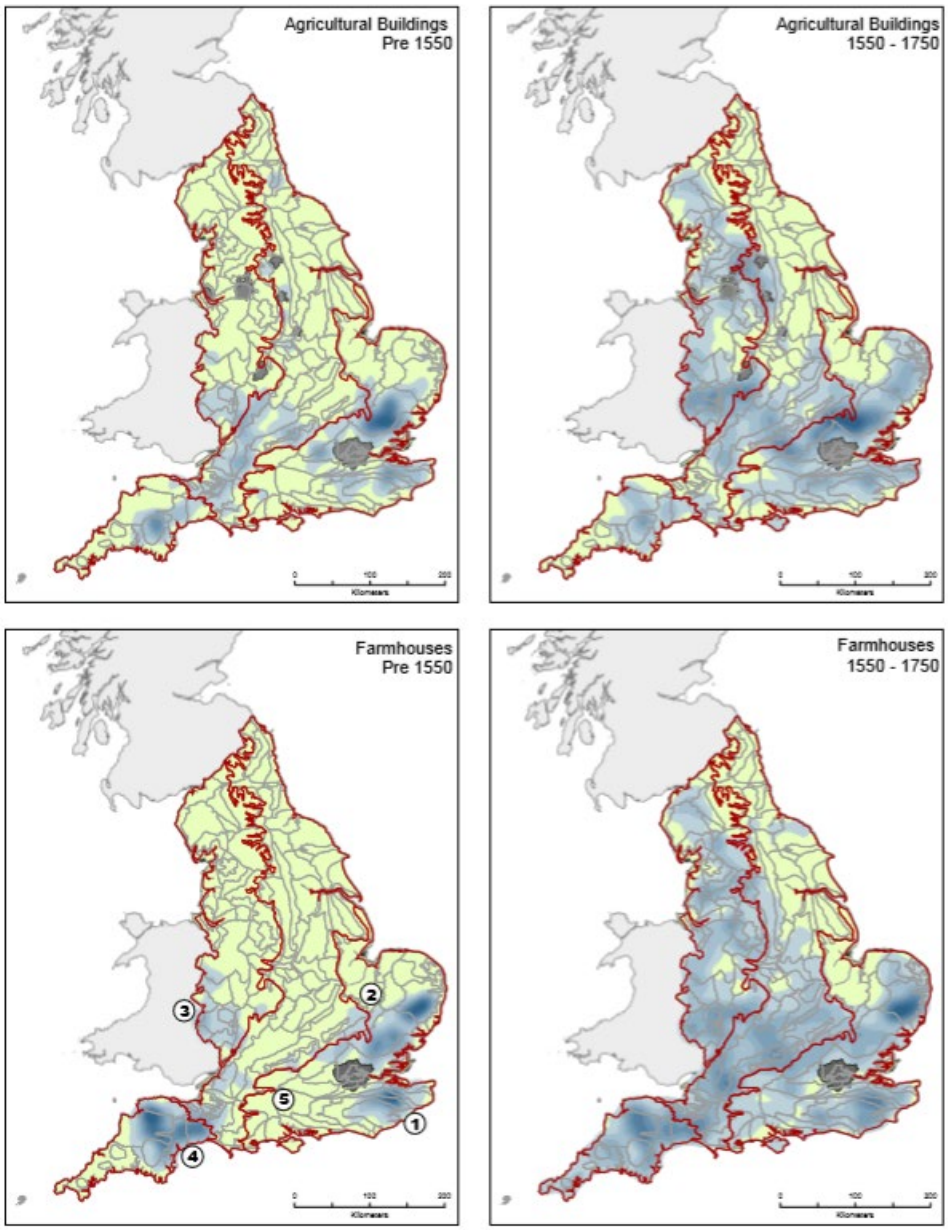

Figure 4: Distribution of pre-1550 and 1550-1750 listed farmhouses and farm buildings, showing Province boundaries (Roberts and Wrathmell 2000) and NCAs. The red lines mark the boundaries between the Central Province dominated since the 11th-12th century by village-based settlement and more dispersed settlement in the settlement provinces either side. The majority of farmhouses and farm buildings (almost all barns) associated with the development of peasant holdings and farms date from the 15th and early 16th centuries. They are concentrated in the anciently-enclosed farmlands and dispersed farming settlements of south east England (1), East Anglia (2), the southern West Midlands (3) and the south west (4). There is also a concentration in Somerset, where there are many isolated medieval houses as well as those located in villages, and in villages in central southern England (5). By 1750 rebuilding and new building had extended into the Central Province and along the wetter pastoral west up to the Scottish border, survival being lowest in a large part of eastern England whose farming landscapes were most affected by changes (for larger arable-based and stock-fattening farms) after this period.

The main phases for historic development, reflected in watersheds in layout and design and as summarised in Appendix 1, are medieval (pre-1550), post-medieval (to 1749), Georgian and Early Victorian improvement (1750-to 1849), High Victorian and Edwardian Growth (1851-1913), World Wars and Inter-War (1914-1944) and Post-1945. Churches, castles, barns, religious houses and high-status houses comprise the main survivals from the medieval period. Town houses survive from the 12th century and peasant houses from the 13th century, although most of the surviving building stock is 15th and early 16th century and displays strong regional variation with a concentration in the southern half of England. Later waves of rebuilding either made use of or largely swept away the pre-existing stock, there being a sharp contrast between those areas with a strong or weak survival of 1550-1650 or 1650-1750 buildings. As a consequence it is important to be sensitive to those large areas of the country that have been most profoundly affected by post-1750 and later change such as the uplands of northern England and Cornwall, in contrast to the high densities of 17th century and earlier buildings in areas such as the Arden and the Weald.[67] Consideration of patterns of rural rebuilding, obtained from the statutory list as part of the initial stages of Farmsteads Characterisation, has revealed the potential of listing data – if capable of being inputted or searched by date and building type - to act as a research tool for the investigation of historic buildings. It has revealed strongly differential rates of growth in these areas, some areas already peaking by the early 19th century and stagnating thereafter (textile areas such as the Cotswolds and East Anglia), some rural industrial areas (such as the South Pennines) experiencing growth around areas of enclosed and unenclosed commons and others (such as the NCAs around London) experiencing a strong pattern of both nucleated and dispersed rural settlement growth.[68]

These developments paved the way for the transition towards an increasingly urban and industrial economy, the 1851 census famously marking England's emergence as the world's first 'urban society'. 1850 also marks a significant stylistic break or watershed in architectural development, recently reflected in Historic England's revised Principles of Selection for designation.[69] The housing stock has grown by more than a factor of 7 since 1851 (Figure 5), regional variations responding to structural shifts in the economy and to the changing ways that financial surpluses are invested: for example only a fivefold increase in the stock within 50 kms of Manchester, as opposed to a ninefold increase for the London area which peaked during the 1930s. Rural areas display a tendency to more nucleation but strong variation in their contribution to the overall increase – from very high levels of housing development around London and the eastern fringes of Birmingham in contrast to only a threefold increase in the rural parts of northern England, the south-west, East Anglia and the Welsh Marches, leaving the medieval settlement pattern inherited from the medieval period largely untouched. The mid-19th century is also familiar to building historians in marking the development of new architectural styles and an accompanying variety of new building types to serve the needs of a national communications system, new forms of commerce and industry,

[67] For more on the geography of rebuilding in rural areas see Lake and Edwards (2007)
[68] Bibby (2018)
[69] Department for Culture, Media and Sport (2018)

local and national civil society and its supporting infrastructure and regulation for the supply of services and improved standards of sanitation and housing.

After 1918 the widespread introduction of the motor car and electrification sees a significant shift in the 'space economy', with dwelling increasingly decoupled from places of work and a shift from northern to Midland and southern industries. The standardisation and mass production of materials, foreign imports and improved infrastructure reduced costs, and by 1939 nearly a third of the population lived in houses built after 1918. Strong growth in housing from 1945, matched by continuing sharp falls in household size, has been countered by the development of a stronger land-use planning regime. Over the whole period from 1980 to 2011, housing output dropped to 41% of its average level between 1951 and 1980. A far higher proportion of housing in this period has been built on previously developed land, and after 2000 to higher densities. Many new homes built in the period from 1981 to the present have been converted from redundant historic buildings in urban and rural areas, with planning policies seeking to concentrate new houses on existing village settlements in rural areas.[70]

[70] Bibby (2018)

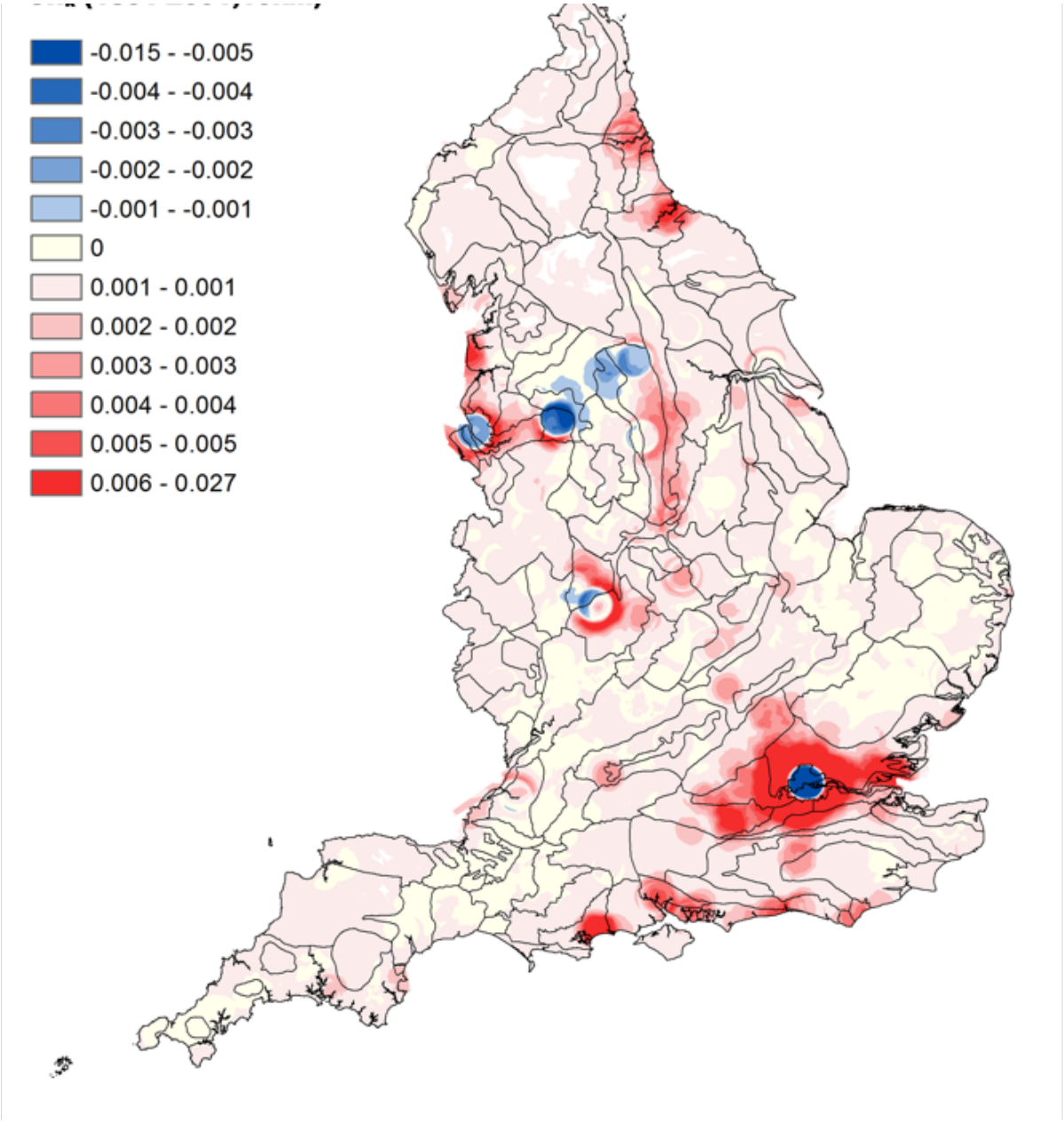

Figure 5: Unequal growth in the dwelling stock between 1851 and 2001, using a moving window of 10km, from Bibby 2018. The map also shows the NCAs.

4.2.3 Architectural style

The building stock displays broad distinctions between:

- Traditional buildings, mostly domestic and agricultural, are dominated by their use of local materials – stone, slate, timber frame, thatch, earth, brick and tile - and through their form, planning and other features. They may also use imported materials such as slates and tiles, but in all cases their form and planning respond to local conditions and needs.
- Designed buildings in a recognisable architectural style – Anglo-Saxon, Romanesque and Gothic to the interplay of modern and revivalist styles in the 20th century - which offer testament to national as well as local influences and developments. They can use the same materials but are more likely at an earlier date to use the specialist services of professional craftsmen and suppliers such as tilers and brickmakers.
- Modern utilitarian buildings using iron, steel and concrete, which in their form and construction display no place-to-place variation and which, after decades of experimentation with emerging technologies, were increasingly used from the 1870s.

Traditional and designed buildings make the most significant contribution to the character of places and how they are experienced. In this respect materials, and the techniques used to assemble them, provide clues to the age and development of buildings. These often vary from place to place, as a result of craft traditions, the local geology, manufacturing and transport costs. Brick and stone, for example, has often replaced or even encased earlier buildings built from timber or earth.

Of particular importance in this respect is the relationship of architectural style, and its association with particular building types, to the time depth of the building stock as set out above:

- Medieval (pre-1550): most commonly ecclesiastical buildings reflecting the development of Anglo-Saxon, Romanesque and Gothic styles and traditional domestic, agricultural buildings and commercial buildings which at a higher social level adopt these styles.
- Post-medieval (to 1749): development of strong local variation in domestic and agricultural architecture, increasing influence of styles derived from Italian Renaissance, Dutch Republic from 1650 etc.
- Georgian and Early Victorian improvement (1750-to 1849): continuing strong local variation in agricultural architecture, increasing diversity and interplay of local and national/international influences in domestic architecture, increasing diversity of building types which also reflect development of standardized approaches to planning, national transport infrastructure etc.
- High Victorian and Edwardian Growth (1851-1913): marks significant stylistic break in end of dominance of Late Stuart/Georgian symmetry and great diversity including Gothic Revival, Domestic Revival and Arts and Crafts styles, and in increasingly conformity of specialized building types to

standardized designs and planning including prefabrication; period marks final phase in development of traditional agricultural buildings.

- World Wars and Inter-War (1914-1944): prefabrication on World Wars and for some building types, limited adoption of international styles (e.g. for Modern Movement housing largely confined to southern England) countered by dominance of historicist styles for public and private domestic architecture.
- Post-1945: move towards rapid/ standardized construction countered by continuing dominance of historicist styles for public and private domestic architecture.

4.3 Landscape and settlement context

4.3.1 Historic landscape and settlement context

The types, dates and architectural of buildings, and the spaces that they required or were built within, have also had a fundamental impact on local character and distinctiveness in urban and rural places:

- *Urban settlement*. 81% of the population now live in urban areas, having populations of more than 10,000 people and which according to the UK NEA occupy 10.6% of England's land area. Urban areas may include areas of enclosed and unenclosed land, sometimes converted to parkland and offering considerable benefits to people and wildlife, and the density of buildings and their related plots is closely linked to their date and type, examples being the provision of large gardens in villa housing and of smaller gardens in grid layouts in terrace housing.
- *Rural settlement*, either within villages – concentrated in a central band across England - or more sparsely-populated areas comprising hamlets, isolated houses and farmsteads. The distribution of historic buildings in rural areas derives from how land was settled and farmed from the late Saxon period, either from village farms working large open fields subdivided into blocks of ploughed strips around them or from smaller settlements and scattered farmsteads which worked a more complex mosaic of open fields/enclosed fields which may again be subdivided by ploughed strips and scatters of common land.
    - Rural villages are concentrated in a 'Central Province' of England (see Figure 4), with most isolated farmsteads and houses resulting from piecemeal or survey-planned enclosure of the open fields around them after 1550.
    - Landscapes of dispersed settlement to either side of the Central Province have fewer and smaller villages and higher densities of isolated houses, farmsteads and hamlets that were intermixed with a complex variety of fieldscapes and often extensive areas of unenclosed land. The siting, dates and layouts of farmsteads and other buildings with their associated spaces and boundaries is closely related to the dates of the enclosed fields

around them, whether pre-1550, 1550-1750 or post-1750 (and usually survey-planned) enclosure.

- Buildings within Unenclosed Land are rare, and mostly comprise outfarms and field barns and buildings to assist in industrial and specialist purposes. Such has been the extent of enclosure since the medieval period that unenclosed land is now rare, even in areas of historic dispersed settlement where it was once more common. Such land includes moorland used for grazing stock, extracting fuel and industry; marshland and mossland for game, fishing and grazing livestock and for growing distinct crops (e.g. willows and reeds as well as peat/turf for fuel); unimproved heathland and downland. They provide valuable habitats for biodiversity or rare species as well as paleoenvironmental remains and some of the best-preserved archaeological evidence of earlier settlement and field systems in England.
- Surviving structures within woodland are very rare, and mostly comprise accommodation for estate workers, built in an integral association with woodland management, and structures (for example military and industrial sites) remaining within areas of woodland regeneration.

Figure 6 demonstrates the limitations of designation data and the potential for mapping building types – in this case farmsteads and field barns – in relationship to landscape character and using this to inform consideration of ecosystem services. Buildings recorded on the Hampshire HER, all comprising listed buildings and most dating from the 17th century and earlier, are concentrated in the lowland and heath area to the north, being most dense within the anciently-enclosed Pasture and Woodland landscape type and along the springline boundary to the Hampshire Downs and in the fertile Greensand. Within the Hampshire Downs, they are also found in the Chalk and Clay landscapes enclosed between the 14th and 18th centuries (where recorded buildings are more commonly of 18th century date) but are largely unrecorded in the post-1750 enclosure Open Arable landscapes. The red dots mark all surviving traditional farmsteads, as shown on Ordnance Survey maps of c.1900 and added to Hampshire's Historic Environment Record as a result of Farmsteads Mapping. Many of these on inspection were shown to have earlier origins, but with buildings remodelled or newly-built in the mid-late 19th century which did not meet listing criteria: the Open Arable is in fact characterised by large courtyard farms of a distinct architectural character which date from the 1780s. Similar contrasts, including emerged when farmsteads were mapped in relationship to HLC.

The challenge for ecosystem services is to build on the approaches summarised in this section and consider fresh ways of assessing buildings in their landscape context. This needs to utilise an integrated understanding of the interplay of natural and historic factors, the importance of observation being underlined by the fact that so many features at the interface of professional disciplines are absent from databases (see Figures 7 and 8).[71]

[71] The summary of Kipscombe arises from a workshop in June 2018 with National Trust Rangers and of Edensor from liaison with the Chatsworth estate prior to a conference outing in September 2018.

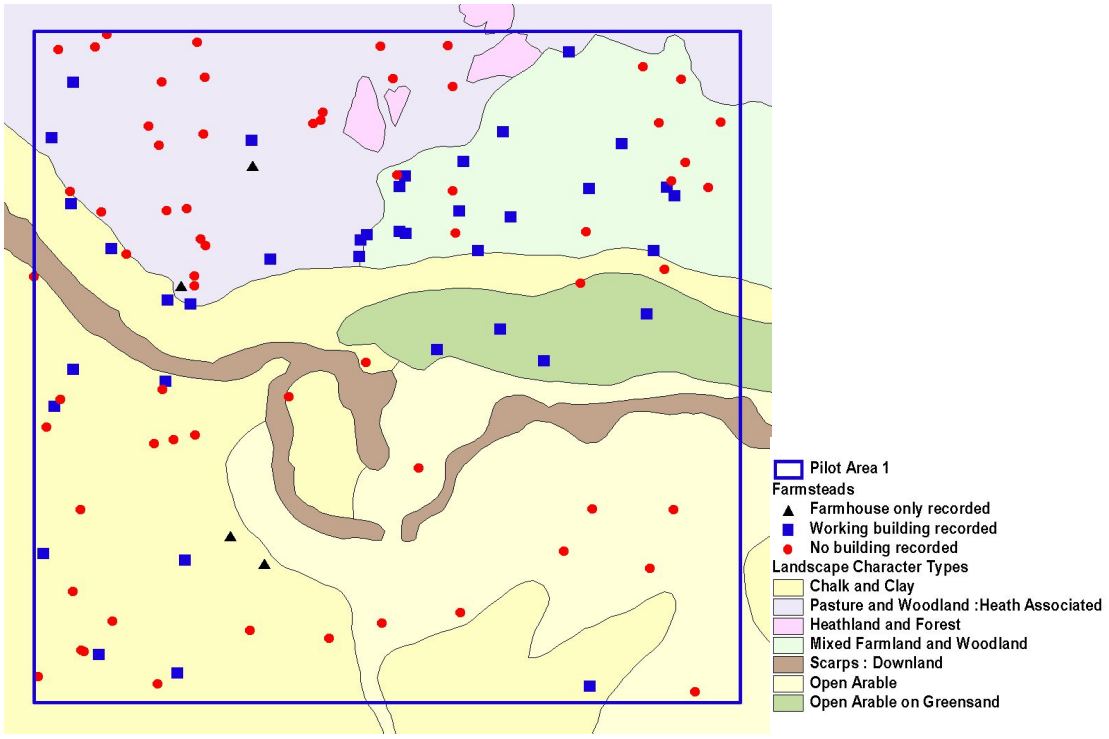

Figure 6: Farmsteads Mapping in Hampshire, showing farmsteads in relationship to Landscape Character Types and ecosystem service provision. (Map from Edwards 2006).

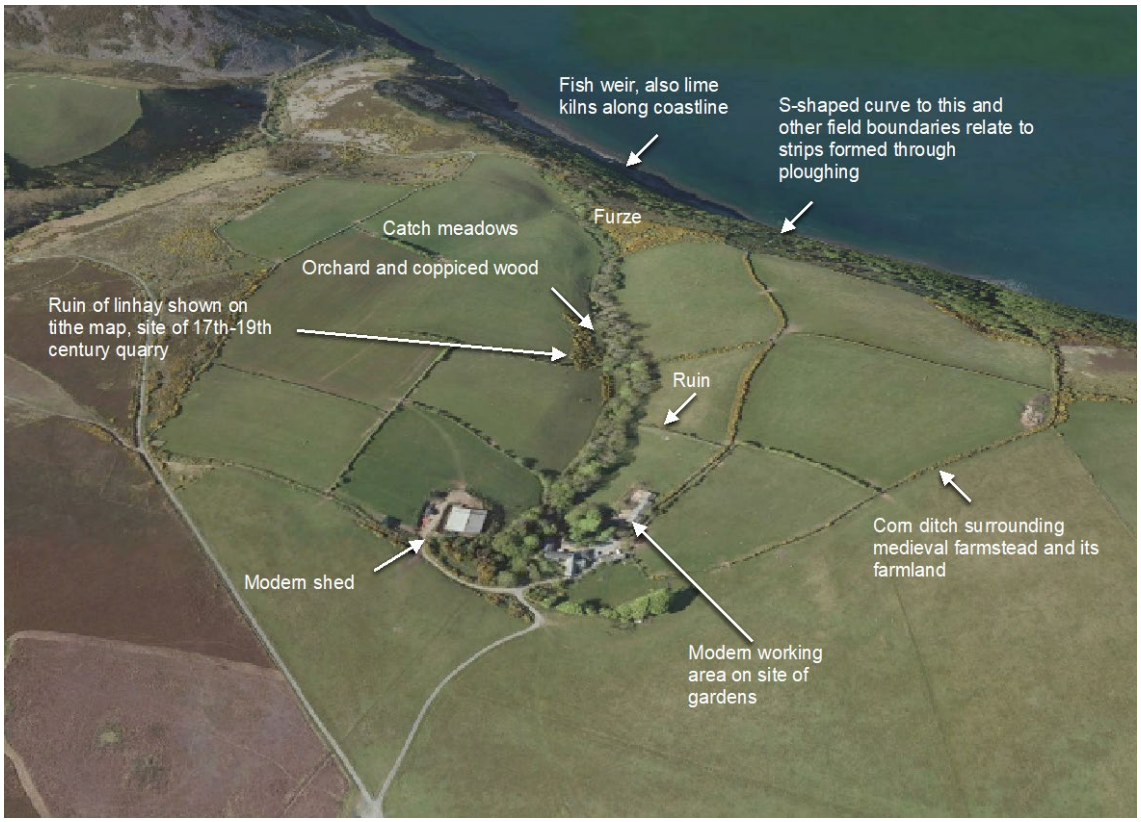

Figure 7: Kipscombe, Exmoor. Google Earth image of Kipscombe, showing the medieval farmstead set in its enclosed landscape with its catch meadow for providing early crops of grass, a mix of S-shaped curves derived from medieval plough strips, later straightened boundaries, a narrowed-down holloway connected to the farmstead and the medieval 'corn ditch' surrounding the farm. Also, key – and absent from the Sites and Monuments Record - is the narrow valley with its coppices, pollards and orchards, its stream and dammed ponds, which together with the furze grounds supplied fuel and materials for making fences and fish in addition to fruit, fuel, fodder and fish brought to the farmstead. The 17th century house was joined to cattle housing and has a cider house, the construction of a bank barn c. 1850 marking a short-lived shift to intensive arable production.

Figure 8: Field barn landscape to west of Edensor, Chatsworth estate, Derbyshire. The Chatsworth estate lies within the Farm Estatelands Character Area as defined in the Peak District Landscape Strategy, which combined the results of HLC and Landscape Character Assessment across the Peak District National Park.[72] The estate has recently invested over £40,000 in maintenance and stabilisation of this group of 14 field barns, including the installation of nesting boxes for owls. They are an integral part of former hay meadows flanking a valley stream and are visible from the footpath approaching Edensor and Chatsworth Park. As traditional farm buildings they provide a strong contrast with the celebrated model village built by the 6th Duke of Devonshire in the 1820s and 1830s, the occupants of whom (resited from their former homes) were allotted holdings to its west. The vast majority of field barns across the Chatsworth estate date from between the 1830s and 1870s, when many of the farmsteads were improved and farmland reorganised. Some contain evidence for timbers taken from earlier timber-framed structures or earlier roofs, and there is scattered earthwork evidence and map evidence suggesting that 18th century and earlier examples were a less common but characteristic feature of the landscape. The great majority are single-storey with far less storage for the hay crop than was the norm further north in the uplands of northern England.

[72] Peak District National Park Authority and Countryscape (2009) *Peak District Landscape Strategy and Action Plan*. www.peakdistrict.gov.uk.

5 SCORING HERITAGE VALUE AND ECOSYSTEM POTENTIAL

5.1 Introduction

This section sets out a framework for the assessment of heritage value and using this to inform consideration of the potential of buildings of different types in different contexts to deliver the broadest range of ecosystem services.

5.2 Scoring heritage value

Consideration of heritage value incorporates three factors into a single scoring system (See Figure 9):

- Time Depth – focusing on the evident date of buildings, and how long they and the spaces they enclose have been part of landscapes and places.
- Legibility – the extent to which buildings and their boundaries (hedges, walls, fences etc.) are present and function together, giving consideration to the historic character of buildings of different types and the spaces (gardens, yards etc.) associated with them.
- Inter-relationships – their relationship to the historic development of the landscapes around them, and any other recorded or observed historic areas, buildings or archaeological sites and features, all of which help to tell the story of how places have developed into their present form.

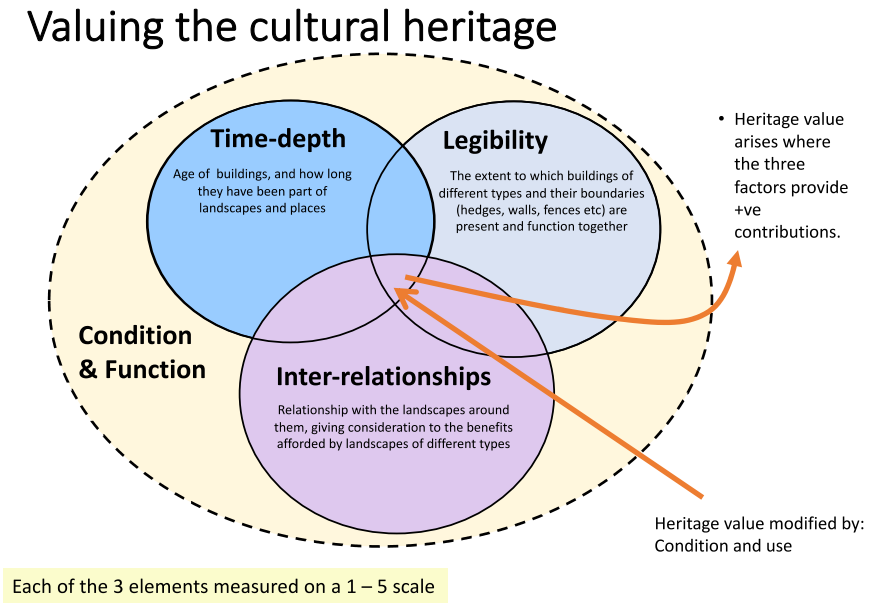

Figure 9: Factors contributing to heritage value of buildings and their associated boundaries and spaces

5.2.1 Time depth

Scoring focuses on the evident and recorded date of buildings within historic settlements or places, recognising the significance in a national context of pre-19th century fabric and traditional rural buildings:

- **Very High**. Historic settlement or place (medieval and later) dominated by its 18th century or earlier building stock.
- **High**. 19th century or earlier settlement or place *with a mix* of 19th century (pre-1914) and earlier buildings.
- **Medium**. 19th century or earlier settlement or place *dominated by* 19th century traditional rural and designed buildings.
- **Low**. 19th century settlement or place dominated by its 1850-1945 building stock, where mass-produced materials and techniques are more common.
- **Very low**. Post-1945 site or settlement, or site wholly redeveloped with post-1945 building stock.

5.2.2 Legibility

Scoring marks the extent to which historic buildings have survived with their spaces (gardens, paddocks, historic plots etc.) and traditional enclosure boundaries (hedges, ditches, dry stone walls, brick walls):

- **Very High**. 19th century or earlier settlement or place with coherent survival of historic spaces and boundaries *and other earlier features* which are known to be medieval (e.g. churchyards, greens) or represent rare survivals of 18th century or earlier historic spaces that developed with historic buildings
- **High**. 19th century or earlier settlement or place, with minor development or loss of its historic spaces and associated features such as ponds, quarries, kitchen gardens, orchards and shelter belts.
- **Medium**. Includes:
    - Mostly extant 19th century or earlier settlement or place, with some development or loss of its historic spaces.
    - Any extant settlement or place dating from after 1850 and pre-dating 1945 which retains its historic plan form or layout with associated spaces.
- **Low**. Includes:
    - Substantially developed 19th century or earlier settlement or place, with development or loss of more than half of its historic spaces.
    - Any extant or partly extant settlement or place dating from after 1850 and pre-dating 1945.
    - Any extant settlement or place dating from after 1945 which retains its historic plan form or layout with associated spaces.
- **Very low**. Includes:

- Settlement or place with no or fragmentary survival of associated green spaces and traditional boundaries.
- Any site dominated by modern utilitarian sheds and hardstandings.

5.2.3 Historic inter-relationships

Scoring marks the contribution of the natural and historic setting to ecosystem services:

- Very High. Place is *located within* the following historic areas or landscape types which also have high archaeological and habitat potential as priority habitats:
  - rural and urban parkland, wood pasture, broadleaved and mixed deciduous woodland, native pine woodland,
  - unenclosed land including heathland, moorland, calcareous grassland and bogs/mossland,
  - lowland and upland hay meadows,
  - typically pre-1550 enclosed fields and fields recorded as resulting from Ancient Enclosure.
- High. Place *borders* any of the areas as defined above AND has plots and boundaries directly linked to enclosed fields, other green space and historic routeways around them.
- Medium. Place has plots and boundaries linked to enclosed fields and their associated historic hedgerows, dry stone walls, ditches and banks.
- Low. Fragmentary survival of historic field and routeway boundaries and/or partial loss of historic landscape context.
- Very low. Surrounding area redeveloped, other heritage assets may include below-ground archaeology but not upstanding archaeological sites or pre-1914 buildings.

5.3 Heritage Value and Ecosystem Service Potential

Assessment of heritage value for ecosystem services must thus consider the inter-relationship of human and natural factors. An obvious example is offered by the relationship of priority habitats to archaeological earthworks (settlement, field systems, medieval lynchets and ridge and furrow) and its potential for further palaeoenvironmental and archaeological evidence, including the potential of undeveloped land within the curtilages of buildings. These inter-relationships are set out in further detail in Appendix 2, with reference to:

- At a broad level the NEA typologies and the habitat types used for the UK Broad Habitat Classification (BHC).[73]
- At a more detailed level the classifications for Phase 1 Habitat Surveys[74] and also priority species and habitats as set out in the *UK Post-2010 Biodiversity Framework,* which succeeded the UK Biodiversity Action Plan.[75]

These have been used to draw up statutory lists of priority habitats[76] and have been used as to monitor change, for example through the Countryside Survey 2000 and since 2006 (within the statutory framework of the Natural Environment and Rural Communities (NERC) Act) in initiatives led by the Joint Nature Conservation Committee (JNCC). Appendix 3 offers further details on the inter-relationship of these Phase 1 habitat types and HLC.

5.4 The contribution of buildings to ecosystem services

This report marks the first, exploratory step in consideration of the ecosystem services provided by buildings and their associated boundaries and spaces, as set out below.

5.4.1 Supporting services:

- Primary production through synthesis of construction materials into organic material and surfaces including lichens and mosses.
- Habitat formation:
    - as a consequence of the materials used for the construction of their walls, roofs, surfaces and boundaries,
    - as a consequence of their time-depth and design, the former being linked to duration of habitat and the latter affording some species habitats,
    - as a consequence of the boundaries and the spaces they enclose, and their connectivity to surrounding landscapes of different types,
    - as a consequence of continued use or redundancy,
    - indirectly through colonising as well as domesticated fauna and flora,
    - as a consequence of walls, other boundaries and gardens including orchards for pollinator species,

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[73] For details of the UK Broad Habitat Classification, including the Defra 2010 *Handbook for Phase One Habitat Survey. A technique for environmental audit,* see the Joint Nature Conservation Committee website at http://jncc.defra.gov.uk/

[74] Joint Nature Conservation Committee (JNCC) and Defra 2010 *Handbook for Phase One Habitat Survey. A technique for environmental audit* - *http://jncc.defra.gov.uk/PDF/pub10_handbookforphase1habitatsurvey.pdf*

[75] Joint Nature Conservation Committee (JNCC) and Defra 2012 UK Post-2010 Biodiversity Framework

[76] Wildlife and habitat designations on the Defra 'MAGIC' online portal (http://magic.defra.gov.uk/); Sites of Special Scientific Interest (SSSI) notified under the Wildlife and Countryside Act (1981) as being of special nature conservation interest - http://www.sssi.naturalengland.org.uk/Special/sssi/search.cfm; Sites of Importance to Nature Conservation (SINC), which are sites of non-statutory designation recognised by local planning policies; Local Nature Reserves (LNR) http://www.lnr.naturalengland.org.uk/Special/lnr/lnr_search.asp

- supporting nitrogen-rich plants and invertebrates in and around farmyards, and food sources for birds (in grain and other foodstuffs spilt from crop-processing and animal-feeding areas).

- Soil formation:
  - through the creation and maintenance of gardens, orchard, yards and paddocks that remain as grassed or cultivated.

5.4.2 Provisioning services:

The density, date and pattern in the landscape of buildings and the boundaries which enclose their associated spaces can provide:

- Housing and shelter for residents and visitors.
- Shelter for machinery, industrial plant and other forms of capital.
- Commercial operating space for businesses, commerce, industry, farming etc.
- Food from local landscapes: through the processing of crops (e.g. barns, mills), the shelter and management of livestock (farm buildings) and the provision of fruit, vegetables and other food (e.g. horticultural/garden buildings).
- Traditional skill maintenance and enhancement, including local geodiversity: through use of traditional materials – stone, slate, brick, lime, timber.

5.4.3 Regulating services:

The density, date and pattern in the landscape of buildings and the boundaries which enclose their associated spaces can serve to regulate:

- Climate: contribute to climate change mitigation through:
  - re-use of traditional materials rather than replacement, utilising the embedded energy in the existing building stock,
  - reuse traditional materials to further reduce the environmental footprint generated in the use of new traditional materials, now often imported over great distances,
  - their orientation and design, from walled gardens and south-facing farmsteads to 19th century hospital design and modern environmental design.
- Soil health and erosion: boundaries and their enclosed spaces (excluding paved and concreted areas) can assist in the management of soil health and erosion by:
  - impeding the through-flow of water and water-borne silts and other material,
  - and by reducing the impact of wind and rain/snow,
  - fertilising and changing soil structures.

- Drainage and flood control: soft surfaces and uncompacted soil in these areas assist in drainage and flood control, and in countering the 'heat effect' of surfaced areas in combination with buildings in urban areas.
- Water supply and sewage treatment - mills and pumping stations, for example, regulated the flow and treatment of water for powering machinery and for the supply of clean water and removal of waste.

5.4.4 Cultural services:

Buildings and the boundaries which enclose their associated spaces are fundamental to sense and place and history. Their diversity of materials, types and style, when considered as a whole with the gardens, yards and other enclosed spaces with which they are associated, offer benefits to:

- Sense of place and aesthetic values as a result of:
  - locally distinctive materials, styles and forms of architecture,
  - traditional or specialist-designed forms and styles that are locally-rooted or influenced by national and international social, economic and aesthetic developments,
  - their direct link to local environments through their use of local earth, clay, timber and stone (geodiversity).
- Sense of history:
  - through offering a rich source of evidence for the historic development of places in their local, national and international context.
- Spiritual and communal value: interaction leading to community cohesion, vibrancy and sustainability, capacity building and enabling opportunity.
- Amenity value: improve quality of life and health and wellbeing, both mental and physical, for example in attracting inward investment, visitor destinations, for people to interact with the natural and historic environment.
- Educational and scientific value because of:
  - inspiring the enjoyment of heritage assets and the historic and natural environment,
  - providing opportunities for discovery, identification, education and research - for example in the transition from communal to more individual ways of living, the adoption of new building techniques and architectural styles and interaction with local ecologies, reflecting people's accommodation of changing ways of living and working.

6 CASE STUDIES

6.1 Introduction

This section considers the historic development and landscape context for three case study areas, followed by a summary of the scoring methodology as set out in 5.2 and the opportunities offered by their landscape context (their Ecosystem Service Potential):

- The Sherborne estate in Gloucestershire's Cotswolds, which is focused around a landscape park and village in the Windrush valley, a 17th century hunting lodge, enclosure-period isolated farmsteads and a Second World War airfield (see Figure 10).
- The Attingham estate in Shropshire, which has higher density of enclosure and pre-enclosure farmsteads set around the park and village close to the banks of the Severn. The National Trust has also selected Attingham as a pilot project for realizing additional income streams through the adaptive reuse of redundant buildings (see Figure 16).
- Upper Booth, a farmstead at Edale in the Peak District (see Figure 21).

This section concludes with consideration of the effectiveness of the natural and historic environment data curated by the National Trust's Conservation Information Team and local HERs, and the advantages and disadvantages of rapid assessment which can enable identification of ecosystem service potential. Appendices 4-6 set out the details for each site with their Heritage Value scores.

Different levels of data and survey have been used to present this analysis:

- Sherborne: half-day extensive survey and GIS mapping of the National Trust HBSMR and the Habitat Survey Codes.
- Attingham and Upper Booth: half-day extensive survey (for Upper Booth as part of the Peak District Walls Project), GIS mapping of the National Trust HBSMR and the Habitat Survey Codes and also of Farmsteads Mapping data, HLC and the Historic Environment Record; Attingham has also benefitted from Historic Farmsteads Assessment, using the results of Farmsteads Mapping and the development of Historic England's Farmsteads Assessment Framework.[77]
- Detailed species data collected for the Attingham estate, which proved to be difficult to use due to the long period over which the data has been collected and its location to the corners of grid squares rather than specific sites.[78]

Analysis of the overall heritage value scores reveals the following differences between the study areas:

- The overall score (3.6) for Sherborne reflects the generally well-retained character of the estate, significantly above-average scores being for the village

[77] Tyler (2015)
[78] A web map with a wide range of data sites for all layers is available here - https://arcg.is/188ifW

(1-3), Lodge Park (11) and the outfarm sited within its park (12). The cultural value of the remains of RAF Windrush were more difficult to assess in relationship to ecosystem services: the control tower group with its pillbox and Romney huts is well-retained in a national context but has been scored lower than the technical buildings primarily due to the latter's location within high-scoring woodland.

- The overall score (3.4) for the Attingham estate farmsteads reflect a generally higher level of change than Sherborne's well-retained farmsteads, significantly above-average scores being for Home Farm (1), Cronkhill (2) and Lower Betton (4): all of these have well-retained areas that are integral and consequent to their origins and development.
- The overall score (4.0) for Upper Booth reflects the farmstead's well-preserved historic character in its typical Dark Peak setting. Its field barns also make a strong contribution to sense of place, sense of history, food provision and biodiversity, as well as providing physical and intellectual access and recreation.

Analysis of the individual heritage value scores reveal interesting variations between and within each of the study areas which are set out in further detail in Section 6.2-4:

- *Time Depth (average 3.6).* Sherborne (scoring 3.1) has fewer 18th century or earlier buildings as a proportion of its stock than Attingham (3.8) and Upper Booth (4)
- *Legibility (average 3.6).* In contrast a lower score for Attingham reflects higher levels of change to its traditional farmsteads (matching the data from Farmsteads Mapping for the wider area) in contrast to Sherborne (3.6) and Upper Booth (4).
- *Inter-relationships (average 3.6).* Upper Booth at Edale (4) retains a coherent enclosure landscape adjoining woodland and with access to moorland, and Sherborne (3.9) retains its 19th century designed landscape with many buildings sited within historic parkland and adjacent to notable meadow landscapes, and Attingham (3.0) has experienced high degrees of change to the farmed landscape.

It was also considered, as this project progressed in realization of the limitations of site-specific data to identify habitats and species, that the narrative method for setting out Ecosystem Service Potential or Opportunities might offer a useful framework for rapid assessment of a wide suite of issues that cut across disciplines, complementing and offering context to the detailed methods of assessing individual buildings, habitats and sites required for planning permission and listed building consent. Any assessment of this type needs to consider the local context as set out in the NCAs and more fine-grained Landscape Character Assessment, time constraints focusing the project's efforts on the former.

6.2 The Sherborne estate

6.2.1 Summary and landscape context

Sherborne (Figures 10-15) developed as a nucleated settlement from the Late Saxon period. Sherborne House was built after 1551 for Thomas Dutton, who had bought the manor (part of the holdings of Winchcombe Abbey from the late 8th century) from the Crown.[79] The parkland (a grade II Registered Park and Garden), as remodelled from 1726, survives as the most intact example of Charles Bridgeman's work as a landscape designer. A deer park to the south east (a grade I Registered Park and Garden), was built after John Dutton had acquired land for deer coursing in 1624. The village had developed with West and East Ends by the 14th century, the less compact eastern end being subject to a comprehensive programme of rebuilding by the estate in the early 19th century including a row of almshouses. The village is set within an area of historic meadow along the Windrush, a central core of parkland last subject to extensive remodelling in the mid-19th century and piecemeal enclosure of former open fields around the village. Farmsteads comprise medium-to-large scale courtyard layouts, with threshing barns, stables, cart sheds and granaries, that are also typical of the Cotswolds area. The turnpike along the ridge to the south (the present A40) dates from an Act of 1751, prior to which the main east-west routeway passed through the village. Just under half of the fields in the parish had been enclosed prior to the last phase of enclosure ushered in by a parliamentary act passed in 1777. The parish church was rebuilt in Middle Pointed style in 1850, retaining its 14th century tower, and Sherborne House in around 1830. This is reflected in the HLC for the area within and around the estate, which shows a basic distinction between the piecemeal enclosure of medieval strip fields and meadows in the river-valley settlements, the parkland and plantations associated with the Sherborne, Barrington and other estates and the post-1750 regular enclosure of open wolds on the plateaux.[80] This pattern of enclosure and the evidence offered by the buildings across the estate (particularly its large and many threshing barns with granaries, stabling and cattle yards) demonstrate the increasing dominance of arable cultivation since this period, confining surviving and more species-rich grassland to areas of historic meadow and parkland around the village, along riverine edges and within Lodge Park.

The traditional settlements and buildings on the Sherborne estate share many of the key characteristics of the Cotswolds NCA within which it is situated,[81] of particular relevance here being:

- Its development around a village settlement with its riverside water meadows, with a country house and medieval church at the core of historic parkland.
- A coherent building tradition in limestone, using numerous small quarries which remained open into the early 20th century.

[79] The history of the village is summarised in 'Parishes: Sherborne', in *A History of the County of Gloucester: Volume 6*, ed. C R Elrington (London, 1965), pp. 120-127. *British History Online* http://www.british-history.ac.uk/vch/glos/vol6/pp120-127 [accessed 16 October 2018].
[80] Hoyle (2006)
[81] Natural England, NCA Profile 107: Cotswolds

- How it illustrates the consolidation of estates from the 16th century, with their associated landscapes ranging from formal late 17th century to 19th and early 20th century.
- A 19th century estate style, drawing from traditional Cotswold architecture, and also within the context of designed estate landscapes.

The relevant SEO for the NCA comprise:

- SEO 1: 'Protect and enhance the highly distinctive farmed landscape', including its parklands and dry stone walls
- SEO 2: 'Protect and conserve the historic environment, cultural heritage and geodiversity' including its settlement pattern, traditional architecture, quarries, field patterns and 'small woodlands windbreaks and copses' seeking opportunities for 'new planting, where appropriate, for the benefits this will bring forward for water regulation, carbon capture and storage, biodiversity and landscape character'
- SEO 3: 'Protect, maintain and expand the distinctive character of the Cotswolds and the network of semi-natural and arable habitats .... To enhance water quality, strengthen ecological and landscape connectivity, support rare species and allow for adaptation to changes in climate'.
- SEO 4: 'Safeguard and manage soil and water resources...'

6.2.2 Heritage value for ecosystem services

Time Depth
An average score of 3.1 (3.6 for all case study areas). The highest scores relate to Lodge Park (11) and the core of the village with its medieval church and country house grouping, with high scores also accorded to the West End of the village which includes 17th century buildings (3). Medium scores relate to 19th century farmsteads which comprise most of the remaining sites, with the exception of modern farm groupings (6) and the control tower and maintenance sheds at former RAF Windrush (15) and its technical buildings (17).

Legibility
An average score of 3.6 (3.6 for all case study areas). The highest scores relate to the retention of the 17th century sporting landscape with Lodge Park (11) and the diversity of site types within the estate core of the village (1). The predominance of high to medium scores also relates to the above-average retention of traditional historic character in close association with dry stone walls and some hedgerows to plot boundaries, estate gardens and farmstead yards and paddocks. The score accorded to the wartime airfield groupings acknowledges their degree of survival in a national context.

Inter-relationships
An average score of 3.9 (3.6 for all case study areas). The overall above-average score reflects most farmsteads being located within well-retained patterns of historic

enclosure which now comprise improved grassland and arable habitat types, particularly designed landscapes of regular planned enclosure with shelter belts, and routeways dating from the medieval period. The highest scores are accorded to settlement scores and farmsteads which also adjoin historic parkland and meadow (2, 3) and the very highest to those sites within parkland (1, 4, 11).

6.2.3 Ecosystem Service Potential

Supporting and provisioning

- Domestic gardens, farmsteads and outfarms enabled the provision of products for domestic consumption and export, arable farming and the fattening of stock in farmyards being of particular importance historically.
- There is a strong relationship of this historic character to habitat diversity and potential, as affected by modern agriculture. Most sites relate to improved grassland and arable farming, making their connectivity to hedgerows all the more important.
- The location of other sites (4, 12) within and adjoining historic parkland (2), only Lodge Park (11) being noted as having more species-diverse semi-natural grassland.
- The location of the medieval village core (1) within parkland and alongside historic meadows.
- Buildings within the village (1-3), although largely built or rebuilt in the 19th century, relate to a continuous history of occupation and cultivation for household consumption from the late Saxon period.
- Limestone walls and roofs of buildings, and dry stone walls and hedgerows of their associated spaces, relate to the celebrated geodiversity of the Cotswolds and offer habitats for local fauna and flora.
- In one case (8, Hill Barn), the presence of a disused quarry as part of the curtilage of an outfarm in an arable farming landscape has stimulated woodland regeneration, as has the abandonment of the technical site – constructed from machine brick and concrete - at RAF Windrush (17). The conversion of an outfarm now outside the estate (Blackpits Barn 14) to commercial use (as a wedding venue) has afforded the opportunity for additional shelter belt planting and a small lawned area.
- Outlying farmsteads and outfarms relate to intensification of manuring and expansion of arable in the early-mid 19th century.

Regulating

- The village (1-3) has retained an above-average number of historic plots as gardens for amenity and production of fruit and vegetables, also important for the absorption of rainwater, and regulating soil quality and erosion.

- New farmyards with hard-standings and sheds have mostly been created to the side of historic farmyards, most on sites in agricultural use having the potential for adaptive reuse (agricultural, commercial or residential) that can use their embedded energy and realise opportunities for restoration and creation of spaces to assist in drainage and flood control.

Cultural

- The historic buildings in the parish make a strong contribution as a whole group to sense of place and history, due to:
    - Their construction in Cotswold stone and slate, using local craft techniques, and the continuing adoption of traditional Cotswolds style with distinctive details such as stone-mullioned windows and stone-coped gables into the 19th century.
    - The evidence that they offer for the improvement of the great house with its stables, kitchen gardens and other buildings, the farming estate – farmsteads, outfarms and their associated spaces bounded by dry stone walls - and the provision of estate workers' housing in the 19th century, in a consistent architectural style.
    - This evidence for improvement of the estate, including the adoption of a recognisable style based on 16th-18th century Cotswolds architecture - fitting into a story of how this estate has developed from the Late Saxon period as part of a monastic and then (from the 16th century) secular estate.
    - How they complement the story of farming and living in this landscape from the prehistoric period - the Late Bronze Age/ Early Iron Age Windrush Fort.
- Recreation, of particular importance being the popularity of the historic village (1-3) in its river valley setting, visitor access to Lodge Park (11) and access into the estate from the 19th outfarm at Ewepen Buildings (9); the control tower at RAF Windrush (15) is also open to visitors on an occasional basis and is sited close to a footpath.

Figure 10: Sherborne. Map showing sites listed in Appendix 4, listed buildings and extent of the designated parkland. Also shown are the quarries of 19th century and earlier date shown on the HBSMR.

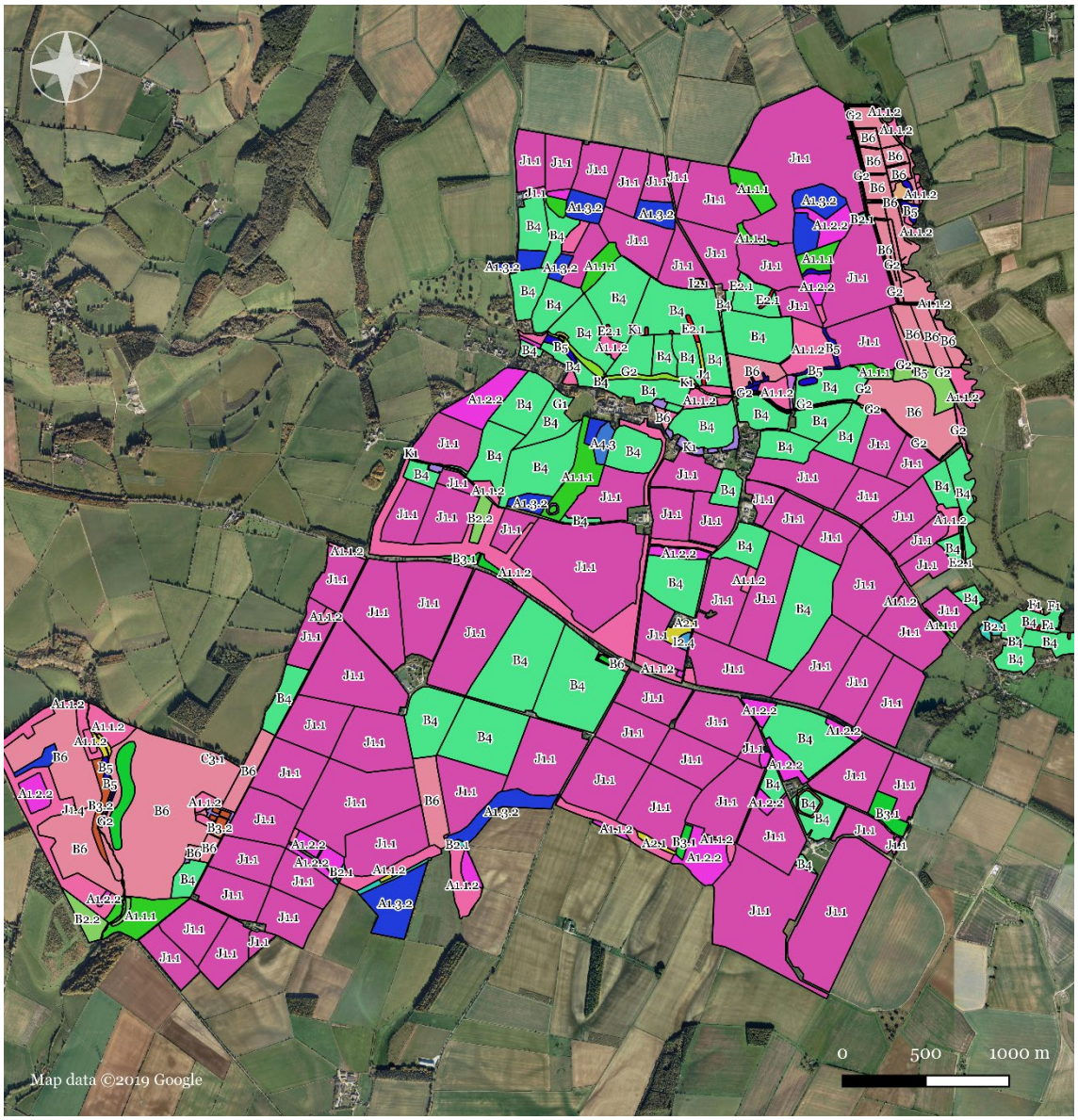

Figure 11: Sherborne. Map showing Habitat Classifications. Note dominance of arable (J1.1, in purple) and improved grassland (B4, in light green), and relationship of east end of village (2) and sites 5, 11 and 12 to 'poor semi-improved grassland' (B6, in pink). The habitat classification does not clearly display the extent of the historic parkland with its veteran trees etc or the presence of the historic meadowland.

Figure 12: Sherborne. Mid-19th century estate cottages in East End (2). Each of these have former vegetable gardens bounded by roadside dry stone walls. © Jeremy Lake.

Figure 13: Ewepen Buildings (9). The mid-19th century outfarm is extant and set in a formal designed landscape of regular enclosures and plantations (bottom Google Earth image and top view from north east). To the west is car parking for visitors to the estate, with access to the former barn (centre) now with interpretation panels focused on the estate's history. The eastern yards are still used for stocking cattle.

Figure 14: Blackpits Barn, from the east. This is no longer part of the estate but is illustrated as an example of another mid-19th century outfarm which in this instance has been converted to use as a wedding venue – conserving the early 20th century corrugated iron cattle sheds and with trees planted around lawned areas and a car park. Lodge Park (11) from the east showing the deer coursing ground in the foreground. Also located within its parkland to the south is another outfarm (12), viewed from the north. © Jeremy Lake.

Figure 15: The control tower, pillbox and (to left) Romney huts form the core of a well-retained group of Second World War airfield buildings at former RAF Windrush. The control tower is open to visitors on an occasional basis. Pillboxes such as this are well-known as bat habitats. Note the hard-standing in the foreground. © Jeremy Lake.

6.3 Attingham estate

6.3.1 Summary and landscape context

The Attingham estate (Figures 16-20) is focused on the country house of 1783-5 by George Steuart. The parkland (a grade II* Registered Park and Garden) around the house was remodelled after 1797 to the designs of Humphrey Repton with later additions by John Nash including the lodge at its southern entrance (1807). This assessment focuses on the estate's farmsteads, all of which were affected by rebuilding as medium-to-large-scale courtyard farmsteads between the late 18th and the mid-19th century, with late 19th to early 20th century Dutch barns to store hay. This rebuilding followed and, in some cases, accompanied a phase of reorganising fields enclosed from medieval strip fields and an area of heathland.[82] There are extensive traces of (mostly ploughed-out, surviving within the historic parkland) of medieval ridge and furrow and some traces of shrunken and deserted medieval settlement: most HBSMR entries comprise findspots.

Attingham sits within the 'Estate Farmlands' character area, as defined in the *Shropshire Landscape Typology,*[83] that integrated HLC into an inter-disciplinary framework for planning and land management. These landscapes have been affected by the reorganisation of fields and other changes wrought by estates, leaving also a legacy of country houses with their parklands. Farmsteads Mapping and observation of the rural architectural pattern added depth to this understanding through establishing the dominance of large courtyard farmsteads which developed from the late 18th century, often with large farmhouses with their own gardens and access.

Farmsteads also commonly developed around an earlier core of timber-framed houses and barns, this time-depth being reflected also in how late 18th and 19th century reorganisation of the landscape has left many earlier sinuous field boundaries resulting from the piecemeal enclosure of medieval open fields, and traces of ridge and furrow and medieval settlement often now ploughed out. Mid-late 19th century farmworkers' cottages, and evidence for horse- and steam-powered mechanisation, are another characteristic of this area. As elsewhere in England, reorganisation by estates bequeathed a framework and infrastructure of fields and farms that enabled the return of high-input high-output agriculture from the 1950s. The restructuring of farms since the late 18th century, working upon an earlier enclosed landscape, is reflected in the predominance of 'Reorganised piecemeal enclosure', 'Large irregular fields' and 'Very large post-war fields' in the HLC for this area, at its core being the historic park and to its east remnants of the heathland. As a result of the requirement for modern sheds on or around farmsteads, there has

[82] For additional context see: D C Cox, J R Edwards, R C Hill, Ann J Kettle, R Perren, Trevor Rowley and P A Stamper, 'Agriculture', in *A History of the County of Shropshire: Volume 4, Agriculture*, ed. G C Baugh and C R Elrington (London, 1989), pp. 1-4. *British History Online*http://www.british-history.ac.uk/vch/salop/vol4/pp1-4 [accessed 30 October 2018].
[83] Shropshire County Council (2006), The Shropshire Landscape Typology at https://shropshire.gov.uk/media/1803/the-shropshire-landscape-typology.pdf

also been a higher rate of loss of traditional farmstead buildings than in other parts of the county.[84]

The traditional settlements and buildings on the Attingham estate share many of the key characteristics of the Shropshire, Cheshire and Staffordshire Plain NCA within which it is situated,[85] of particular relevance here being:

- The whole NCA is dominated by planned farmsteads of late 18th and mostly 19th/early 20th century date, which are associated with the reorganisation and enlargement of holdings and the removal/reorganisation of earlier boundaries of 18th and 19th century date. The increased interest of large landowners in improving agriculture from the late 18th century often resulted in the consolidation of holdings, re-organisation of fields and the provision of new farm buildings.
- Early timber-framed buildings concentrated in the southern sub-area in which Attingham is located, including threshing barns and multi-functional ranges which were incorporated within regular courtyard plan farmsteads. Mixed arable-based agriculture combined with stock fattening and some dairying was generally concentrated in this area.
- Canals and later rail enabled the development of cheese production in the later 18th and 19th centuries, replaced by liquid milk by the early 20th century.
- There were also areas of heathland in east Shropshire and west Staffordshire, which were subject to both large-scale improvement by estates and the growth of small farms and smallholdings.

The relevant SEO for the NCA comprise:

- SEO 2: 'Protect the landscape of the plain, recognising its importance to food production and incorporating well-maintained hedgerows, ponds and lowland grassland margins within agricultural systems, to secure resource protection and maintain productivity, while reducing fragmentation of semi-natural habitats to benefit a wide range of services, such as landscape character, sense of place, water quality and biodiversity.' Specific objectives include reuse of traditional farm buildings to encourage farm diversification, restoration of hedgerows and ensuring new development contributes to local character.
- SEO 3: 'Manage and restore lowland heathland and ancient and plantation woodland …' including traditional orchards.'
- SEO 4: 'Protect and manage the nationally important geological sites and heritage features demonstrating how the interaction of natural and historical factors influenced the distinctive character of its landscape and settlement patterns, and help to promote greater understanding of the link between wildlife, heritage and geodiversity' – includes 'using understanding of the traditional and historic architecture and its distinct patterns of settlement to

[84] Baxter and Lake 2009; for reports see Shropshire Council website Farmstead Characterisation pages at https://www.shropshire.gov.uk/environment/landscape/historic-landscape-characterisation/historic-farmstead-characterisation/
[85] Natural England, NCA Profile 61: Cheshire, Shropshire and Staffordshire Plain

inform appropriate conservation and use of historic buildings and to plan for and inspire any environmentally beneficial new development which makes a positive contribution to local character.'

6.3.2 Heritage value for ecosystem services

Time Depth
An average score of 3.8 (3.6 for all case study areas). The predominance of medium scores reflect the extent of mid-19th century rebuilding, although at 3.8 the average score is higher than for Sherborne. This is due to high-scoring (4) farmsteads with 17th century houses and more rarely barns (sites 1-4, 7-9, 11).

Legibility
An average score of 3.2 (3.6 for all case study areas). The below-average score contrasts with Sherborne and reflects the generally greater levels of post-1900 change to the farmsteads. The farmsteads are extensive sites, mostly with a clear distinction between houses facing into their gardens and the traditional farmsteads themselves, most sites also with associated orchards and other planting. Five sites survive as extant groupings with associated green spaces and yards. An equal number survive as partly-altered with modern sheds and hard standings occupied up to half of their historic extent. Distinct patterns emerge when the sites are subdivided, most farmsteads being subdivided into three areas: houses with their gardens have typically developed to one side of the steading, and are most likely to have retained historic boundaries; some steadings have lost most of their historic yards and paddocks to hard standings and all have modern sheds which in some instances have replaced the historic footprint. One site (5, Upper Brompton Farm) developed with five sub-areas including workers' housing and an orchard which are an integral part of its character.

Inter-relationships
An average score of 3.0 (3.6 for all case study areas). The below-average score reflects the high degree of change to the farmed landscape across the estate. Most farmsteads are located within historic enclosure patterns resulting from the late 18th and 19th century reorganisation of earlier post-medieval enclosure – arable and improved grassland habitat types. Whilst the fields around many sites have lost one or more of their historic boundaries, a notable characteristic is the relationship of many sites to pre-19th century routeways. The highest scoring site (1, Home Farm, scoring 5) is located within the historic park and close to a shrunken medieval settlement with ridge and furrow. Most other sites (7 out of 11) have retained connectivity to historic boundaries, woodland and other features around them.

6.3.3 Ecosystem Service Potential

Supporting and provisioning

- There is a strong relationship of historic character to habitat diversity and potential, as affected by modern agriculture. Most sites relate to improved

grassland and arable farming, making any connectivity to hedgerows and woodland (Sites 1 and 2) all the more important. Two sites (6 and 9) adjoin unimproved grassland – former meadow but not surviving as historic meadow - close to the River Severn.

- Buildings and the boundaries around them have obvious habitat potential for bats, birds and invertebrates, although there is not a systematic or consistently-dated record of these across the estate. The manner in which they connect to boundaries, woodlands, orchards and pasture also potentially contributes to the enhancement of habitats and networks, and to water, soil and sediment flows and nutrient content, maintenance and creation. Management of boundaries (e.g. hedgerows, walls, trees) will impact on habitat potential and food availability for different species though lack of detailed information on species types and numbers will limit the capacity of the model to assess values with accuracy.
- Geodiversity is provided through information, interpretation and access (physical and intellectual), particularly through building materials and their origins, which also provides for acknowledgement of wider links e.g. slate from Wales. Also, traditional skill maintenance and enhancement through provision of traditional materials – timber, stone, clay etc. for traditional building repair and maintenance.
- Provisioning services are sustained and enhanced through the contribution that buildings make to sense of place and history as well as providing spaces for traditional skills, materials storage and farm and other business activities. Historic buildings also provide location for information, interpretation and education activities and services.
- Provisioning also met through management of woodlands, providing timber (if only for wood fuel – biomass boiler) but, as long as such management includes re-planting, then opportunities for provision of access, information/interpretation, leading to recreation, tranquillity and possibly biodiversity and cultural heritage gains – sense of place, sense of history through landscape character as well.

Regulating

- Boundary and woodland management across the estate provides for water management/availability, through managing surface flows through barriers (boundaries) or take-up (trees) – natural water storage – as well as soil management.
- Location and design of farmsteads to incorporate sustainable urban drainage schemes, minimise run-off, capture rainwater etc can contribute to Catchment Sensitive Farming (one of the issues under SEO 4) through Management of farm/stockyards, silage clamps etc. contributes to reduced effluent and pollution of water courses (SEO 1), with impacts on biodiversity.
- New farmyards with hard-standings and sheds have mostly been created to the side of historic farmyards, most on sites in agricultural use having the potential for adaptive reuse (agricultural, commercial or residential) that can

use their embedded energy and realise opportunities for restoration and creation of spaces to assist in drainage and flood control.

Cultural

- The historic buildings in the parish make a strong contribution as a whole group to local character and distinctiveness, due to:
    - Their construction in timber frame and 19th century rebuilding in brick, plain tile and Welsh slate, a characteristic shared with most farmsteads in this NCA.
    - The evidence that they offer for the improvement of the estate's farms resulting from the consolidation of the estate over the 18th century.
    - How they complement the story of farming and living in this landscape from the prehistoric period which can be read in surviving or (more commonly) the ploughed-out traces of medieval ridge and furrow and earlier land use boundaries and settlements.
- Sense of place provided through buildings and their materials, boundaries (hedgerows and walls and their constituent species and materials), woodlands, orchards and water bodies. These all provide for information, interpretation, education and understanding: how geology and landform has contributed to/governed settlement patterns, human activity and innovation over time. Access to the landscape provides recreation, and health and wellbeing opportunities, while maintaining or enhancing food production functions alongside maintenance of historic character through maintenance/gapping-up of field boundaries, for example.
- Equally, sense of history is provided through landscape features such as the boundaries, woodlands, orchards, buildings which offer all the opportunities noted above under sense of place.
- Tranquillity is provided for through the open/enclosed landscapes and their component parts such as woodlands. The parkland contributes to dark skies and the tranquillity they provide, as well as sensory environments provided by woodland, gardens and parkland their history and biodiversity, achieved through access, information and understanding.
- Cultural heritage, biodiversity, landscape, flora and fauna (and their sustainable management) all provide for recreational access (physical and intellectual), enhanced by information, interpretation and the ensuing understanding and enjoyment of Attingham and its contextual landscape. Access also provides for the health and wellbeing agenda, both physically and intellectually, providing inspiration, tranquillity and comfort.

Figure 16: Attingham estate. Map showing sites listed in Appendix 5.

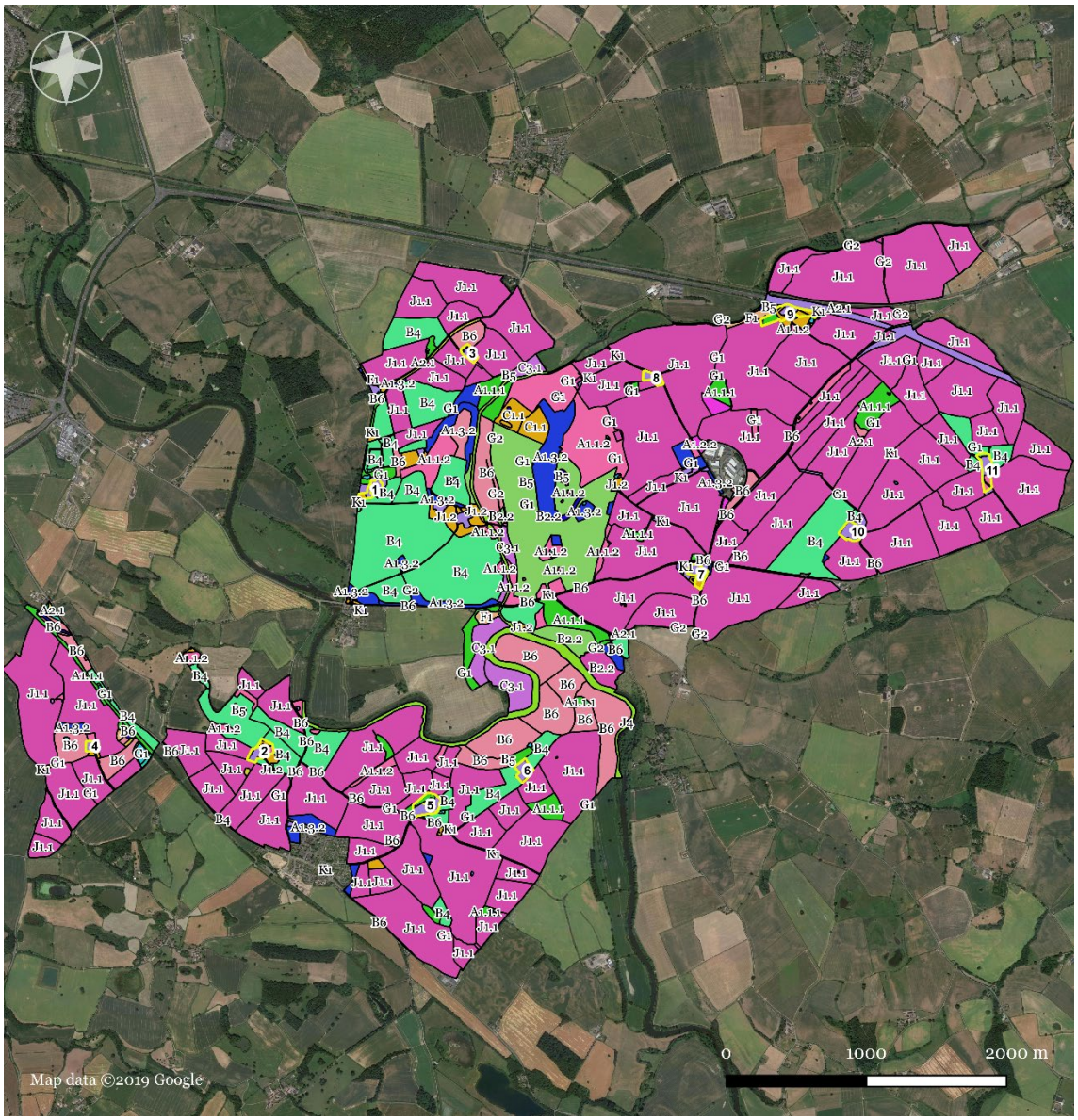

Figure 17: The Attingham estate. Map showing the dominance of arable cultivation (marked in purple) in the JNCC habitat classifications, which as a result of extensive boundary removal are mostly classified in Shropshire's Historic Landscape Classification as 'Large Post-War Fields', the notable exception being the grassland, woodland and parkland habitats in Attingham Park. The medieval ridge and furrow south of Home Farm (1) is classified as 'Poor semi-improved grassland' habitat type. Note also the grassland (B6, in pink), this being meadows and pastures drained in the 19th century, extending towards 6 (Lower Brompton Farm). improved grassland (B4, light green), and various types of woodland and parkland (A, olive green) in Attingham Park.

Berwick New House. The late 18th century farmhouse in its garden and (below) the 17th century barn reclad in brick in several phases and converted into a cowhouse and dairy in the early 1900s. © Jeremy Lake.

Berwick New House (Site 3, overall Heritage Value score 3.3). The whole site, showing to the south east the farmhouse with its former orchard now connected to the parkland by a wooded strip, (2) the traditional farm buildings, including a reclad 17th century barn and half of which have been lost since c. 1900, and (3) the modern working yard partly on the site of a large yard for stacking corn - with its early 20th century Dutch barn and post-1970s modern sheds. The stack yard to its north has been absorbed into an enlarged field, the other thorn hedgerows relating to a straight routeway and boundaries dating from the late 18th century.

Figure 18: Berwick New House (3)

Figure 19: Home Farm (Site 1, overall Heritage Value score 4.3). View looking north from the parkland (in the foreground being species-grassland over ridge and furrow relating to the deserted village earthworks), also showing the 15th century farmhouse to left and the mature trees and hedgerow bounding the site. To the north is a medieval moated site with fishponds and post-medieval woodland. The whole site can be subdivided into the house with its garden to south west, the traditional farmstead and the post-1950s modern sheds to the north east.

Figure 20: Norton Farm (Site 7, overall Heritage Value score 2.7). This site has a high score for Time Depth due to the 17th century house (in Area 1 with its garden) and 1745 barn, but the traditional farmstead (Area 2) has less than 25% survival of its historic plan form. The trees around the modern farmyard date from the second half of the 20th century and the site has otherwise low inter-relationships due to the loss of its connecting boundaries and hedgerows including to the routeway.

6.4 Upper Booth, Edale

6.4.1 Summary and landscape context

The farmstead and field barns at Upper Booth Farm (Figure 21) are located within the upper part of Edale in the Dark Peak (NCA 51). Upper Booth is one of the five 'booths' established within Edale purportedly by King John's second wife, between 1199 and 1216 as summer pastures for sheep and cattle. It may originally have been called Crowdenlee Booth. These vaccaries for cattle or booths for mixed stock may have only been formalised then as Edale is recorded in Domesday Book (AD1086) as part of the royal manor of Hope. There is medieval ridge and furrow to the south west, and the farmstead developed at the intersection of historic routeways, including a sled route with access to peat cuttings in the moorland to the north. There is ancient woodland to the east and south. The farmstead is located within an area of enclosed landscape identified in the Peak District National Park's HLC as 'Enclosures of Uncertain Date', meaning that no historic maps have provided any form dating for the existence of fields prior to 1650. However, the Farmsteads Characterisation completed across the National Park suggests that many of these enclosure landscapes result from the reorganisation of complex patterns of enclosure dating to the medieval period and even earlier.

Taken as a whole, Upper Booth is strongly representative of the local area, with well-preserved traditional farmsteads and field barns which provide testament to the importance of dairying here in the 19th century, although the railway for the export of liquid milk to nearby towns was not driven through the area before 1890.

Upper Booth in Edale shares many of the key characteristics of the Dark Peak NCA within which it is situated,[86] of particular relevance here being:

- High densities of dispersed settlement, with farmsteads set in landscapes enclosed from the medieval period with ancient woodland in the valleys retaining much evidence for industrial activity. Many farmsteads developed on the edge of the gritstone moorlands, alongside tracks.
- There is an exceptionally high survival of traditional farmsteads as in many of the other northern England uplands and upland fringes. This significance is heightened by the fact that the farmsteads and working buildings, including their field barns, sit within a landscape which retains visible evidence for land use and settlement from the prehistoric period.
- Most farmsteads rebuilt in 19th century around earlier cores.
- Field barns and field barn landscapes are another distinctive feature.

The relevant SEO for the Dark Peak NCA comprise:

- SEO 2: 'Manage and enhance the moorland fringes and valleys, with their mosaics of pastures and meadows, and their strong field patterns defined by dry stone walls, to improve ecological networks and strengthen landscape character.'

[86] Natural England, NCA Profile 51: Dark Peak

- SEO 3: 'Improve opportunities for the enjoyment and understanding of the National Park landscape, and to experience the sense of escapism and inspiration offered by the wide, open moorlands, while also conserving the qualities of the landscape and its valuable historic, geological and wildlife features.' These include 'Providing interpretation of historic buildings and other heritage assets to explain their role in the development of the landscape over time, facilitating access where appropriate.'.

There is (unusually as these are normally integrated into NCA SEOs) an additional objective for protection of the cultural heritage and its historic landscape setting for its intrinsic value which focuses on settlement patterns and buildings.

6.4.2 Heritage value for ecosystem services

Time Depth
An average score of 4.0 (3.6 for all case study areas) reflects the development of this farmstead with its 17th-19th century buildings, the oldest building being the combination barn with its very large 'orthostatic' lintel. Buildings are mostly for cattle and their fodder. Two 19th century field barns for cattle and their fodder.

Legibility
An average score of 4.0 (3.6 for all case study areas) reflects the substantially complete historic grouping, also retaining its field barns, built in local stone and slate.

Inter-relationships
An average score of 4.0 (3.6 for all case study areas) reflects the site's strong relationship to enclosed farmland, now mostly improved grassland habitat type, and to historic woodland and moorland habitat types characteristic of the NCA:

- One of a grouping of farmsteads at Upper Booth, set in landscapes enclosed from at least the medieval period had access via historic routeways to moorland grazing, a characteristic of the Dark Peak. Routeways – sled routes - also gave access to upland peat cuttings associated with each booth.
- The development of Upper Booth Farm occurred at the meeting point of historic routeways and close to an ovoid field enclosure that could be medieval or even earlier in origin.
- The number of sheep folds on the higher moorland and sheep washes in the valley bottom indicating the parallel importance of sheep.

6.4.3 Ecosystem Service Potential

Supporting and provisioning

- The time-depth (medieval origins) of the site, its legibility and inter-relationships offer high potential to contribute to supporting services in terms of food provision and sense of place.

- Biodiversity provided for by the sustainable management of permanent pasture, woodlands, boundaries, soils and water and provision/maintenance of connectivity.
- Buildings and the boundaries around them have obvious habitat potential for bats, birds and invertebrates, this potential will be enhanced through the site's close proximity to ancient woodland.

Regulating

- Yards and buildings for housing cattle takes them away from farmland and thus assists in minimising poaching (during wet weather periods), run-off from soils, and nutrient losses.
- In terms of the wider context:
    - The farmstead and its field barns have developed as an integral element in a landscape of permanent pasture which now contributes to climate regulation through minimising carbon loss from soils and is positive for biodiversity.
    - Regulating climate through management of permanent pasture with low artificial fertiliser input, avoiding diffuse pollution as well and maintaining biodiversity on and off the holding.

Cultural

- Sense of place is provided by the farmstead's location between the bounded permanent pasture and the higher, more-open moorland; by the maintenance/restoration of boundaries and traditional farm buildings, which also provide a sense of history and contribute to biodiversity, geodiversity through the use of traditional materials which also supports traditional skills; through information/interpretation on geology, landform, history, providing understanding and enjoyment as well as access (physical and intellectual) and contributing to the health and welfare agenda and tranquillity.
- Sense of history is provided by the farmstead's location within its historic enclosed landscape, traditional materials, field patterns and historic dispersed settlement patterns – the time depth within the landscape which emphasises sense of place. Sustainable management of this sense of history contributes to traditional skills, biodiversity, recreation and understanding, access, tranquillity and health and wellbeing.
- Tranquillity, resulting from the farmstead's remote location, is provided by dark skies.
- Recreational and educational value is provided through access and accessibility – by road, rail and footpaths (local and national trails) – on or adjacent to the holding.
- Geodiversity provided by traditional buildings and their materials, sustained by repair and maintenance using traditional materials.

- In terms of the wider context:
    - Derbyshire Gritstone sheep contribute to rare breed maintenance and genetic diversity; also sense of place, sense of history, food provision and biodiversity.

Figure 21: Upper Booth, Edale. Map showing sites listed in Appendix 6. The main farmyard (1), northern farmyard (2) and surviving field barns (3 and 4).

7 VALUATION METHODOLOGY FOR ECOSYSTEM SERVICES

7.1 Introduction

A modified form of 'return-on-investment' model (Figure 22) was developed based on an ecosystem services framework in order to capture and value the benefits and costs flowing from buildings and structures. The model works through identifying 'streams' of costs and benefits that 'flow' over time from the existence and utilisation of buildings and structures. The approach is made more complex through changing and multiple uses of structures and the nature of buildings which often form part of a larger complex. A stately home for example, may be a historic site visited by tourists, but outbuildings could also include workshops and residences. A historic farmhouse may continue to be someone's home, or parts may be rented out for a range of uses including processing of farm produce, or commercial space to generate additional income. Farms and estates tend to consist of groups of buildings that operate together requiring each building (which may be of different ages and construction) to be considered both independently and part of a larger integrated whole.

Capturing the variability described above in an ecosystems-based modelling approach has proved difficult, and various simplifications have been made in order to fit the model into the project constraints. This has been somewhat frustrating as there is clearly some potential for developing a more coherent set of models to explore cultural heritage and other values arising from a wide array of buildings and structures. The model presented here is thus a simplified approach to valuing the benefits flows arising from buildings (and other structures), designed to demonstrate the possibilities of using an ecosystems-based approach.

The model operates through identifying streams or flows of outcomes (both positive and negative) arising from individual structures or from groups of buildings. Flows are categorised under the four main types of ecosystem services:

- Supporting.
- Provisioning.
- Regulating.
- Cultural.

Under each category, for each identified outcome we identify an indicator that can be used to measure the magnitude of the outcome (and also any changes in the flow). A single structure may produce multiple outcomes, ranging from providing habitat (e.g. for birds, bats, small mammals and invertebrates), to provisioning such as livestock shelter, and cultural values due to its age and historic characteristics. Multiple use structures are likely to create a larger range of outcomes that can all be measured through development of indicators. Cultural heritage indicators have

been developed based on time-depth, legibility and inter-relationships of buildings and structures (see Section 5.1 for a more complete description).

Once a valid indicator is in place the valuation process then requires identification of who (or what) benefits from an outcome flow. The number of people who benefit from each outcome flow is identified. The model focuses on identifying direct benefits, i.e. those individuals or groups who directly benefit from an outcome (such as a farmer who may utilise a building for storage of fodder, or a visitor to a stately home), and not those who may benefit indirectly (such as those in the general population who might place an existence value on the enhanced biodiversity provided by old buildings). The method takes a conservative approach to assessing values, focusing on direct benefits to those living and working in the locality of a structure, and visitors. The wider indirect measures often included in the 'non-market' valuation of natural capital such as option, existence, and bequest values are not incorporated into the calculations in this model. Instead the model identifies financial approximations (proxy prices) to determine values of outcomes. The aim is to select goods and services with market prices that are similar in nature to the outcome being valued and use them to 'approximate' a value for something that has no market price (such as the wellbeing obtained from visiting a cultural heritage site). Where financial proxies cannot be found, non-market values are applied from the academic literature. The indicator of the magnitude of an outcome benefit is applied to the total number benefitting and then multiplied by the financial proxy to obtain annual flows of benefits. These are then forecast over the 50-year time horizon and values discounted back the present day (using the standard recommended Treasury discount rate of 3.5%). The present-day sum of benefit flows and costs over the 50 years are then compared to provide a ratio of benefits to costs. The model also takes into account the current efficiency of functional utilisation for each outcome, and the current condition of the structure which may affect the magnitude or quality of the outcome.

The model is focused on measuring the value of the flow of benefits arising from a capital stock of buildings/structures. The model is not measuring the value of the capital stock itself, but the flow of benefits over time. This is an important distinction to make as it determines who gets included, and the time-based nature of the valuation process itself. Currently the model is based on assessing flows of outcomes over a 50-year time period, necessitating application of a discounting process (with the acknowledged difficulties that creates) to enable comparison of present-day values of future streams of costs and benefits. The model does not measure the value of the capital stock, i.e. the current value of a building or structure, its replacement cost, or its place within a wider stock of structures of a similar type. The aim is to throw some light on the value of outcomes flowing from the stock, and on who benefits.

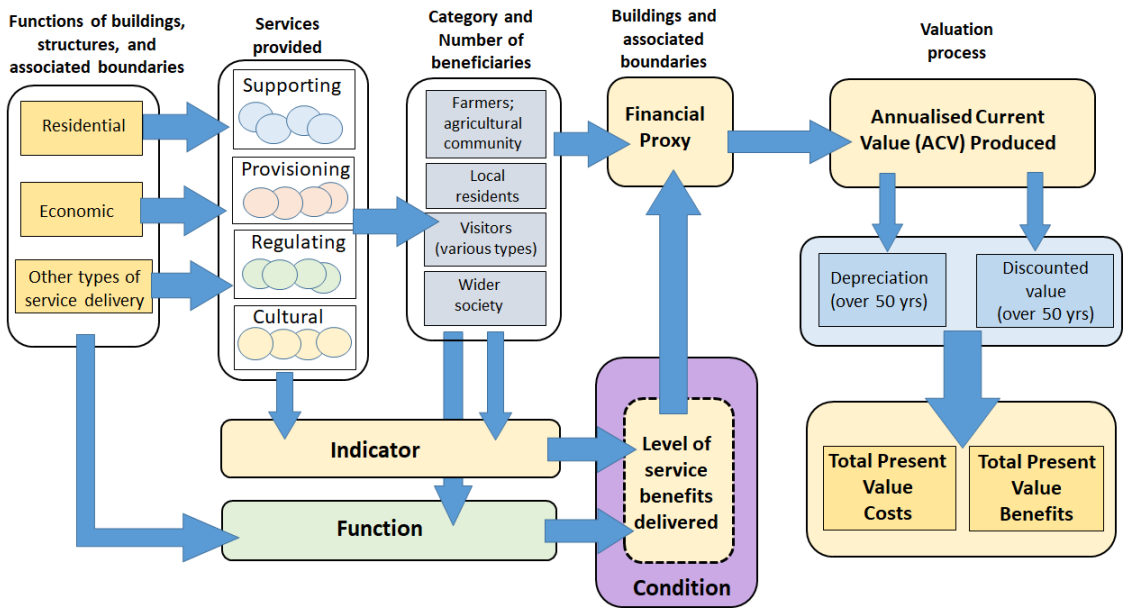

Figure 22: Structure of the valuation model

7.2 Identifying and categorising the stock of the asset

The range of buildings, building types, styles, and materials is very wide with regional and temporal variations. Different structures of the same style/type will also have variable sized areas of land surrounding them (e.g. gardens, yards, enclosed fields) which are included as part of the 'footprint' of the structure and perform a range of ecosystem functions with a consequent variability in the beneficiaries and benefit streams based on local context. The model is therefore based on a division of buildings and structures into the following three main categories:

- Residential/domestic.
- Economic activities.
- Service provision.

These are summarised in Table 1 below. The difficulty in developing a typology of buildings & structures for the model design arises due to the variety of structures and the changing and sometimes overlapping functions over time. A set of farm buildings, for example, may incorporate residential housing, economic activities as well as crop storage and livestock management. A castle may be utilised as a residence as well as a tourism attraction, and a church may provide a range of community services from its buildings. Where we cannot differentiate building uses or separate out beneficiaries of different forms of utilisation we cannot effectively incorporate measures functional use into the valuation model. The model compromises by calculating current functional uses based on the predominant category of utilisation in terms of three main activities of residential, economic, and service provision.

Table 1: Categorisation of building types and broad types of activity

Category	Broad type of activity	Description
Residential	Domestic	Houses and all other forms of dwelling, with private and communal gardens.
Service provision	Spiritual, commemorative	Religious places for worship and burial including crematoria. Includes sites and structures to commemorate lives and events.
	Public services provision	Civil: including some state-sponsored sites such as prisons, workhouses and coastguard stations. Sometimes set in extensive grounds, including former parks and gardens to large houses.
		Education: schools, colleges, universities and their associated grounds.
		Health and welfare: buildings and sites to treat mental and physical illness and offer health benefits such as spas.
	Recreation (public)	Parks, gardens, and urban spaces: may include associated buildings such as cafes, lodges glasshouses and pavilions.
	Defence	Defence: castles, coastal and inland defences with related defensible landscapes; often extensive grounds to depots, training and support bases and airfields.
Economic	Agriculture	Agriculture and subsistence: mostly comprising farm buildings (farmsteads and field barns) and their associated gardens, orchards, paddocks and yards; includes some buildings associated with fishing industry.
	Commercial Services	Leisure: a wide range of structures and sites, including eating and drinking establishments and sports sites and clubs with extensive grounds
		Commercial – include markets, hotels, shops, pubs and restaurants, offices and warehousing; include a high proportion adapted from historic buildings in town centres.
		Utilities - water supply and drainage; sewage treatment; electricity generating and supply.
	Industrial	Industrial – structures and associated working spaces for the extraction of raw materials (e.g. mines and quarries) and for refining, processing and manufacturing.
	Communications	Transport – buildings and structures associated with air, rail, road, water (sea and inland) transport and navigation.
		Maritime – buildings and sites to help build and maintain marine transport and trade (docks, ports), enable and regulate safe passage (locks, navigation aids etc.).
		Telecommunications structures – towers, exchanges, sub-stations, telephone and computer support structures, etc.

7.2.1 Key aspects affecting provision of ecosystem services

Value arises from the current level and quality of the stock, and the functions providing benefit streams that enhance social welfare. These include:

- Biodiversity.
- Economic.
- Recreational.
- Spiritual.
- Landscape and aesthetic.
- Sense of place and well-being.
- Sense of history and understanding of land management.

Provision of ecosystem services and the benefit streams arising from them are influenced by a number of factors affecting the quality and the capacity for buildings/structures to generate flows over time. These factors include the following:

Construction materials

- Variable quality in construction (durability range (1 – 1,000 yrs).
- Variable maintenance costs.
- Skills required for restoration/maintenance.
- Local economic impacts from investment in construction and maintenance.
- Variable styles, condition.
- Variable age (1 – 1,000 yrs) and historical associations.

Condition

- Age of the structure.
- Derelict to fully restored/maintained.
- Alteration from original appearance.
- Maintenance costs.

Operational scale

- Scale at which the structure operates (e.g. farm building plus yard; house plus garden; farmstead with domestic area and modern working yard; hamlet, village, housing estate etc.).
- Size of the structure/area covered (m^2).

Function

- Current function (will affect provisioning services delivered and potentially supporting/cultural services).
- Form of agricultural utilisation.
- Original vs current utilisation (extent to which it alters heritage value).

Context

Historic buildings and structures deliver a wide range of benefits arising from the ecosystem services generated through their existence and utilisation. Each building or set of structures is given a score based on the following three factors:

- Time depth: its age and links to past local activities (e.g. some form of economic activity).
- Legibility: the extent to which past uses and linkages can be accessed and understood.
- Inter-relationships: its local context and linkages with the immediate setting/landscape over time.

Each of the three aspects is scored on a 1-5 scale and an overall average score obtained for each building for inclusion in the model as a measure of historical significance. Within the model the score becomes further modified through assessment of current condition (again scored on a 1 – 5 scale to denote current state of the building from dereliction through to good condition) and the type functional use being made (which influences the number and type of beneficiaries that are associated with the flow of ecosystem services from that building/structure). The model thus incorporates measures of both cultural heritage and use (through provisioning services) values. Cultural heritage value of a building/structure depends on the assigned overall heritage score (based on the average scores across time-depth, legibility, and inter-relationships) modified by condition and use values flowing from the current dominant form of utilisation.

7.3 Proposed approach

The proposed approach is a modified cost-benefit analysis based on a return-on-investment model using proxy measures to estimate values of non-market benefit flows. The tables in Appendix 7 identify functions of buildings and structures found in rural areas, allocated to the four main ecosystem services categories. Ecosystem service outcomes and benefits are modelled over a 50-year time horizon. A 50-year period will capture the full range of costs that incorporates an annualised maintenance value and captures the benefit flows. Given the durability of buildings it might be necessary to expand the time frame across 100 - 200 years or even longer to fully explore the balance of costs and benefits. However, discounting techniques start to break down and require some heroic assumptions about future conditions when such long time-frames are considered.

7.4 Model outputs

The model was applied to structures at three case study locations: Attingham, Sherborne, and Edale. In each case a range of building types was included in the case study. In order to simplify the modelling process, the total area (in metres^2) of buildings and context (e.g. gardens, farmyards, associated immediate surroundings) were incorporated into the model. Estimates of areal extent of buildings and structures were identified using GIS software. Buildings, structures, and associated built environment (such as covered yards) were identified and measured separately from natural surroundings (such as orchards, large gardens, woodland).

The case study areas encompass the following elements (Tables 2-4):

Table 2: SHERBORNE

Description	Utilisation	Area (m^2)
Ewepen Buildings	Eastern yards used for stocking cattle; western yard for parking cars for visitors to estate; barn with interpretation panels for estate's history	3, 262
Windrush Airfield Control Tower	Sheds in industrial use/ storage; control tower conserved as a museum with occasional use; pillbox empty and most probably a nesting site	20, 041

Table 3: ATTINGHAM

Description	Utilisation	Area (m²)
Area 1: Home Farm	Working farm, also farm shop and historic buildings open to public http://www.homefarmattingham.co.uk/	11,402
	Sub-area 1: a farmhouse and gardens including mature trees and pond	3,951
	Sub-area 2: traditional working buildings now in agricultural, farm shop and amenity use	2,869
	Sub-area 3: a modern working farmyard	4,582
Area 2: Berwick New House	Site in agricultural use but with differences in sub-areas	7,395
	Sub-area 1: house and garden/former orchard;	3,144
	Sub-area 2: redundant traditional buildings;	2,299
	Sub-area 3: modern buildings still in use for agricultural storage	1,952
Area 3: Upper Brompton	A large site with several different activities	22,706
	Sub-area 1: domestic	3,530
	Sub-area 2: mix of redundant traditional buildings and now cookery school	4,275
	Sub-area 3: in agricultural use (storage)	2,806
	Sub-area 4: former orchards now woodland	9,333
	Sub-area 5: Domestic area	2,762
Area 4: Norton Farm	A working farm	13,584
	Sub-area 1: house and garden	4,402
	Sub-area 2: traditional farmyard but with < 25% survival of traditional buildings	3,511
	Sub-area 3: modern farmyard	5,671
Total area included in the case study		55,087

Table 4: EDALE

Description	Utilisation	Area (m²)
An upland working farm	Sheep farm	11,222
	Sub-area 1: farmstead with farmhouse in domestic and agricultural use	4,032
	Sub-area 2: traditional farm buildings and former farmyard now mostly in domestic use	6,787
	Sub-area 3: field barn in light agricultural use (young stock and storage)	151
	Sub-area 4: field barn in light agricultural use (young stock and storage)	252

Areas covered by buildings and structures in the case studies were assigned to the three categories off residential use, service provision (e.g. water, communications, defence), and economic activity (manufacturing and commercial space, farm activity). The ecosystem services flowing from each category were identified and incorporated into the model. The total area allocated for each building category within a case study area was utilised as the 'asset' which generated outcomes (benefit streams). For each identified outcome the following beneficiary types were identified:

- Residents.
- Property owners.
- Users of the building/structure.
- Households in the local area.
- Visitors to the local area.

Outcomes may have single or multiple beneficiary types. For the purposes of this project beneficiary numbers were estimated where no data was readily available (e.g. property owners, residents, users). The model enables input variables to be varied thus the sensitivity of model outputs to changes in inputs can be explored. Where input variables are uncertain minimum and maximum values can be utilised to create a range of likely outcomes.

Indicators were developed to assess the magnitude of the outcome on the beneficiaries, and then multiplied by a financial approximation to provide monetary values for the benefit streams (details can be found in Appendix 7). Outcomes were modified by an assessment of the current 'function' and 'condition' of the building/structure (i.e. its capacity' to deliver each outcome).

The final part of the model allows for structural depreciation of the asset (building/structure) over the 50-year time horizon (assessed as a 'drop-off' in functional delivery), and discounting of the annualised flows of benefits back to the present. The model thus takes a conservative approach to valuation of the benefit streams arising from ecosystem service outcomes. Restoration and maintenance costs are assessed for each building category and discounted over the time period to provide present day value estimates of the total expenditure to maintain the buildings/structures in their current condition. The total present-day value of the stream of benefits arising from all outcomes are compared to costs to arrive at a benefits to cost ratio for each case study site.

Table 5 below provides the summary outcomes from the model for the range of buildings at each of the case study sites. Lowest present value (PV) benefits are found at Edale, which is the smallest site, and also the most remote with a small local population and fewest visitors. The benefit to cost ratio is 1.82:1 across the 50-year time horizon (i.e. every £1 in restoration and maintenance costs generates £1.82 in benefits of the 50-year time horizon when discounted to present values). Total PV of benefit streams is relatively low, partially due to the low number of

beneficiaries in the area (e.g. few visitors, small local population in the area, and few residents/users of the buildings). Highest benefit streams are generated by provisioning ecosystems, mainly driven by agriculturally related outcomes. Cultural services make up just over one quarter (27.25%) of the total PV. At the same time, restoration and maintenance costs are relatively high, reflecting the exposed situation of the farm high in the Pennines of the Peak District.

Highest PV of outcomes and also the largest benefit to cost ratio (5.07:1) is found for Attingham. The scale of the PV of benefits is not surprising given that this is the largest set of structures considered out of the three case studies and is a well-known historical site with high visitor numbers. The high benefit to cost ratio is partially due to the high number of visitors directly benefitting, but also to the multiple uses of buildings included in the case study. Cultural services contribute just over one quarter (27.85%) of the PV of total benefits while provisioning services contribute almost half (47.23%) of the value of total benefits.

Sherborne is also a relatively small case study area (in comparison to Attingham) made up largely of old defence installations and agricultural buildings. The site reveals an interesting pattern of PV outcomes, with the greatest proportion allocated to cultural services, but closely followed by provisioning services, indicating the importance of visitor numbers and of agricultural and other uses of the buildings and structures.

Over the three case study sites provisioning services provided the largest contribution of value to the Total PV of outcomes (48.5%), while cultural services (incorporating cultural heritage outcomes and values) contributed the second largest proportion (33.8%). Supporting services contributed very little (less than 1%) to overall PV, which is not surprising given that the focus of the assessment is on values generated from buildings and structures, which only provide minimal scope for contribution to the support of ecosystems. In the same way, regulating services (such as flood management, carbon sequestration) make relatively minor contributions to ecosystems given the small scale of areas considered, and limited opportunities for regulating services to operate.

It is clear that scale of the settlement that is included in the assessment affects overall value (see Table 5). The larger the 'settlement' (in terms of number of buildings/structures) the more likely the site will draw larger numbers of visitors, and potentially have the capacity for a higher level of provision services. Access is also an issue however, both in terms of remoteness from urban centres, and ease of transport communications. The cultural heritage values delivered by the three sites are clearly affected by scale with Sherborne providing a cultural value 20% greater than either of the other sites. Sherborne also has a much higher level of structures, visitor numbers, and provisioning service uses accounting for the total value of the 50-year period. The results suggest that local context is significant for assessing cultural heritage value using an ecosystems services approach, as the values obtained are based on the range of benefit flows and number of beneficiaries.

Table 5: Summary outputs from the buildings and structures valuation model

Service type	Attingham	Contribution of service type to Total PV	Sherborne	Contribution of service type to Total PV	Edale	Contribution of service type to Total PV	Average contribution to Total PV of service types across three case study areas
Supporting	27495.88	0.30%	10,226	0.45%	4,643	0.80%	**0.5%**
Provisioning	4392380.71	47.23%	982,100	43.01%	321,713	55.29%	**48.5%**
Regulating	2163943.88	23.27%	215,189	9.42%	96,957	16.66%	**16.5%**
Cultural	2589986.97	27.85%	1,060,308	46.44%	158,598	27.25%	**33.8%**
Total PV (£)	**£9,300,681**		**£2,283,368**		**£581,910**		
Maintenance costs (£)	**£1,833,701**		**£803,863**		**£320,120**		
Benefit-Cost Ratio	**5.07**		**2.84**		**1.82**		

7.4.1 Aggregating to a national level

The application of the model to a range of situations indicates the importance of the need for detailed information on the utilisation, condition and historical context of each building within large sites. At the minimum buildings and structures need to be identified in terms of their original and current functions in order to determine flows of ecosystem service outcomes.

Exploration of the potential for allocating single heritage values to sites with multiple uses and buildings failed to capture the variability in outcomes and benefit streams, leading to a loss of information. Creating a single score for cultural heritage value across a site containing multiple structures with multiple uses would make application at larger scales easier (i.e. at regional or national scales) but loses the sense of uniqueness of specific sites leading to a reduction in ecosystem service outcomes identified, and consequently lower values. If historical value were the only determinant then application of a single score to sites (such as the case studies described in this report) would be easier, perhaps, for example, by using existing HLC data to determine broad types. Taking an ecosystem services approach, however, there is a need to explore a much wider range of outcomes, requiring more detailed analysis of building function, condition and immediate context in order to capture the supporting, regulating, and provisioning services generated.

7.5 Discussion points

The accounting model is a pilot to test the feasibility of taking an ecosystems services approach to valuing the cultural heritage value of buildings and their associated boundaries and spaces. It has revealed a number of issues that need further examination if the approach is to be developed for more widespread application.

7.5.1 Current weaknesses in the model

Using data

Experimentation with a range of data has shown that:

- Data on designated heritage assets is easy to download and map and offers a means of rapidly understanding the temporal and typological range of buildings – accepting that designated buildings are a small proportion of the stock and are focused on those of pre-1850 date that retain a significant proportion of their original fabric.
- HER data and National Trust HBSMR data on individual buildings is also highly selective, the exception to this being Farmsteads Mapping data which records the recorded date, survival and historic layout of traditional farmsteads, field barns and outfarms; this provides a framework for site survey (being used for the Attingham and Edale case studies), including a context for considering the degree to which their historic character and significance is representative of the area in which they are located.
- Detailed ecological data on individual sites and buildings is similarly limited, variable in the date of capture and only enabling identification of species within grid squares.
- HLC and EUS enables identification of historic landscape types including settlement cores and extensions in which the bulk of buildings other than in farmsteads are located.
- Similarly, the UK Habitat Classifications and Types offer a framework for consideration of habitats and their connectivity and potential within and more commonly around building plots.

As with any modelling approach, a number of assumptions have been made regarding variables where data was not available (or available at the correct scale). These include:

- size of buildings and structures have been derived from GIS data but relate only to the footprint of the building on the ground, not to height or volumetric area. In some cases, this might be an issue (for example assessment of ecological supporting service provided by structures).
- Function and condition of structures within case study areas. Function and condition were determined through field visits but given the limited resources available for the project, the areal extent of multiple buildings dedicated to specific functions could not be determined with accuracy, hence the utilisation of three broad categories of use (residential, economic, and service provision). Ideally more detailed assessment would be required utilising a template for data collection. This is an area where neither map-based information, historical, nor GIS data sources can provide the information required. Some form of sampling with ground-truthing might provide an alternative way forward.

- Local context for case study sites. Limited information is available about residential use of buildings, numbers of different types of user, local populations in the vicinity of a site, and information on numbers of visitors. Estimates have been made of the following:
    - Number of farm holdings/farmers in the vicinity of case study sites.
    - Number of residents of buildings
    - Number of users (of different types) benefitting from utilisation of buildings
    - Resident population in the immediate vicinity of case study sites.
    - Numbers of visitors in the case study areas varies widely. For some well-known sites, visitor numbers are maintained, but for less well-known, or remote sites interpolation is required from data relating to visitor numbers to a large area.
    - External surface area of structures contributing to biodiversity through provision of shelter/habitat. Estimates were made based on a mean building height and proportion of surface area likely to provide supporting services such as habitat. More comprehensive information could be provided from detailed habitat surveys and applied to different types or categories of building.

Users of the model need to keep in mind the values obtained are based on current use levels applied over a 50-year time period. The model takes into account depreciation and maintenance costs over the period but no sensitivity analysis has been carried out to explore how potential changes in service delivery might alter benefit flows, nor how external factors (such as changes in attitudes, transport costs, visitor numbers) might influence the cultural heritage value scores or magnitude of benefit flows. Further research is required to explore these issues in more depth.

Using narrative

Awareness of the strengths and limitations of data also informed the development of a narrative-based approach that – through generalising and understanding of the historic character and context of the area and use of the Heritage Value scores - offers a framework for considering the range of ecosystem service outcomes delivered by buildings and their boundaries within an area. Due to the predictive and forward-looking nature of the model we suggest these outcomes could be considered as 'ecosystem service potential', offering a means of bringing together different sources of data and using narrative as an inter-disciplinary and predictive framework prior to site survey. Ecosystem service 'potential' offers an opportunity to explore the possible range of benefits that can flow from the historic character of buildings with their associated enclosed spaces, and the inter-relationship of historic and natural factors is particularly important in this respect. This does not have to be a 'resource-heavy' approach: assessment can be rapid and extensive in its nature and can be undertaken with reference to a basic understanding of the historic character and services offered (using for example the NCA profiles or more detailed Landscape Character Assessment and Historic Characterisation reports).

Current functionality and condition

Functionality of buildings/structures clearly influences the benefit streams produced, and where functional use has altered from the original it is important to capture the extent to which the building operates effectively. The historic character of buildings and their enclosed spaces flows from their original function, as well as how they have been adapted to continue serving this function or new functions. These changes require consideration along with assessment of their current function, when assessing their ecosystem service 'potential'. If the buildings carried out a similar range of functions but had no historic interest, then the cultural heritage value could be subtracted from the benefit flows provided by ecosystem services. It is also likely that if there were no historical value there would be no visitors or education value, which might also reduce some of the provision services delivered.

The project has experimented with the creation of functional zones that deliver different types and scales of uses and benefits, for example, houses with their gardens and sometimes orchards, traditional buildings with yards and working areas, modern working areas with their hard surfaces and sheds, ponds, quarries and other areas such as orchards that have reverted to scrub woodland.

Condition of buildings also provides indications both of ecological services generated and efficiency of operation of a building in terms of outcome delivery. Where an old barn is being utilised for livestock management, for example, the construction or layout may not support investment in modern technology (e.g. robotics) to maximise production efficiency. At the same time supporting services may continue to be generated through provision of habitat within the building structure. This suggests the need for detailed structural assessment which would be expensive to carry out at any large scale. Sampling of buildings within sites could provide sufficient detail to enable interpolation across buildings of similar age/construction, and/or across sites.

The issue of scale

Assessment can range from landscapes to individual farmsteads and buildings. The larger the area, the greater the potential to capture a broad range of ES benefits and to consider buildings as an integral part of how places have developed. Whilst site-specific ecological data might not be forthcoming, understanding of the inter-relationship of historic character to habitats at different scales has proven to be useful.

Assessment can focus on the scale of individual buildings, but this is very costly and demands much more in terms of site-specific data that is also up-to-date. It is suggested that this take places through established means, for example surveys that are required for planning applications for development. Strategic overviews can be rapid – half a day for a site, 2 days for an estate – and cost-effective. Strategic overviews can use HLC and EUS, particularly where these have considered the biodiversity as well as the archaeological potential of HLC and EUS Types

Aggregating values
Without a detailed assessment of every individual building at a site (which is not possible given resource implications) there is a need to develop some form of aggregation methodology that allows buildings/structures, and their beneficiaries, to be assessed within categories or some form of typology. In this pilot project buildings/structures have been grouped into three broad categories, based on whether the main use is residential, economic (including agriculture) or provision of some form of service function.

Beneficiaries are also aggregated and allocated to one of the following categories: resident, user (but not resident), property owner, resident of the local area, visitor. The rationale for this is that categories of user benefit from outcomes at different levels of intensity requiring variability in scoring and assignment of value.

Local context is important in assessing ecosystem service outcomes, and numbers of beneficiaries, which mitigates against any approach that might try to aggregate building types (or sites) across larger areas (e.g. at landscape character or national scale). Our experience with aggregation suggests that aggregation across larger areas, or through lumping together similar building types from different locations, loses information in relation to magnitude of outcomes arising from specific sites, and the value of benefit streams to beneficiaries. Local context is significant when it comes to assessing outcome values generated by ecosystem services.

7.5.2 Strengths

Flexibility
The accounting model developed is a straightforward 'return on investment' approach, which compares values of a range of benefit flows to expenditure on restoration and maintenance over a specific period of time (in this case 50 years). The model takes the current stock of buildings and structures as a given and does not try to value the stock; it only values the benefits that flow from that level of stock, and the costs of maintaining the stock at the current level.

The model is flexible in relation to the following:

- It can be applied across variable time scales (the current model is set at 50 years, but this can be shortened or lengthened, which may alter the benefit-to-investment ratio).
- It can be applied across variable spatial scales (the model can be applied at a range of spatial scales, although if the area is too small some benefit flows will decrease, due to the inability to identify beneficiaries (e.g. residents, or visitors to an area).
- Incorporates changes in function/condition of buildings and structures and reflect changes in functional activity through the range and magnitude of ecosystem services generated.
- Enables comparisons. The models can be varied in a number of ways to enable comparisons and exploration of changes in key variables. The model:

- Allows for comparison across time scales.
- Allows for comparison between areas.
- Enables the user to explore the impact of changes in key variables (e.g. condition, functionality).

Exploration of ecosystem service values by beneficiary type
Values of ecosystem services can be explored for each individual service identified, for categories of ecosystem service (i.e. cultural, provisioning, supporting, regulating), and for different types of beneficiary.

A case-study approach
A case study approach was selected in order to capture some of the variability across building types and settings. Time and resources limited the number of case studies, but three different areas were selected in order to test the sensitivity of the model to variability in key characteristics of the buildings/structures. The approach demonstrated some of the strengths and weakness of the model, in particular the high degree of variability in the built environment even within relatively small geographic areas. This suggests that the method might need to be applied at a fine-grained local level, rather than across large areas. It also suggests that if valuation over large areas is of interest then some form of sampling will be required.

The alternative option is some form of benefit transfer approach based on a set of readily identifiable characteristics of building 'types' within an area, or 'functional scenarios'. The disadvantage with the scenario-based approach is its inability to capture the variability that exists on the ground in relation to generation of ecosystem service outcomes. A small number of scenarios could illustrate differences based on agreed characteristics but would not be a valid means of undertaking benefits transfer from one place to another.

What the benefits transfer approach misses, is that the value of many environmental services comes from their place-based characteristics and the integration of ecological and socio-economic factors. What we are valuing in the project described in this report, are unique socio-economic and ecological systems. Each locality is unique. It is the mix of services and the different inter-relationships that have evolved between humans and their environment, in a specific place, that creates value (economically, socially, culturally and ecologically), and determines how and why buildings and structures are utilised, their condition, and their future resilience. This cannot be captured by benefit transfer processes, which (at best) tend to just homogenise value based on some basic characteristics derived from a small sample of places.

8 CONCLUSIONS

8.1 Introduction

This project aimed to explore and test how the cultural heritage values of buildings and structures can be incorporated into an ecosystem services framework, through considering them as both an integral part of their associated historic spaces (gardens, yards etc.) and of their wider landscape settings. The project has applied a methodology that identifies the ecosystem service outcomes from buildings, expressed in terms of flows of benefits over time, and attributes monetary values that are compatible with the ecosystem services approach. The method focuses on identifying and measuring the flow of ecosystem services over time arising from the current level of 'natural capital' (the stock), in a site or a defined area.

The project team have developed and applied an environmental value accounting model that identifies the benefits and attributes the values associated with historic buildings and structures. The model is based on a 'return-on-investment' accounting framework that integrates historic function, character and significance of buildings (or other structures) with a range of agricultural, environmental, economic, and social functions to analyse the range of values generated. The cultural heritage (historic) value of buildings in the case study areas was assessed through the integration of three scored characteristics (time depth, inter-relationships, legibility). This desk-based identification of the extent to which the historic buildings and structures in an area contribute ecosystem services was aimed at enhancing understanding the value of the annual flow of benefits cultural benefits generated. It was not aimed at identification of the intrinsic heritage significance and value of buildings or structures, as defined in the NPPF and Historic England's Conservation Principles.

Individual buildings or structures were not valued directly in this project, the methodology assesses the value of a grouping of buildings within a defined cultural setting. The model utilises a return-on-investment approach to provide a ratio of benefits generated by identified ecosystem services in relation to restoration & maintenance costs. Present values (PV) of the flow of costs and benefits are calculated and compared over a 50-year time horizon (using a standard 3.5% discount rate). Model outputs were generated for three case study areas, Attingham in Shropshire, Sherborne in Gloucestershire, and Upper Booth farm in Edale, Derbyshire.

Discounted values generated by buildings and structures in the case study areas over the 50-year period vary with changes in: size of the case study (in terms of m^2 of buildings included in the project), resident population and visitor numbers, current utilisation of buildings, and historic value. Total ecosystem service values generated over the 50-year time horizon per m^2 area in the case study areas range from a low of £51.85/m^2 for a single farmstead and barns in Derbyshire up to £168.83/m^2 for a much larger area of buildings on the Attingham estate in Shropshire, receiving much higher visitor numbers. Return on investment ratios

(present value comparison of costs and benefits across the 50-year time period) range from 1.82:1 for Edale to 5.07:1 for Attingham.

8.2 Strengths and weaknesses of the approach

Strengths of the model lie in its flexibility to explore a range of different building types within different historical and environmental contexts, and ability to analyse values across a range of time frames as well as focus on values of individual outcomes from the four categories of ecosystem services. Current weaknesses of the model relate to the need for improved quality of data. The current model is based on a pilot project with limited field sampling of building characteristics within the sample sites, particularly in regard to factors such as current function, condition, number of residents, owners, local population and visitors. Improvements could be made to the model through a more detailed sampling approach to explore the likely range of factors affecting magnitude and timeframe of benefit streams.

8.3 Lessons learned

Thinking about historic buildings as an integral part of landscapes provides a wider range of planning and design options. Key lessons include the following:

- the wide range of benefits that they offer to society, could make an innovative and significant contribution to how we plan for the growth of settlements, and adapt to climate change and other future scenarios.
- valuing the cultural heritage and ecosystem services of buildings and structures can contribute to improved understanding, at a national to local scale, of the benefits that can be delivered by sustainable adaptation of historic buildings and new design in different contexts. Examples at a local scale include the approach adopted by South Downs National Park for planning applications.[87]
- the government's recently-released National Design Guide[88] offers a further opportunity to develop an integrated understanding of the character of the historic and natural environment in planning for future change.

It must be emphasised that this report has tested and indeed stretched the limits of how far heritage assets can be described in terms of ecosystem services. We have shown that available data on the natural and historic environment presents serious limitations to developing such an approach. We have also shown that the mapping of post-1850 development at a national level (Bibby 2018), and the mapping of traditional farmsteads at a local level, can offer a context for assessment that extends beyond the limitations of national designations and the content of local HERs.

We consider that the most cost-effective method of developing an approach to inform future change would be one that places buildings into the context of their

[87] See Policy SD2 in the South Downs National Park Local Plan and its guidance for householder applications (https://www.southdowns.gov.uk/planning/national-park-local-plan)
[88] Ministry of Housing, Communities and Local Government 2019, National Design Guide. Planning practice guidance for beautiful, enduring and successful places.

landscapes, and that thus enables users to see the building stock as fundamental in telling the story of how places have developed and can change in the future: an easily accessible context and starting point, in this respect, are the National Character Areas. The profiles for each of these bring together a wide range of environmental information in order to set out the key characteristics (resulting from centuries of natural and historic change), issues for change, statements of environmental opportunity, and supporting data.

8.4 Applicability of the method at a national scale

8.4.1 Potential for future development: scoring methodology

The date and type of the built environment results from the establishment of distinct types of settlements that find their reflection in patterns of enclosure, routeways and other attributes that need to be considered as a whole. There is potential to develop this understanding at a national level using National HLC and the dataset arising from the Future of Rural Settlement project, which has identified variations in post-1850 development in relationship to the mapping of rural settlement derived from the medieval period. This and Farmsteads Mapping (in limited areas of England) has used the NCAs as a reporting framework. This data could also be analysed in relationship to the NHLE (the criteria for which focus on the pre-1850 building stock), environmental and habitat designations and classifications used for Phase 1 Habitat Surveys.

The historic landscape types identified in National HLC can also be analysed in relationship to these habitat classifications, thus offering a powerful Open Source dataset that can be read in relationship to enhanced text for Historic Building and Historic Landscape Types, using the Characterisation Thesaurus, that articulates the habitat and biodiversity potential, and the inter-relationship of the diversity of historic and natural factors within each of them as articulated in and Appendix 2.

The Future of Rural Settlement data, which enables comparison of the rate of post-1850 change within the context of earlier inherited patterns of settlement, can be developed as a powerful Open Source dataset. It would benefit from integration with data on building type and data from the NHLE.

8.4.2 Potential for future development: valuation model

Whereas the heritage scoring approach could be applied at a much wider level, it would be difficult to apply the valuation model at a national scale at the present time. Further development work is required to explore techniques for arriving at more accurate valuation of the benefits streams flowing from ecosystem services outcomes. For example, supporting services across the three studies were valued at very low levels (less than 1% of the total Present value of all ecosystem services). While the value of supporting services is expected to be low for man-made structures, it is not clear whether ecological outcomes are being adequately captured. Further work on the ecological outcomes around buildings in a range of different context is required.

Other key areas requiring development include the following:

- A method to identify local populations, residents and users of structures.
- Greater accuracy of carbon sequestration within different types/ages of buildings and structures.
- A clearer set of outcomes classified as 'regulating services'.

Next steps require development of a more detailed model that can capture more of the variability among building types and techniques to enable ecosystem service outcomes, benefit flows and monetary valuation to be captured with a higher degree of confidence.

9 APPENDIX 1: TIME DEPTH

9.1 Introduction

Rising incomes, trends towards smaller households and other factors (such as second homes) have contributed to the growth in the number of dwellings since 1851 by a factor of 7.2, as opposed to the increase in population of 3.5. The historic character and growth of the housing stock (doubling every 50 years since 1801 and by a factor of 7 since 1851) has been conditioned by patterns of settlement and economic growth extending into the medieval period, as summarised below.

9.2 The medieval period: pre-1550

- The Reformation of the 1530s is commonly regarded as marking the end of the medieval period. Churches, castles, barns, religious houses and high-status houses comprise the main survivals. Town houses survive from the 12th century and peasant houses from the 13th century, although most of the surviving building stock is 15th and early 16th century – reflecting the growing confidence of mercantile classes in urban areas (many since converted into commercial uses) and of an emerging class of wealthier farmers. There is an increasing tendency, working through the social scales and with strong local variation, in the provision of more private chambers and the ending of the communal tradition of the open hall.
- Bridges, market buildings and inns provide evidence of a strategic transport and commercial network that used much of the road system inherited from the Roman period.

9.3 Post-medieval rebuilding: 1550-1749

- By 1750 the population had recovered to 5.74 million, probably the same as that of around 1300, when cultivation had reached its limit and prior to the impact of the Black Death. This was accompanied by growth in more private styles of living, the increasing influence of classical architecture and more centralized planning of houses.
- Phases of rebuilding affect all rural and urban areas, often more inter-related than is commonly realized. Whilst much of the pre-1750 building stock dates from before 1650 in the southern half of England, the area from northern Lancashire to Cumbria was more profoundly affected by post-1650 rebuilding. Rural areas in eastern England (from the estatelands of northern Norfolk to the great estates of Northumberland) were relatively unaffected, whereas the post-1750 refronting and new building in urban areas has hidden a rich heritage of earlier fabric.
- Abandonment and adaptation of religious houses accompanied by growth in numbers of gentry and country houses with associated parks and gardens. These houses and other changes in rural areas also reflect growth of large landed estates that consolidated holdings into single blocks from late 17th century.

- Increase in terrace housing from late 17th century, particularly in urban areas, and growth of villas (detached or semi-detached) especially marked in areas of new enclosure with improved transport links.
- Increasing variety of farm buildings, offering evidence of specialisation in food production alongside new crops, including improvements to pastures, and rotations boosting yields.
- Evidence of workshops and industrial buildings increasing from late 17th century.

9.4 Georgian and Early Victorian Improvement: 1750-1849

- Rapid transition towards an increasingly urban and industrial economy, increase in population to 16.8 million by 1851 sustained by improvement, taking-in and enclosure of farmland. Urban areas were rebuilt and expanded rapidly, most notably London, industrial towns and coastal and inland leisure resorts. There was considerable expansion of middle-class suburbs and of suburban towns with access to improved communications. This was accompanied by significant growth in the numbers of places of worship (mostly nonconformist chapels, followed from the 1820s by an increasingly-organised Anglican Church), especially in urban and rural-industrial areas.
- Rebuilding of large houses and rural villas associated with continued growth of large landed estates and development of parklands with exotic new species. Striking contrast between areas of adaptation and new building of farmsteads (concentrated in areas subject to re-planning of landscapes) to enable processing of crops, better management of livestock and production of manure to boost yields.
- Increased standardisation of building techniques and planning (for example of working-class terrace housing), combined with more demand for privacy extending to rising importance of private gardens, houses often being built or remodelled to face towards them or to exploit viewpoints in the landscape.
- New building types reflect the development of industrial manufactories and the application of steam power, the development of the road, canal and finally the first phase of the rail network, the development of the secondary economy (workshops and from 1770s factories for making raw materials into goods) and the tertiary economy (shops etc). Welsh slate and other building materials, including pine imported from the Baltic, became more widespread.

9.5 Victorian and Edwardian Growth: 1850-1913

- The 1851 census famously marks England's transition from a rural to an urban society. Mechanisation on farms, increasingly steam-powered, is accompanied by further reorganisation of fields, a decline (relative to other industries) in rural labour, the rebuilding of workers' housing and the continued rebuilding of farmsteads. Growth slows down after the onset of agricultural depression in the late 1870s, after which there is more prefabrication and standardisation to minimize labour and meet hygiene and

other regulations. Landed interests decline relative to the increasing power of urban voters.

- Continued growth of ports, resorts, suburban centres and industrial foci including engineering centres, stimulated by the massive growth of the rail network. The explosion in house building is marked by a strong contrast between areas of high-density and often gridded urban housing, increasingly subject to public health acts and bylaws, and lower-density villa and suburban housing. The latter also extends into rural areas, particularly in areas of parkland and poorer agricultural land close to London (this being especially marked) and other urban centres. The latter was strongly influenced from 1918 by the Garden City Movement, piloted at Letchworth and Hampstead.
- House building is accompanied by expansion of commercial buildings and places of worship, including restoration of medieval churches by the Anglican Church. Increasing importance of civic society and state regulation reflected in increased standardisation of construction and sanitation in housing, and new building types such as workhouses, hospitals and pumping stations set in landscaped grounds for water and sewage. Reform of the state education system from 1872 initiated major programme of building schools.

9.6 World wars and inter-war expansion: 1914-1944

- Massive increase in home ownership enabled by reorganisation of housing industry, increased social mobility and extension of credit. Increase in public housing, accounted for one in four of the four million new houses (mostly in urban or suburban areas) built in 1918-1939.[89] The standardisation and mass production of materials, foreign imports and improved infrastructure reduced costs and by 1939 nearly a third of the population lived in houses built after 1918.
- Motor transport and the development of the electricity grid also enable development along roads and in previously less-accessible rural areas (particularly in the South East), the availability of land for development also enabled by massive land sales following the Liberal budget of 1910 and the First World War.
- The Garden City movement has a profound impact on suburban architecture and planning, the most marked growth being along the south coast, around London and in the West Midlands. The impact of modernism is mostly confined to southern England, and high-density urban living, in the form of flats or maisonettes, remained relatively uncommon by European standards.
- An increasing amount of land was subject to expansion of the defence estate, from anti-invasion sites and the military-industrial complexes to the extensive areas of land for training, airfields and other purposes in two world wars.

[89] Rowley 2006, 198-200

9.7 Post-1945 growth and containment

- Period first marked by a massive investment in local authority housing (their tenants comprising a quarter of the population by 1961), accompanied by establishment of new towns and high-rise flats. This declines in the 1970s, followed by the introduction of 'right to buy' at a reduced market cost. Owner occupation peaked at 71% of households in 2003, dropping to 63% in 2016-17.[90]

- Strong growth in housing, matched by continuing sharp falls in household size, is countered by the development of a stronger land-use planning regime. A desire to limit housing in rural areas, following the 1947 Town and Country Planning Act, was accompanied also by the introduction of statutory protection ('listing') for historic buildings of special architectural and historic interest, the introduction of National Parks and AONBs and from 1967 Conservation Areas. Simplicity of design and standardisation using prefabricated techniques characterises the period to the 1970s, followed by a desire for more variation in house design.

- Planning strongly limited dispersed settlement, at the same time that restructuring of the farming industry witnessed increasing redundancy of agricultural buildings. Manufacturing peaked in mid 1960s followed by the shift to a service economy. From the late 1980s an increasing proportion of housing has been located on previously-developed land, including the Government Estate, and within urban areas including the subdivision and conversion of properties.

- Over the whole period from 1980 to 2011, housing output dropped to 41% of its average level between 1951 and 1980. Housing Associations, typically working on small sites, took the lead in the design of affordable housing (10.3% of the housing stock in 2016-17 as opposed to 6.8% local authority, 20.5% private rented and 62.4% owner-occupied).[91] A far higher proportion of housing in this period has been built on previously developed land, including land sold by the Defence Estate, and after 2000 to higher densities. Many new homes built in the period from 1981 to the present have been converted from redundant historic buildings in urban and rural areas, with planning policies seeking to concentrate new houses on existing village settlements in rural areas.

- New development through new construction and modification has been concentrated within existing settlements, including in areas following from the 1970s and earlier the large-scale release of industrial land, and from the 1980s historic sites such as Victorian institutions and former airfields. Existing buildings in urban and rural settlements have been subdivided or converted to create more dwellings. This has been encouraged by densification policy since 2000, working upon the policy for containment that has prevailed since the Second World War: a consequence of this, for

[90] English Housing Survey, Headline Report for 2016 to 2017 (Ministry of Housing, Communities and Local Government, https://www.gov.uk/government/statistics/english-housing-survey)
[91] English Housing Survey, Headline Report for 2016 to 2017 (Ministry of Housing, Communities and Local Government, https://www.gov.uk/government/statistics/english-housing-survey)

example, has been the shift of north and west London's growth to the clay vales beyond the Chilterns (now including the 'Oxford-Milton Keynes - Cambridge corridor' growth area). Much future growth, including new settlements on surplus public sector land, will result from the production of registers of brownfield and other land.

10 APPENDIX 2: HISTORIC CHARACTER AND CONTEXT

10.1 Introduction

The columns in Table 6 set out the historic character and associated landscape and settlement context for each of the broad classes of building types.

10.2 Historic character of each building type

These set out:

- 1) the Broad Class Types set out in Historic England's Thesaurus of Terms for recording the built and buried heritage to a common standard including for local HERs,[92] cross-referred to the related terms in the Historic Characterisation Thesaurus (HCT)[93]
- 2) their associated dominant architectural style and date range
- 3) the boundaries and spaces typically associated with them
- 4) the Broad Types set out in the Historic Characterisation Thesaurus, which are subdivided into narrower types for Historic Landscape and Urban Characterisation

10.3 Landscape and settlement context most commonly associated with each building type

- 5) Historic Landscape Context. With reference to the Broad Types set out in the Historic Characterisation Thesaurus, of which the most relevant are:
    - Rural Settlement, usually subdivided into isolated dwelling, farmstead, village, hamlet and housing estate – inclusion of components of dispersed settlement very variable
    - Urban Settlement, often including other HLC types and subdivided into dwelling (detached housing, flats and apartments, semi-detached housing, terraced housing) and different urban types from historic urban core to residential area and urban extension.
    - Enclosure landscapes, subdivided into narrow types according to whether the enclosure is ancient, piecemeal or regular in form

Buildings are comparatively rare in Unimproved land (such as unimproved grassland, heathland, moorland, rough ground, marsh, scrub and dunes), Woodland and Valley Floor landscapes.

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[92] Historic England 2014 *Forum on Information Standards in Heritage (FISH) Thesauri* (http://thesaurus.historicengland.org.uk) The *Thesaurus* also includes Monuments and a class termed 'Unassigned' from aircraft crash sites to yards.

[93] Historic England 2015 *Historic Characterisation Thesaurus* (http://www.heritage-standards.org.uk/wp-content/uploads/2016/05/Historic-Characterisation-Thesaurus-Aug-2015.pdf)

- 6) the NEA type and the habitat type derived from the UK BHC, which defines 27 habitat types for the UK (see Appendix 3 for further details), there being a broad inter-relationship between the two categories as follows:
    - NEA Urban (10.6%) and BHC Urban and Suburban
    - NEA Enclosed Land which includes almost all rural settlements (55.3%); most common related BHC Types are boundary and linear features, Arable and Horticulture, Grassland types (Improved, Neutral, Calcareous, Acid)
    - the other NEA types of Mountain, Moorland and Heath (5.3%) and Semi-natural Grassland (14%), from which historic enclosure and settlement may have retreated; these relate to the BHC Types of Calcareous Grassland, Acid Grassland, Neutral Grassland, Bracken, Dwarf Shrub Heath, Fen, Marsh and Swamp, Bogs
    - in rare instances to Woodland (9.5%, often as a result of 20th century scrub and tree growth which has colonized defence and industrial sites)
    - and most rarely to Freshwaters (1%) or Coastal Margins (1.5%), and the related BH types of Standing Open Water and Canals, Rivers and Streams

Table 6: historic character and associated landscape and settlement context for each of the broad classes of building types

HISTORIC CHARACTER			LANDSCAPE AND SETTLEMENT CONTEXT	
1.Building type (Thesaurus Class Type), associated dominant architectural style and date range (Time Depth)	3.Associated spaces and boundaries	4.Historic Characterisation Class and Broad Type (where specification necessary)	5.Historic landscape context	6. National Ecosystem Assessment and Broad Habitat Context
Agriculture and subsistence – mostly comprising farm buildings (farmsteads and field barns) and their associated spaces; also including fishing sites. Dominant style: Mostly traditional, houses and estate farms most likely to be in an architectural style, modern utilitarian structures from late 19th century and dominate post-1950 farmsteads with concreted yards. Time Depth: All periods, but strong local variation in survival of rare pre-C19 buildings.	Farmsteads: gardens, orchards, paddocks and yards, bounded by hedgerows, dry stone walls, hedgebanks etc. Outfarms and field barns have paddocks and yards with similar boundaries.	Enclosure and Rural settlement. Fisheries and Aquaculture. Orchards and Horticulture, including allotments and hop and market gardens.	Rural settlement. Mostly within Enclosure landscapes, rarely in Unenclosed Land and Urban context. Very rarely in context of Cultural Topography (Coastal and Intertidal, Wetland, Upland etc.)	NEA Enclosed Land, and most commonly relating to BHC arable/ horticulture and grassland types. Field barns and outfarms also in unimproved NEA types (Wetland and flood plain, Semi-Natural Grasslands and Mountains, Moorland and Heath) and BHC grassland types. Fishing sites in Freshwaters, Coastal Margins and Marine.
Civil – for the provision of civic services, also including some state-sponsored sites such as prisons, workhouses and coastguard stations. Sometimes set in extensive grounds,	Sometimes set in extensive grounds, including former parks	Civic Provision (NT Civil, Penalty, Emergency Services).	Mostly within Urban Settlement.	Mostly NEA Urban.

including former parks and gardens to large houses. Dominant style: designed, some inherited traditional, modern utilitarian from late 19th century. Time Depth: Mostly post-1750.	and gardens to large houses.	Mostly urban or peri-urban.		
Commemorative – sites and structures to commemorate lives and events, most numerous being post-1918 war memorials. Rare to find these sites within enclosed boundaries. Dominant style: designed. Time Depth: Mostly post-1919	Rare to find these sites within enclosed boundaries.	Mostly Civic Provision; also Commemorative, Religious Ritual and Funerary.	Rural Settlement and Urban Settlement.	Mostly NEA Urban and Enclosed Farmland.
Commercial – include markets, hotels, shops, pubs and restaurants, offices and warehousing; include a high proportion adapted from historic buildings in town centres. Dominant style: designed, some inherited traditional, modern utilitarian from late 19th century. Time Depth: Purpose-built structures rare before 1750, increasingly common from 1850s.	Predominantly urban context means that most of these have lost their historic boundaries other than being conserved in the layout of buildings, parking and other spaces within historic plots such as medieval burgage plots.	Commerce.	Mostly within Urban Settlement.	Mostly NEA Urban, some in Enclosed Farmland.

Communications – focused on sites and structures associated with the development from the late 18th century of signal, wire, radio, electric and digital communication	Typically purpose-built and bounded by non-traditional boundaries.	Communication.	Rural Settlement and Urban Settlement.	Mostly NEA Urban and Enclosed Farmland.
Defence – castles, coastal and inland defences with related defensible landscapes; often extensive grounds to depots, training and support bases and airfields. Dominant style: designed, some traditional, modern utilitarian from late 19th century. Time Depth: All periods, include medieval castles to state-sponsored coastal defence from 1530s, training and support bases from 1750s and especially 1850s, airfields from 1910.	Areas within defence sites, although typically bounded by non-traditional boundaries, can be rich in biodiversity.	Military.	Rural Settlement and Urban Settlement.	Widely distributed and can occur in all NEA Types.
Domestic – houses and all other forms of dwelling, which display through their scale, layout and style the status and aspiration of their occupants and developing attitudes towards communal, family and individual lifestyles. Dominant style: traditional and designed.	Traditional and non-traditional boundaries to gardens, amenity and communal areas.	Rural Settlement (Housing estate, Isolated Dwelling and Farm, Nucleated Settlement). Urban Settlement (City, Dwellings, Historic Urban Core, Residential Area, Town, Urban Extension).	Core to many urban and some rural settlements pre-1550 and extending into extensive areas of Enclosed and Unenclosed Land post-1850.	Widely distributed and can occur in all NEA Types, largest-scale sites (airfields) concentrated in areas taken out of Enclosed Farmland.

Time Depth: All periods, strong local variation in survival.				
Education – schools, colleges, universities and their associated grounds Dominant style: designed. Time Depth: Mostly post-1850.	Sometimes set in extensive grounds, including former parks and gardens to large houses.	Civic Provision (NT Education).	Mostly within and integral to Rural Settlement and Urban Settlement. Houses (including within farmsteads) located within Enclosure landscapes.	Mostly Urban and Enclosed Farmland. NEA: Enclosed Land, and most commonly relating to BHC arable and grassland types.
Gardens, parks and urban spaces – which may include associated buildings such as cafes, lodges glasshouses and pavilions. Dominant style: designed. Time Depth: Parks can be medieval in date, some 1750-1849 and most post-1850.	Buildings can be sited within extensive grounds with no clear relationship to boundaries.	Ornamentation (NT avenue, plantations, parks, pleasure grounds, shelterbelts). Recreation and Leisure	Rural Settlement, mostly Urban Settlement. Sometimes set in extensive grounds, including former parks and gardens to large houses.	Mostly Urban and Enclosed Farmland.
Health and welfare – buildings and sites to treat mental and physical illness (hospitals and workhouses) and offer health benefits such as spas	Typically purpose-built and bounded by non-traditional boundaries, the principal exception being some convalescent hospitals and asylums where buildings were designed as an integral	Civic Provision (NT Health).	Mostly within Urban Settlement and bordering Enclosed landscapes.	Mostly Urban, most pre-1750 parkland in Enclosed Farmland.

Dominant style: designed. Time Depth: Mostly post-1850.	part of restorative open spaces.			
Industrial – structures and sites for the extraction of raw materials (mostly mines and quarries) and for refining, processing and manufacturing Dominant style: designed, some traditional, modern utilitarian from late 19th century. Time Depth: Most sites are post-1750.	Buildings can be sited within extensive grounds with no clear relationship to boundaries, and often where the archaeological remains of industrial activity are more legible. .	Industry.	Mostly Urban and in Enclosed Farmland and more rarely Unenclosed Land (e.g. asylums and isolation hospitals).	Mostly Urban and Enclosed Farmland.
Maritime – buildings and sites to help build and maintain marine transport and trade (docks, ports), enable and regulate safe passage (locks, navigation aids etc.) Dominant style: designed, some traditional, modern utilitarian from late 19th century. Time Depth: Purpose-built structures rare before 1750.	Typically purpose-built and bounded by non-traditional boundaries.	Industry (NT Shipping Industry).	Mostly within Urban Settlement.	Found in all landscape contexts.
Recreational – a wide range of structures and sites, including eating and drinking establishments and sports sites and clubs mostly dating from the 19th century	Buildings can be sited within extensive open grounds with no clear relationship to boundaries.	Recreation and Leisure.	Rural and Urban Settlement.	Mostly Urban and Rural Settlement, and Enclosed Farmland.
Religious, ritual and funerary – places of worship, religious houses and communities	Churchyards attracting a diversity of species.	Civic Provision (NT Religion).	Rural Settlement, Urban Settlement, Enclosure	Mostly Urban and Enclosed Farmland.

and places (from Saxon and medieval churches to 20th century crematoria) for the commemoration and burial of the dead Dominant style: designed. Time Depth: All periods, particularly pre-1550 and post-1750.	Designed landscapes can provide settings to cemeteries and crematoria.		Landscapes, Unimproved Land more commonly associated with early ritual sites.	
Transport – buildings and structures associated with air, rail, road, water (sea and inland) transport and navigation Dominant style: designed, some inherited traditional, modern utilitarian from late 19th century. Time Depth: Mostly post-1750.		Communications and Movement.	All types.	Urban. Also, strong relationship to Enclosed Land and rarely (excepting early ritual sites) to other NEA Types.
Water Supply and Drainage – buildings and sites for the provisioning and regulation of water and the treatment of sewage. Dominant style: designed. Time Depth: Rare pre-1850, as most sites date from national and local efforts after 1840s to improve the supply and quality of water.	Can be designed within extensive designed landscapes.	Civic Amenities	Mostly within Urban Settlement, some in Enclosure Landscapes.	Mostly Urban and Enclosed Farmland.

11 APPENDIX 3: HABITAT CLASSIFICATIONS AND HISTORIC LANDSCAPE CHARACTERISATION

11.1 Introduction

Table 7 below offers a broad indication of the inter-relationship of the UK broad habitats with the UK Biodiversity Action Plan's priority habitat types and HLC's broad and narrow types. It shows:

- The Broad Habitat Types as listed in the UK Habitat Classification, as set out in column 6 in Appendix 2.
- The related Habitat Codes used in the Phase 1 Habitat Surveys,[94] which provide a basis for the assessment of habitat types and their potential for nature conservation.
- The related Biodiversity Action Plan Priority Habitats as set out in the *UK Post-2010 Biodiversity Framework,* which succeeded the UK Biodiversity Action Plan.[95]
- The related Broad and where relevant Narrow Types used for HLC, including terms (if different) used for the National Historic Landscape Characterisation (NHLC). More than one Priority Habitat and HLC Type might relate to a single HLC Broad Habitat Type.

The table shows an expected alignment between the types that would merit further investigation using GIS-based analysis as a research priority for ecosystem services:

Table 7: Inter-relationship of the UK broad habitats with the UK Biodiversity Action Plan's priority habitat types and HLC's broad and narrow types

Broad Habitat Type and (in brackets) relevant Phase 1 Habitat Codes	Priority Habitat Types	Historic Landscape Characterisation Broad Types and Narrow Types (NT)
Built-up areas and gardens (J3)		HC: Urban and Rural Settlement, Civic Provision, Commerce, Recreation and Leisure, Ornamental, Industry, Military
Cultivated/disturbed land including Arable (J1.1) and field boundary types (J2)	Arable Field Margins Hedgerows	HC: Enclosure (NHLC: Enclosed Agricultural Land)
Open Water (G)	Rivers Includes ponds	HC: Communications and Movement (Water Transport) HC: Fisheries and Aquaculture HC: Recreation and Leisure

[94] Joint Nature Conservation Committee (JNCC) and Defra 2010 Handbook for Phase One Habitat Survey. A technique for environmental audit - http://jncc.defra.gov.uk/PDF/pub10_handbookforphase1habitatsurvey.pdf

[95] Joint Nature Conservation Committee (JNCC) and Defra 2012 UK Post-2010 Biodiversity Framework

		HC: Cultural Topography (Coastal and Intertidal, Freshwater Body, Marine)
Woodland		
Woodland (A) Woodland (broadleaf, coniferous, mixed and plantations, A1) Scrub (A2) Parkland and scattered trees (A3) Recently-felled woodland (A4)	Traditional Orchards	HC: Orchard and Horticulture
	Wood-Pasture and Parkland	HC: Woodland (Wood Pasture) HC Recreation and Leisure (Country Sport/ Deer Park)
	Upland Oakwood	HC: Woodland (Ancient Woodland, Coppice, Plantation, Replanted Woodland, Secondary Woodland, Woodland (broadleaf, coniferous and mixed) HC: Ornamentation for plantations and shelterbelts in the context of designed landscapes
	Lowland Beech and Yew Woodland	
	Upland Mixed Ashwoods	
	Wet Woodland	
	Lowland Mixed Deciduous Woodland	
	Native Pine Woodlands	Ancient Woodland (Coniferous)
Grassland and Marsh		
Acid Grassland (B1) Calcareous Grassland (B3) Neutral Grassland (B2) Improved Grassland (B4) Marsh/ Marshy Grassland (B5) Poor semi-improved grassland (B6) Tall herb, bracken and fen (C)	Lowland Dry Acid Grassland	HC: Unimproved Land HC: Enclosure (all types) (NHLC: Enclosed Agricultural Land) For Lowland Meadows see HC: Valley Floor and Wetland
	Lowland Calcareous Grassland	
	Upland Calcareous Grassland	
	Lowland Meadows	
	Upland Hay Meadows	
	Coastal and Floodplain Grazing Marsh	
Heathland (D)	Lowland Heathland	
	Upland Heathland	
Bog and fen (E) Swamp, marginal and inundation (F) Coastland (H), includes saltmarsh	Upland Flushes, Fens and Swamps	HC: Unimproved Land
	Purple Moor Grass and Rush Pastures	
	Lowland Fens	
	Reedbeds	
	Lowland Raised Bog	

	Blanket Bog	
Natural exposures (11) Artificial exposures and waste tips (12)	Mountain Heaths and Willow Scrub Inland Rock Outcrop and Scree Habitats Calaminarian Grasslands Open Mosaic Habitats on Previously Developed Land (updated July 2010) Limestone Pavements Maritime Cliff and Slope Coastal Vegetated Shingle Machair Coastal Sand Dunes	HC: Unimproved Land HC: related use types, e.g. Industrial
Miscellaneous (J) includes: Arable (J1)		

12 APPENDIX 4: SHERBORNE CASE STUDY - SITE LIST WITH SCORES

Table 8: Sherbourne case study – site list with scores

Ref.	Site	Time Depth		Legibility		Inter-Relationships		Total
1	Sherborne Parkland Core II* Sherborne House and church; grade II walls and buildings; Grade II park	4	Medieval settlement core, buildings mid C18-mid C19, C14 church tower	5	Coherent group of country house with its gardens, historic stable yard, medieval churchyard, enclosed kitchen gardens and associated buildings	5	Within historic park, adjoins meadow	4.7
2	Sherborne East End Grade II houses and farm buildings	3	Early-mid C19 century estate village, some C18 fabric	4	Hedges and dry stone walls to C19 and earlier gardens to houses, village school (late C19) and farmstead yards	4	Hedges and dry stone walls connect to piecemeal enclosure of former open fields and meadow AND to historic parkland and meadow	4
3	Sherborne West End Grade II houses and farm buildings	4	Medieval settlement, C17 intermixed with C19-20 houses and farm buildings	4	Hedges and dry stone walls to C20, C19 and earlier gardens	4	Hedges and dry stone walls connect to piecemeal enclosure to former open fields and meadow AND to historic parkland and meadow	4
4	Sheafhouse II Farm buildings II; Grade II park	3	1831 stables, quadrangular regular courtyard layout	3	Stables extant, dry stone walls to paddocks, some loss of these and shelter belt	5	Within historic park, hedges and dry stone walls connect to designed farming landscape	3.7
5	Northfield Barn Farm buildings II	3	Early C19 outfarm, regular courtyard layout; mid-late C20 house with garden and sheds	3	Outfarm with dry stone walls extant; C20 detached house and trees within paddock; sheds in rick yard to north	4	Piecemeal and planned enclosed land, links to dry stone walls and hedges. Quarry site now car park to NW. Adjoins historic parkland and meadow.	3.3

6	Modern Farm, East End	1	c. 1970s group	4	Some perimeter trees	3	Historic patterns of piecemeal and planned enclosed land retained. Perimeter trees 1970s and later	2.0
7	Home Farm House and farm buildings II	3	Early C19 farmstead, regular courtyard layout (multi-yards) with detached house	4	Farmstead extant. Majority of site with dry stone walls to farmyards and garden to detached house intact	4	Retains links to dry stone walls and hedges in planned/piecemeal enclosure. Adjoins mixed species C19 plantation.	3.7
8	Hill Barn	3	Early C19 outfarm, regular courtyard layout	3	Partly redeveloped, partial survival of boundaries, woodland has grown over most of site	3	Outfarm adjoins historic quarry, hedges and dry stone walls connect to planned enclosure landscape	3
9	Ewepen Buildings Farm buildings II	3	Early C19 outfarm, regular courtyard layout	4	Coherent group with dry stone walls to farmyards	3	In planned enclosure landscape, connects to dry stone walls.	3.3
10	Woeful Lake Farm	3	Early C19 farmstead, regular courtyard layout (multi-yards) with detached house	3	House and barns survive. Retains outer boundaries with shelter belt, most inner walls and minor buildings demolished	3	In planned enclosure landscape, connects to dry stone walls with boundary trees	3
11	Lodge Park Grade I Park and hunting lodge; Grade II late C19 structures	5	1630s grandstand for deer coursing in rare surviving sporting landscape; converted into house with gates and lodge late C19	5	Integral part of sporting landscape with unimproved grassland and shelter belt to W	5	In grade I park/ semi-natural grassland habitat type	5
12	Lodge Park Buildings	3	Early C19 outfarm, regular courtyard layout	4	Extant group, retains dry stone wall boundaries as part of original scheme	5	In grade I park/ semi-natural grassland habitat type	4
13	Conygree Farm	3	Early C19 farmstead, regular courtyard layout with detached house	4	Extant group, retains dry stone wall boundaries as part of original scheme; late C20 sheds set aside to NE	3	In planned enclosure landscape, connects to dry stone walls with boundary trees	3.3
14	Blackpits Barn	3	Early C19 outfarm, now wedding venue	4	Extant group, loss of outer walled boundary counterbalanced by	3	In planned enclosure landscape, connects to dry stone walls with sparse	3.3

					extensive planting to garden and car park that mirrors shelterbelts		boundary trees typical of plateau farmlands. Shelterbelts planted as part of conversion to commercial use.	
15	Windrush Airfield Control Tower	2	WWII control tower and two repair workshops (Romney huts)	2	Unusual as extant WWII temporary airfield grouping, with relationship to perimeter track intact	3	Open relationship to planned enclosure landscape with sparse boundary trees typical of plateau farmlands, to NW of Late Bronze Age/ Early Iron Age univallate fort (SAM)	2.3
16	Camp Barn	3	Early C19 farmstead, regular courtyard layout with detached house	3	More than 75% extant (loss of NW farmyard), no clear internal boundary survival.	4	Hedges and dry stone walls connect to planned enclosure landscape, AND now linked to mixed post-1945 woodland to its north	3.3
17	Windrush Airfield Technical Site	4	WWII technical site buildings	3	Extant technical group, derelict and ruinous buildings now within woodland	5	In regenerated post-1945 mixed woodland.	4
AVERAGE SCORE		3.1		3.6		3.9		3.6

13 APPENDIX 5: ATTINGHAM CASE STUDY - SITE LIST WITH SCORES

Table 9: Attingham case study – site list with scores

Ref.	Site	Time Depth		Legibility		Inter-Relationships		Total
1	Home Farm (Farmhouse II) Grade II* parkland Working farm, also farm shop and historic buildings open to public http://www.homefarmattingham.co.uk/	4	Medieval settlement site. Early-mid C19 farm buildings with good survival of internal fixtures and fittings, C18 barn, C15 house; Dutch barn.	4	Extant plan form (regular multi-yard plan) - (Area 2). Detached house, mature garden including access to mixed species plantation with pond (Area 1). Modern sheds to NE (Area 3) Boundary hedge to S (Area 1)	5	Sited within park; shrunken medieval village (Berwick Maviston) with ridge and furrow to S, mixed woodland and moated site with fishponds (SAM) to N	4.3
2	Cronkhill Farm (Farm buildings II; Cronkhill Villa I) Cronkhill Villa let (residential) Working farm	4	Early-mid 19th century farmstead (probable earlier site) to west of agent's house by architect John Nash (c.1802-5); Dutch barn rebuilt 2014, modern sheds to west	4	Extant plan form (regular multi-yard plan – Area 2) Villa – a nationally significant example of its type - set in own grounds including mixed plantation and historic boundaries (Area 1) Modern sheds to SW (Area 3) set within hedged boundary of C19 paddock	4	Borders small woodland to N. Connects to historic access (hedged), regenerated (post-1900) areas of woodland to N and in former orchard and paddock to SW and SE	4
3	Berwick New House Working farm	4	Late C18 and C19 remodelling – as a regular E- plan with late C18 house - of earlier farmstead (barn probably late C17). Dutch barn and modern sheds on site.	3	Loss of around half of historic plan form, some hedged boundaries removed (Area 2).	3	Straight access road, some boundary removal, garden connects to woodland strip to SE and hedge linking to Attingham Park to SE	3.3

					Detached house and garden woodland in former orchard, with historic boundaries (Area 1). C20 yard to W with Dutch Barn (Area 3)			
4	Lower Betton Farm (Farmhouse and stables II) Modern sheds let on agricultural tenancy Traditional farm buildings (unconverted) and house let on business/ residential tenancy	4	c. 1780 farmhouse and flanking stables; C18 barn incorporated into U-shaped C19 yard with good survival of fixtures and fittings.	4	More than 75% of farmstead (Area 2) extant with outer hedged boundary, includes modern shed partly on site of lost N range and early C20 Dutch barn to W. House faces E garden (Area 1).	4	Connects to late C18 straight routeway and regular enclosure hedged boundaries, and to wooded areas N and S (former orchards) and now-wooded former paddock to SW.	4
5	Upper Brompton Farm Working farm (large modern shed only) Traditional farm buildings (unconverted and in use as cookery school - https://www.bromptoncookeryschool.co.uk/). House let on residential tenancy	3	C19 farmstead, Dutch barn and modern sheds to side.	4	More than 75% of farmstead (Area 2) extant. Detached house and C19 worker's in mature gardens with historic boundaries (Area 1). Modern sheds, partly on site of early C20 extension, to E (Area 3). Historic orchard has expanded into woodland to N-NW (Area 4). Workers' housing with gardens to SW (5)	3	Despite hard surfaces to Areas 2-3, the site connects to historic hedgerows including pre-C19 routeways	3.3
6	Lower Brompton Farm One modern shed in use as part of working farm, most of rest in residential tenancy (buildings unconverted)	3	c.1855 farmhouse and planned farmstead with good survival of fixtures and fittings; modern sheds on site of lost buildings	3	Around half of historic plan form extant (Area 2), modern shed partly on site of lost range (Area 3). Large detached house and garden (Area 1). Most outer boundaries remain.	3	Loss of many hedgerows to historic routeway and boundaries, adjoins mixed woodland and marshland to NE	3
7	Norton Farm	4	C17 house, 1745 barn, modern sheds replace most C19 farm buildings	2	Less than 25% survival of historic plan form (Area 2),	2	Site now surrounded by post-1950 green area with trees	2.7

	(Farmhouse II) Working farm				hard surfaces around house and modern sheds (Areas 1 and 3).		and shrubs, but loss of hedgerows in areas results in relatively poor connectivity	
8	Smethcote Farm Working farm	4	Late C17 house, C18 fabric in barn, Dutch barn and modern sheds to W	3	One boundary wall survives, less than 50% survival of historic plan form (Area 3). Detached house and farm building conversion face east to own gardens (Areas 1 and 2).	3	Linked to hedged pre-C19 and C19 routeways to two sides with hedgerows, some hedgerow loss in wider landscape.	3.7
9	Duncote Farm (Farmhouse grade II) Working farm	4	C17 timber-framed house, probable medieval site; mid C19 farm buildings; Dutch barn and modern sheds on site	2	Less than 50% survival of historic plan form (Area 2), most hedged boundaries removed, extensive hard surfaces. Detached house faces mature gardens (Area 1).	2	Most boundaries lost, A5 to north with established buffer of trees. Surrounding grassed areas with trees are mostly post-1950.	2.7
10	Uckington Farm Working farm	4	Late C18 farmhouse, large early-mid C19 regular multi-yard plan. One Dutch barn of 1888 (very early example)	3	Less than 50% survival of historic plan form, hedged boundaries removed to N (Area 2). Detached house and mature gardens (Area 1) but boundaries removed in this area.	3	Some field boundaries lost to creation of WWII airfield and post-war modern agriculture. Pre-C19 routeway divides farmstead from hamlet to NE.	3.7
11	Wheathill Farm Working farm	4	Mid-late C18 farmstead with stable and barn, extended C19. Modern sheds on site of lost buildings and in yard.	3	Partial survival of historic plan form and boundaries (Area 2). Detached house and gardens to N, latter extended C20 (Area 1).	2	Connects to intact network of hedges and former orchard to S extended into woodland	3
		3.8		3.6		3.6		3.6

14 APPENDIX 6: EDALE CASE STUDY - SITE LIST WITH SCORES

Table10: Edale case study – site list with scores

Ref	Site	Time Depth		Legibility		Inter-Relationships		Total
1	Upper Booth Farmhouse II SK 102853	4	Early C18 farmhouse but a medieval site. C17-19 farm buildings. Strong local traditional character.	4	More than 75% of traditional farmstead extant, in stone and slate with dry stone walls to boundaries. Building to south of trackway and range to north of yard demolished.	4	At intersection of historic routeways, including sled route to peat cuttings to north. Ancient woodland to E and S, intact piecemeal/regular enclosure pattern.	4.3
2	Northern farmyard	4	19th century farmyards and buildings, now partly in domestic use	4	Buildings remain in adapted form, with hedged boundaries	3	To N of historic farmyard, within a pattern of regular enclosure	4.3
3	Field barn at SK 100854	4	19th century field barn	4	Extant traditional building in stone and slate	3	Sited to N of early ovoid enclosure that may be medieval or earlier, dry stone walls	4.3
4	Field barn at SK 102856	4	19th century field barn	4	Extant traditional building in stone and slate	3	Sited in piecemeal enclosure field, dry stone walls	4.3
AVERAGE SCORE		4		4		3.25		4.3

15 APPENDIX 7: HERITAGE ACCOUNTING FRAMEWORK: BUILDINGS AND STRUCTURES MODEL

15.1 Introduction

This section consists of a set of tables identifying the service flows from buildings and their boundaries. Tables are organised to identify the services generated according the four main categories of ecosystem services:

- Supporting
- Provisioning
- Regulating
- Cultural

Tables are colour coded and presented in the following order

- Green - Residential
- Blue – Economic
- Red – Service provision

15.2 Value of service of service flows model: Residential

Supporting

Service category	Asset/service	Function	Stakeholder type	Indicator	Measure	Indicator score
Supporting	Primary production (e.g. lichens; nutrient cycling);	Nutrient cycling; Provision through synthesis of construction materials into organic material and surfaces including lichens and mosses	• Society overall • Landowners and farmers • Local community • Higher level species	Variety of plant species; age of structure/area	Average per m^2 of structure (including immediate surroundings such as garden/yard, etc.)	1 – 5 scale Where 1=Low level of support from the structure; 5=High level
	Formation of species habitat	Flora - long-term habitat creation (e.g. plant habitats; enhanced biodiversity); important habitats for pollinator species Might include exotic species (e.g. extensive garden, arboretum)	• Society overall • Landowner and farmers • Local community • Local ecological system	Number of species present; Protected species present. Existence of protected species enhances value (differentiate between local, national, international significance)	Average per m^2 of structure (including immediate surroundings such as garden/yard, etc.)	1 – 5 scale Where 1=Low quantity/significance of species present; 5=High level.
	Formation of species habitat	Fauna - long-term habitat creation (e.g. for insects, reptiles, small mammals, birds, other species); enhanced biodiversity; Food source for insects and wildlife	• Society overall • Landowners and farmers • Local community • Local ecological system	Number of species present; Protected species present. Existence of protected species enhances value (differentiate between local, national, international significance)	Average per m^2 of structure (including immediate surroundings such as garden/yard, etc.)	1 – 5 Scale Where 1=Low quantity/significance of species present; 5=High level.

Provisioning

Service category	Asset/service	Function	Stakeholder type	Indicator	Measure	Indicator score
Provisioning	Housing/shelter	Residential living Home Sense of place	• Residents (owners, tenants, occupants)	Number of people residing.	Average occupants per m^2 of structure.	1 – 5 scale Where 1=Low level of residence associated with the structure; 5=High level
	Shelter	Provision of shelter for seeds, plants, fauna. Creation of micro-climate	• Biodiversity (flora/fauna) - Be aware of double counting!	Supports high nature value; exotic species, etc.		1 – 5 scale Where 1=Low level of support from the structure; 5=High level
	Food source	Provision of berries, fruits, plants for food/medicine (e.g. from gardens)	• Residents • Local businesses	Quantity of fruit produced; range of food/medicinal plants available	Amount produced/m^2 of structure. Market value of similar fruit/food/medicinal plants obtained	1 – 5 scale Where 1=Low level of production; 5=High level
	Traditional skills	Traditional skills for construction, repair, maintenance; skills are in short supply; creates local jobs	• Skilled craftsmen • Casual labour • Local communities • Local businesses	Maintenance of traditional skills associated with traditional forms of construction (e.g. thatching, lime-based techniques).	Average hourly income for skills and unskilled labour	Average number hours work/m^2/year

Regulating

Service category	Asset/service	Function	Stakeholder type	Indicator	Measure	Indicator score
Regulating			•			
	Carbon sequestration	Locking up carbon in construction materials	• Property owner • Wider community	Amount of carbon locked up in structure (embodied carbon). Multiplier applied to capture 'heritage' value.? If carbon captured for 500 yrs this removes it for significantly longer than if structure only 100 yrs old.	Kg Carbon per m^2 of structure	1 – 5 scale Where 1=Low amount of Carbon/m^2 associated with the structure; 5=High level
	Energy consumption	Cost	•			
	Water consumption	Cost	•			

Cultural

Service category	Asset/service	Function	Stakeholder type	Indicator	Measure	Indicator score
Cultural	Architectural, landscape and aesthetic	Sense of place Wellbeing Sense of history	• Residents • Owners • Local communities	Improved sense of well-being from living in or near an 'historic site'	Wellbeing improvement measure	1 – 5 scale Where 1=Low level of well-being associated with the structure; 5=High level
	Tourism	Valued historic structure attracts visitors Sense of history	• Visitors • Local businesses	Improved sense of well-being from visiting an 'historic site'	Wellbeing improvement measure	1 – 5 scale Where 1=Low level of well-being associated with the structure; 5=High level
	Educational visitors	Increasing knowledge and understanding of the past	• Visitors	Improved sense of knowledge and understanding from visiting an 'historic site'	Knowledge improvement measure	1 – 5 scale Where 1=Low level of knowledge obtained; 5=High level
			•			

15.3 Value of service of service flows model: Economic

Supporting

Service category	Asset/service	Function	Stakeholder type	Indicator	Measure	Indicator score
Supporting	Primary production (e.g. lichens; nutrient cycling);	Nutrient cycling; Synthesis of materials into organic material and surfaces including lichens and mosses Enhanced biodiversity	• Society overall • Landowners; farmers • Local community • Higher level species	Variety of plant species; age of structure/area.	Average per m^2 of structure (including immediate surroundings such as garden/yard, etc.)	1 – 5 scale Where 1=Low level of support from the structure; 5=High level
	Formation of species habitat	Flora - long-term habitat creation (e.g. plant habitats; enhanced biodiversity); important habitats for pollinator species. Enhanced biodiversity Might include exotic species (e.g. extensive garden, arboretum)	• Society overall • Landowners; farmers; • Local community • Local ecological system	Number of species present; Protected species present. Existence of protected species enhances value (differentiate between local, national, international significance)	Average per m^2 of structure (including immediate surroundings such as garden/yard, etc.)	1 – 5 scale Where 1=Low quantity/significance of species present; 5=High level.
	Formation of species habitat	Fauna - long-term habitat creation (e.g. for insects, reptiles, small mammals, birds, other species); enhanced biodiversity; Food source for insects and wildlife. Enhanced biodiversity	• Society overall • Landowners; farmers; • Local community • Local ecological system	Number of species present; Protected species present. (differentiate between local, national, international significance)	Average per m^2 of structure	1 – 5 Scale Where 1=Low significance of species present; 5=High level.
			•			

Provisioning

Service category	Asset/service	Function	Stakeholder type	Indicator	Measure	Indicator score
Provisioning	Livestock management	Provision of shelter in poor weather/winter season for livestock; Shelter for breeding, feeding, milking, etc.	• Livestock farmers • Sheep • Cattle • Other	In situ shelter – enables livestock to be left outside in poor weather; Reduces mortality (e.g. lambing; winter)	Estimated efficiency savings from use of structure	1 – 5 scale Where 1=Low level of support from the structure; 5=High level
	Livestock management	Separation of animal types and by gender	• Livestock farmers	Improved efficiency of livestock production through ability to separate animals	Estimated efficiency savings from use of structure	1 – 5 scale Where 1=Low level of support from the structure; 5=High level
	Storage	Machinery, feed, crops, warehousing of supplies, finished goods, materials	• Farmers • Manufacturers • Local businesses Property owners	Average m^2 storage space provided/structure	Estimated efficiency savings from use of structure	1 – 5 scale Where 1=Low level of support from the structure; 5=High level
	Manufacturing space	Manufacturing/ processing space	• Farmers • Manufacturers • Local businesses Property owners	Average m^2 processing space provided/structure	Estimated efficiency savings from use of structure	1 – 5 scale Where 1=Low level of support from the structure; 5=High level
	Commercial operating space	Office space Hospitality/service space	• Farmers • Manufacturers • Local businesses Property owners	Average m^2 operating space provided/structure	Estimated efficiency savings from use of structure	1 – 5 scale Where 1=Low level of support from the structure; 5=High level

Regulating

Service category	Asset/service	Function	Stakeholder type	Indicator	Measure	Indicator score
Regulating	Boundary marker	Identification of ownership boundaries. Provision of certainty over property ownership. Reduction in need for land surveys at point of sale of property. Markers for historical ownership and landscape management	• Property owners • Local community (to a lesser extent)	Length of property boundary between land ownership units.	Km of boundary feature per m^2 of structure	1 – 5 scale Where 1=Low proportion of boundary feature associated with the structure; 5=High level
	Carbon sequestration	Locking up carbon in construction materials	• Property owner • Wider community	Amount of carbon locked up in structure (embodied carbon). Multiplier applied to capture 'heritage' value.? If carbon captured for 500 yrs this removes it for significantly longer than if structure only 100 yrs old.	Kg Carbon per m^2 of structure	1 – 5 scale Where 1=Low amount of Carbon/m^2 associated with the structure; 5=High level
	Energy consumption	Cost	•			
	Water consumption	Cost	•			

Cultural

Service category	Asset/service	Function	Stakeholder type	Indicator	Measure	Indicator score
Cultural	Architectural, landscape and aesthetic	Sense of place Wellbeing Sense of history	• Workers • Owners	Improved sense of well-being from working in or near an 'historic site'	Wellbeing improvement measure	1 – 5 scale Where 1=Low level of well-being associated with the structure; 5=High level
	Architectural, landscape and aesthetic	Continued utilisation of historic site in its local context	• Residents of the local area	Improved sense of well-being from living in or near an 'historic site'	Wellbeing improvement measure	1 – 5 scale Where 1=Low level of well-being associated with the structure; 5=High level
	Tourism	Valued historic structure attracts visitors Sense of history	• Visitors • Local businesses	Improved sense of well-being from visiting an 'historic site'	Wellbeing improvement measure	1 – 5 scale Where 1=Low level of well-being associated with the structure; 5=High level
	Educational visitors	Increasing knowledge and understanding of the past	• Visitors	Improved sense of knowledge and understanding from visiting an 'historic site'	Knowledge improvement measure	1 – 5 scale Where 1=Low level of knowledge obtained; 5=High level

15.4 Value of service of service flows model: Service provision

Servicing

Service category	Asset/service	Function	Stakeholder type	Indicator	Measure	Indicator score
Supporting	Primary production (e.g. lichens; nutrient cycling);	Nutrient cycling; Provision of habitat for lichens, mosses, and other plants. Enhanced biodiversity	• Society overall • Landowners • Local community • Higher level species	Variety of plant species; age of structure/area.	Average per m^2 of structure (including immediate surroundings such as garden/yard, etc.)	1 – 5 scale Where 1=Low level of support from the structure; 5=High level
	Formation of species habitat	Flora - long-term habitat creation (e.g. plant habitats; enhanced biodiversity); important habitats for pollinator species. Enhanced biodiversity Might include exotic species (e.g. extensive garden, arboretum) Might include long-lived plants, (e.g. churchyard yews)	• Society overall • Landowners; • Local community • Local ecological system	Number of species present; Protected species present. Existence of protected species enhances value (differentiate between local, national, international significance)	Average per m^2 of structure (including immediate surroundings such as garden/yard, etc.)	1 – 5 scale Where 1=Low quantity/significance of species present; 5=High level.
	Formation of species habitat	Fauna - long-term habitat creation (e.g. for insects, reptiles, small mammals, birds, other species); enhanced biodiversity;	• Society overall • Landowners; farmers; • Local community • Local ecological system	Number of species present; Protected species present. Existence of protected species enhances value	Average per m^2 of structure	1 – 5 Scale Where 1=Low significance of species; 5=High level.
			•			

Provisioning

Service category	Service	Function	Stakeholder type	Indicator	Measure	Indicator score
Provisioning	Spiritual	Church; graveyard, commemorative structure Does this fall under cultural or provisioning?	• Local area residents • Church congregations • Service users			
	Education	Does this fall under cultural or provisioning?	• Service providers • Service users			
	Health	Improvement in health and well-being	• Service providers • Service users			
	Storage	Machinery, warehousing of supplies, materials	• Service providers • Public enterprises • Property owners	Average m^2 storage space provided/structure	Estimated efficiency savings from use of structure	1 – 5 scale Where 1=Low level of support 5=High level
	Machinery space	Manufacturing/ processing space	• Service providers • Commercial enterprises • Property owners	Average m^2 processing space provided/structure	Estimated efficiency savings from use of structure	1 – 5 scale Where 1=Low level of support from the structure; 5=High level
	Commercial operating space	Office space Operational service space Hiring out of venue for events	• Service providers • Commercial enterprises • Property owners	Average m^2 operating space provided/structure	Estimated efficiency savings from use of structure	1 – 5 scale Where 1=Low level of support from the structure; 5=High level
	Recreation	Parks and gardens Other public structures	• Recreational users • Local area residents			

Regulating

Service category	Asset/service	Function	Stakeholder type	Indicator	Measure	Indicator score
Regulating	Boundary marker	Identification of ownership boundaries. Provision of certainty over property ownership. Reduction in need for land surveys at point of sale of property. Markers for historical ownership and landscape management	• Property owners • Local community (to a lesser extent)	Length of property boundary between land ownership units.	Km of boundary feature per m^2 of structure	1 – 5 scale Where 1=Low proportion of boundary feature associated with the structure; 5=High level
	Carbon sequestration	Locking up carbon in construction materials	• Property owner • Wider community	Amount of carbon locked up in structure (embodied carbon). Multiplier applied to capture 'heritage' value.? If carbon captured for 500 yrs this removes it for significantly longer than if structure only 100 yrs old.	Kg Carbon per m^2 of structure	1 – 5 scale Where 1=Low amount of Carbon/m^2 associated with the structure; 5=High level
	Energy consumption	Cost	•			
	Water consumption	Cost	•			

Cultural

Service category	Service	Function	Stakeholder type	Indicator	Measure	Indicator score
Cultural	Architectural, landscape and aesthetic	Sense of place Sense of history	• Workers • Owners	Improved sense of well-being from working in or near an 'historic site'	Wellbeing improvement measure	1 – 5 scale Where 1=Low level of well-being associated with the structure; 5=High level
	Architectural, landscape and aesthetic	Continued utilisation of historic site in its local context Provides link to the past Access to sacred space	Residents of the local area. Users of the structure (e.g. church congregation)	Improved sense of well-being from living in or near an 'historic site'	Wellbeing improvement measure	1 – 5 scale Where 1=Low level of well-being associated with the structure; 5=High level
	Tourism	Valued historic structure attracts visitors Sense of history	• Visitors • Local businesses	Improved sense of well-being from visiting an 'historic site'	Wellbeing improvement measure	1 – 5 scale Where 1=Low level of well-being associated with the structure; 5=High level
	Education	Increasing knowledge and understanding of the past	• Visitors	Improved sense of knowledge and understanding from visiting an 'historic site'	Knowledge improvement measure	1 – 5 scale Where 1=Low level of knowledge obtained; 5=High level
	Artistic inspiration	Have we already captured this above?	•			

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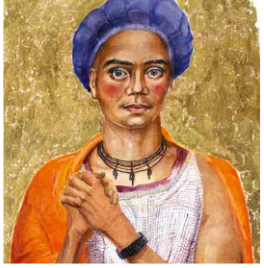



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