

Woodland Futures.

Assessing Impacts of Forestry Strategies on the Historic Environment

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Introduction

The Government has made a commitment to increase the area of forestry coverage in England by 2060. Its intention to expand woodland coverage was set out in Government Forestry and Woodlands Policy Statement (Defra 2013), and was reiterated in the Forestry Commission's Corporate Plan of 2015/16 (2015). The area of woodland coverage in England was at its lowest in the early 20th century, when it stood at around 5%. Woodland increased throughout the 20th century, mainly because of post-1918 expansion, comprising mostly coniferous plantations, and included the replanting of existing woods. At present, woodland covers 13% of the UK, (10% in England) which is a rise from 10% in 2015, though this is still less than half of the European average of 30% (Forestry Commission 2017). The intention is for a further expansion of 2%, for a woodland coverage of 12% in England, by 2060. Woodland is seen by the Government as beneficial, as it can deliver increased social, environmental and economic benefits to society. It also helps to safeguard clean water, help manage flood risk, can improve biodiversity and is a source of renewable energy.

New woodland planting is likely to take place away from the most productive farmland, on poorer soils in areas of permanent pasture or in the upland or on the upland fringes. In these areas, where farm incomes are often lower, woodland planting can provide a means of diversifying the rural economy. Recent large-scale plans for forestry expansion fit into this category, with extensive areas of northern England potentially earmarked for new woodland. The Government has backed the creation of the Northern Forest, for example, which could have up to 50 million trees running in a wide band from Liverpool to Hull, centred on the M62, running through the moors and hills of the Pennines (Woodland Trust 2018). The Forest is aimed at delivering a better environment by improving urban air quality, mitigating flood risk, improving access to nature, and supporting the rural economy through tourism, recreation and timber production. At Doddington North Moor, Northumberland, permission was granted for an extensive new forest of over 600,000 new trees, the largest in over 30 years (Gov.UK 2017). As well as providing red squirrel habitat, the forest is intended to act as a carbon store and form part of flood risk management, but will also have a key economic role for the forestry and timber industries. Woodland change generally reflects biodiversity and economic gain; however, many of the proposed areas are considered to have considerable archaeological potential, even where the number of identified heritage assets is not high, with good preservation of historic landscape features, earthworks and below-ground remains. Woodland planting schemes may, therefore, have a significant impact on the historic environment and on the character of the historic landscape.

In 2016, Historic England commissioned a project from the McCord Centre for Landscape at Newcastle University, to examine how the historic environment would be affected by woodland expansion, and where the historic environment could offer opportunities to inform and benefit planting schemes. There were two aims:

- To demonstrate how the historic environment offers opportunities for woodland expansion, and the benefits thereby provided for the environment, society and the economy.
- Inform the design and siting of new woodland in a manner that respects the historic

character of places and protects the heritage assets within them.

The project's objectives were to:

- Identify those landscape types and areas most prone to transformation through woodland expansion
- Identify the opportunities for and sensitivity to change presented by different historic landscape types and areas
- Identify the issues and opportunities presented by the historic environment for woodland expansion
- Help identify opportunities for using historic character in the selection and design of new woodland, indicating where mitigation may be necessary and how heritage assets can be protected or incorporated in a scheme at a level proportionate to their significance.

The outcomes of the project are a series of statements on the potential for woodland expansion for each of the National Character Areas, and a sensitivity map of England plotting the capacity for woodland planting. This document outlines the methodology used to produce the map, gives a summary of the results of the mapping, and provides an assessment framework for considering the historic environment when planning woodland planting schemes.

Methodology

Data Gathering and Scoring

A series of historic and natural environment datasets were used to map the potential for woodland expansion across England. The map was created using the Geographical Information System, ArcGIS™ 10.3.1 for Desktop. The datasets chosen had to be available for the whole country, with well-defined attributes allowing a scoring system for woodland potential to be applied, and thus providing a total to be given to each defined area. As the intention of the map was to assess the opportunities for woodland planting and its potential impact on the historic environment at a site and landscape level, both historic and natural environment attributes were compared to produce a more holistic result. Many of the datasets, particularly the woodland and historic environment data, are complex and comprise numerous small areas. To produce countrywide coverage of woodland opportunities using such datasets, therefore, would have been a lengthy and complex process, and would have resulted in some very small polygons that were inappropriate for use at a regional or national scale. It was thus decided to map the attributes on a grid for the whole of England. A measured grid, of 1km squares, was generated in ArcGIS™ using the Grids and Graticules Wizard in Data Frame Properties. The grid was then clipped to the England national boundary. Each grid square was scored against the attributes, according to the potential for each attribute to absorb new woodland. A total score for all attributes was then calculated.

Scoring was either 0-2, or 0-1, depending on the attribute, with 0 denoting areas least able to absorb new woodland, and 1 or 2 having the highest potential. Each individual grid square was scored against the attributes, and a total score calculated. The total score indicated the potential for each grid square to absorb new woodland, with higher scores indicating greater potential. The lowest total score was two, and the highest was 13. The complete list of attributes and their scoring scale is given in Appendix 1, and is summarised, below.

The 1km grid meant that the grain of the attribute mapping was fairly coarse, and the complexity and variety of the datasets meant that an assessment had to be made on the dominance or significance of all attributes for each grid square. For small, discrete attributes,

such as scheduled monuments, a score of 0 was applied where the centroid fell within a grid square, even though it might only cover a very small proportion of a square. With more extensive attributes, an assessment was made on the percentage of the attribute covering each square. When assessing the National Forest Inventory, for example, a score of 0 was given to squares with more than 50% woodland, 1 to those with less than 50% coverage (deemed woodland fringe) and 2 to squares with no woodland. Although this methodology lacks accuracy at a local level, the mapping was carried out on a national scale and is meant to be viewed at a county level or greater, reflecting the size of most of the National Character Areas.

Woodland. Information on the distribution of woodland was downloaded from the Forestry Commission's National Forest Inventory (<http://www.forestry.gov.uk/datadownload>). It was used to plot the location of existing woodland, but the map did not distinguish between broadleaf or coniferous trees, nor between plantation and ancient woodland. A score of 0, 1 or 2 was allocated, with 0 for areas that are already wooded, 1 for woodland fringe, and 2 for non-woodland. The assumption was that areas already wooded cannot provide new woodland, woodland fringe will have limited potential, as it is already partially wooded, whilst non-woodland areas could be planted up.

Historic Environment Attributes. Four historic environment attributes were mapped separately: scheduled monuments, registered battlefields, registered parks and gardens, and World Heritage Sites. Grid squares containing these attributes were scored as 0, least able to absorb new woodland, or 1 for all other squares. A score of 0 would thus imply that new woodland planting would have a negative effect on the historic environment asset, either as a direct impact or on its setting. The presence of an historic environment asset within a grid square, however, does not preclude new woodland from being planted, as the potential for an area to absorb new woodland depends on the total attribute score. Where an area is deemed to have woodland potential, even when a historic environment asset is present, the Woodland Expansion Assessment Framework template (see Appendix 2, below) has been designed to provide advice on appropriate planting and management. The original intention was also to map Historic Environment Data as recorded on the Selected Heritage Inventory for Natural England (SHINE) database, which is used to inform Countryside Stewardship applications (www.myshinedata.org.uk), but this was not available during the mapping phase. Similarly, the National Historic Landscape Characterisation (NHLC) data was also unavailable, as the project was still incomplete during this project. The NHLC was completed during the course of this project, and is now available to download from the Archaeology Data Service (http://archaeologydataservice.ac.uk/archives/view/NHLC_NE_2017). It would be possible to incorporate these datasets into the mapping at a later date to provide a more refined, historic-environment-focused map.

Agricultural Land. Agricultural land classifications were downloaded as a GIS layer from MAGIC (Multi-Agency Government Information on the Countryside; <http://magic.defra.gov.uk/>). Agricultural land is graded 1 to 5, with 1 the highest quality and 5 the poorest. Grades 1 and 2 were scored as 0, as they form the most valuable areas of arable farmland. Grades 4 and 5 were scored 1, as these areas may be able to absorb some woodland, but are likely to be of higher historic and natural environment value. Grade 3 land was scored as 2.

Urban/Rural Settlement. National Statistics data on rural/urban classification were made available from Historic England. The data is based on boundary information derived from the 2011 census and mapped population densities according to the Lower Super Output Areas (LSOA), which can be downloaded from <https://census.ukdataservice.ac.uk/use->

[data/guides/boundary-data](#). The data has been divided into three categories for the purposes of the mapping. Scoring 0 are the major urban areas and conurbations. Rural towns and fringe scored 1 and rural villages and dispersed settlement was scored as 2, the most capable of absorbing new woodland.

Priority Habitats. The spatial dataset describes the geographic extent and location of habitats of principal importance, as set out in the Natural Environment and Rural Communities Act (2006), Section 41. It replaces Natural England's previous Biodiversity Action Plan habitat inventories, providing a more robust and consistent dataset. The GIS dataset was downloaded from Natural England's pages on the Government website (www.gov.uk/guidance/how-to-access-natural-englands-maps-and-data). The Priority Habitats layer comprises 28 habitats, which were assessed on their suitability for absorbing new woodland. Most scored 0, that is unsuitable for new woodland planting, whilst mountains heaths and willow scrub, and upland heath were scored as 1. They are considered to have limited potential for new woodland as they support dwarf shrubs and form habitat mosaics. The only Priority Habitat to score 2 is deciduous woodland, alongside the category of no main habitat. Although grid squares containing deciduous woodland could be considered as already wooded, and therefore score 0 as for the National Forest Inventory Layer, they have been scored as 2 because areas of deciduous woodland are mostly very limited in extent. It has been scored against a grid square as long as it is present, regardless of the proportion covered. The score reflects the importance of this attribute as a priority habitat and that small deciduous woodlands such as these are already targeted as environmental opportunities for new planting in the National Character Area descriptions.

Moorland. In addition to the Priority Habitat data, a moorland attribute was included, based on the moorland line previously used by Natural England to help define stewardship grants for hill farming. The spatial data for the moorland line was downloaded as a GIS layer from MAGIC (Multi-Agency Government Information on the Countryside; <http://magic.defra.gov.uk/>). Moorland is defined by its vegetation, which must be predominantly semi-natural upland vegetation, or rock outcrops and semi-natural vegetation, and used primarily for rough grazing. It can include both open moors and enclosed land on the margins of uplands. The character of the vegetation of land above the moorland line means that it was scored at 0, and unsuitable for woodland planting, whilst areas below it were scored as 1.

Data Interpretation

Once the grid had been scored against each attribute and a total calculated, the layer was displayed thematically, using graduated colours according to the total score (figure 1). Any grid square with a score equal to or greater than 10 was considered to have a high potential for new woodland planting. The higher the attribute score, the darker the shade used, and thus the higher the potential for areas to absorb new woodland. The 1km grid square shown in figure 2, illustrates the scoring process. The area, close to the farmstead of Spadeadam in North Cumbria, lies close to areas of commercial forestry. It is wholly uninhabited moorland, but scores as having low potential for new woodland. Its low score is the result of the dominance of grass moorland, a priority habitat, its location above the moorland line, and a scheduled Roman road that form part of the Frontiers of the Roman Empire (Hadrian's Wall) runs across it. It scored 1 point as grade 5 agricultural land, 2 points as a non-urban area, and 1 point each for lying outside any registered park and garden, and registered battlefield.

To highlight the significant areas of greatest and lowest potential for woodland expansion on a national scale, the grid square results were run through a cluster and outlier analysis tool (Anselin Local Moran's I) in ArcGIS™. The tool used the total attribute scores to calculate a

Moran's I value, which identified spatial clusters and spatial outliers, and the statistical significance of the computed values. Where the tool calculated a positive value for I, it indicated that the grid square had neighbours with similar high or low attribute values, and thus was part of a cluster. The results were saved as a separate layer, and the clusters of high and low potential are shown in figure 3.

The results of the grid scores and cluster analysis were analysed against each National Character Area (NCAs). The NCAs divide England into 159 distinct natural areas defined by a combination of characteristics based on landscape, biodiversity, geodiversity, history, and cultural and economic activity. Each NCA has a description and information contained in a character profile (Natural England 2014). The NCAs are used by governmental and non-governmental bodies, particularly Natural England, to inform a range of activities and to help monitor landscape change. Amongst the activities informed by the NCA profiles are forest and woodland plans and strategies. The overall potential for each NCA to absorb new woodland was estimated by calculating the percentage area of each NCA that had a high potential. NCAs with areas of high potential of less than 14% of the total area were considered to have an overall low potential for new woodland, those with a score of between 14% and 20% were considered to have medium potential, and scores of greater than 20% were considered to have high potential (see figure 4). For most of the NCAs, the potential for woodland expansion fits well with the opportunities highlighted for each area as outlined by Natural England in the NCA profiles. For the very small NCAs, such as Lundy Island and the Isle of Portland, the mapping grid was undertaken on too small a scale to provide a statistically valid result. Caution should be taken, therefore, when using the woodland potential map for these areas, and more emphasis should be placed on the written report that accompanies the mapping (see below).

For the Forestry and Woodland Futures project, a short report was produced for each NCA. Each document includes a map of the NCA, overlain by the grid, themed to show the areas of high and low potential for woodland expansion. The document also includes a brief overview of the area taken from the character area profile, a description of the historic environment character and a short statement on the opportunities for woodland expansion. The historic environment character statements were compiled from various sources, including the NCA profile, regional archaeological research framework assessments, and online databases such as Pastscape (Historic England 2015), Historic England's listing descriptions (Historic England 2017) and Local Historic Environment Records accessible through Heritage Gateway (Heritage Gateway 2012), as well as secondary sources. The historic environment character statements are necessarily short and are intended to provide a flavour of each NCAs' historic environment, rather than a detailed description. Descriptions of the opportunities for woodland expansion are based on the overall potential of each NCA for new woodland, compared to the descriptions of woodland character and relevant statements of environmental opportunity set out in each NCA profile. Where the overall potential is low, the description highlights those areas of each NCA where the potential is higher. The description also sets out the limitations and potential restrictions for woodland expansion in relation to the historic environment character, including historic landscape character.

Summary Results: The Mapping of Historic and Natural Environment Attributes

At a national scale, the largest areas with the fewest opportunities for woodland expansion are the urban areas, including London, Birmingham, Merseyside, Manchester, the former industrial towns and cities of the Pennines, and coastal towns. Other areas with low potential are clustered in the east of England, in a wide band from the Wash to London, representing

some of the most valuable arable areas. Areas of high potential for new woodland are scattered more evenly across the country, but include noticeable clusters along the Pennine fringes, in Norfolk, and a wide band stretching across southern England from the Weald to Hampshire.

Ten NCAs had attributes that indicated they had high potential for new woodland:

- Cheshire Sandstone Ridge;
- High Weald;
- Lundy;
- Lincolnshire Coast and Marshes;
- Quantock;
- Morecambe Bay Limestones;
- Morecambe Coast and Lune Estuary;
- New Forest;
- Somerset Levels and Moors;

Of the ten NCAs, only the Lincolnshire Coast and Marshes was an area dominated by arable agriculture, falling within the Eastern Arable agricultural landscape type. Both the High Weald and the New Forest, areas that are already very well-wooded, are part of the South East Mixed (Woodland) agricultural landscape type. Only the Quantock Hills fall within an upland or upland fringe agricultural landscape type, and the remainder are part of the Western Mixed agricultural landscape type. The Solway Basin, a low-lying area in northern Cumbria, currently has very low levels of woodland, but it appears to have been well-wooded in the medieval period. The high score for Lundy is an anomalous result, reflecting the small size of the island in relation to the 1km grid used to map attributes. There is no significant woodland on the island, and given its high historic and nature conservation value as an open landscape, new woodland planting would not be appropriate.

The NCAs which fall within the Upland and Upland Fringe agricultural landscape type generally have a low potential for woodland expansion, reflecting their high historic and environmental potential.

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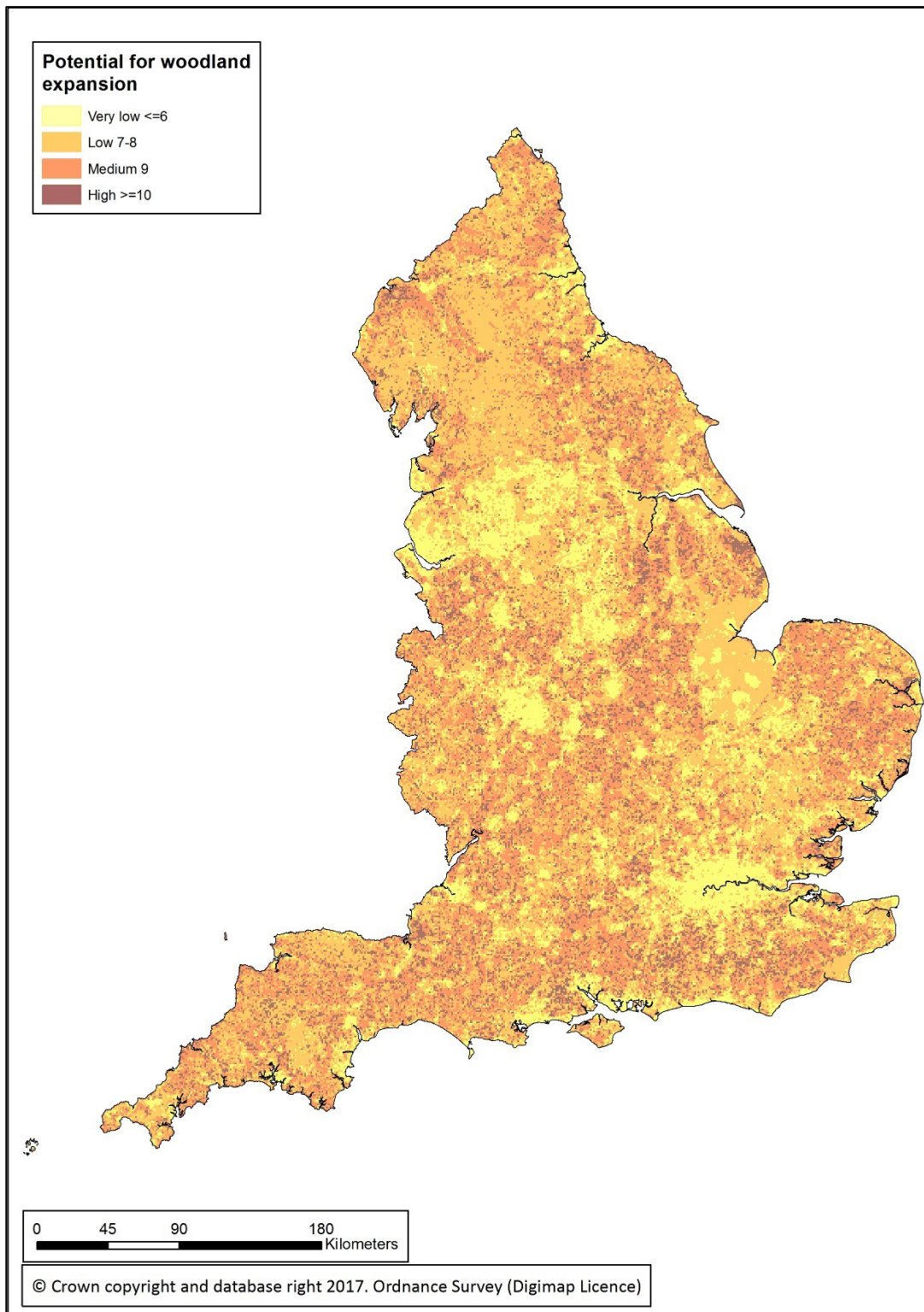
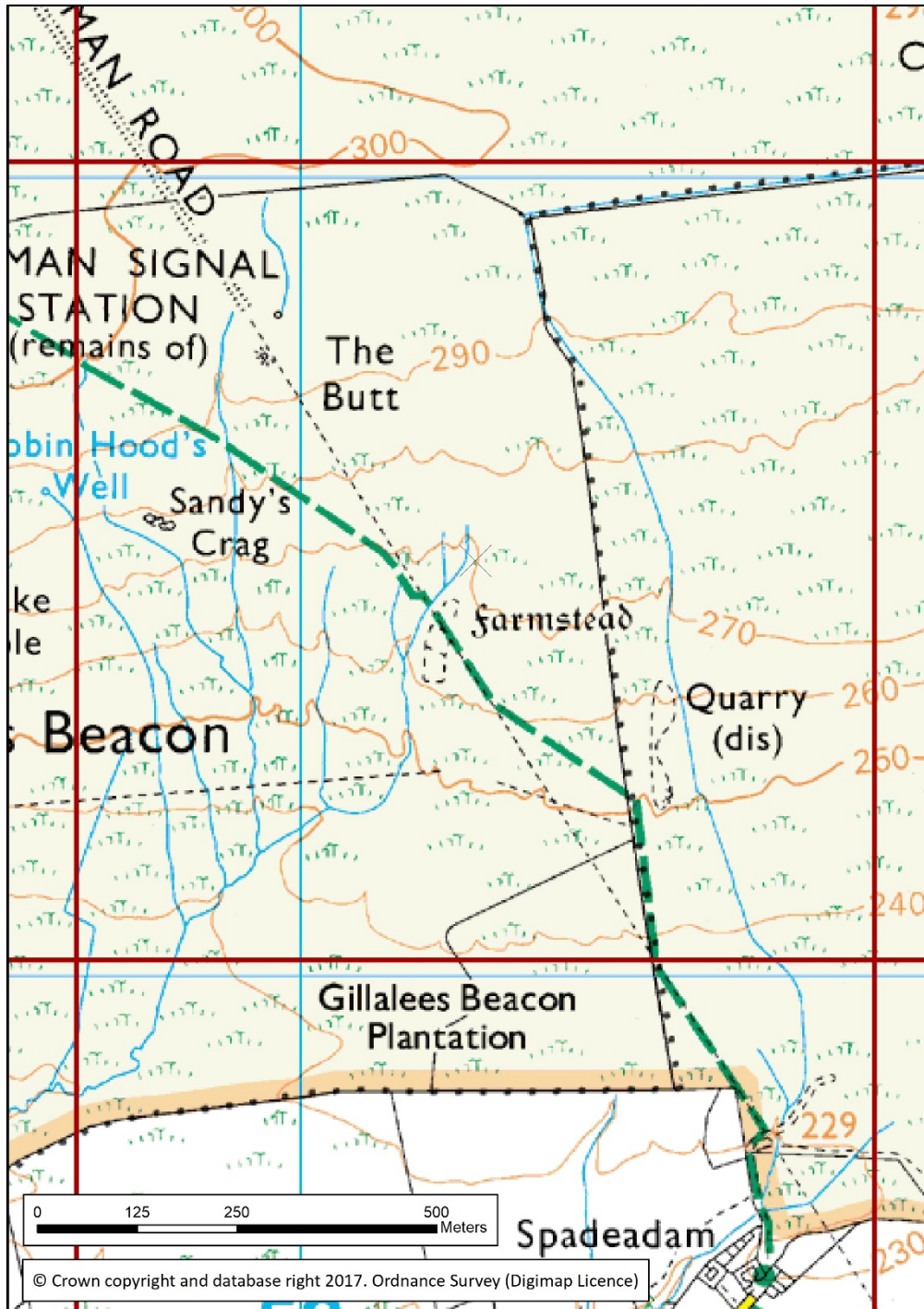


Figure 1. Map of the grid of historic and natural environment attributes across England



Woodland	Agricultural grade	Urban	Priority habitat	Moorland	World Heritage Site	Registered Parks	Battlefield	Scheduled Monument	Score
0	1	2	0	0	0	1	1	0	5

Figure 2. A 1km grid square, at Spadeadam, north Cumbria. The area scores as having low potential against the historic and natural environment attributes. The area is above the moorland line, contains the priority habitat of grass moorland, and the Maiden Way Roman road, a scheduled monument runs through it. The Roman road is also part of the Frontiers of the Roman Empire (Hadrian's Wall) World Heritage Site.

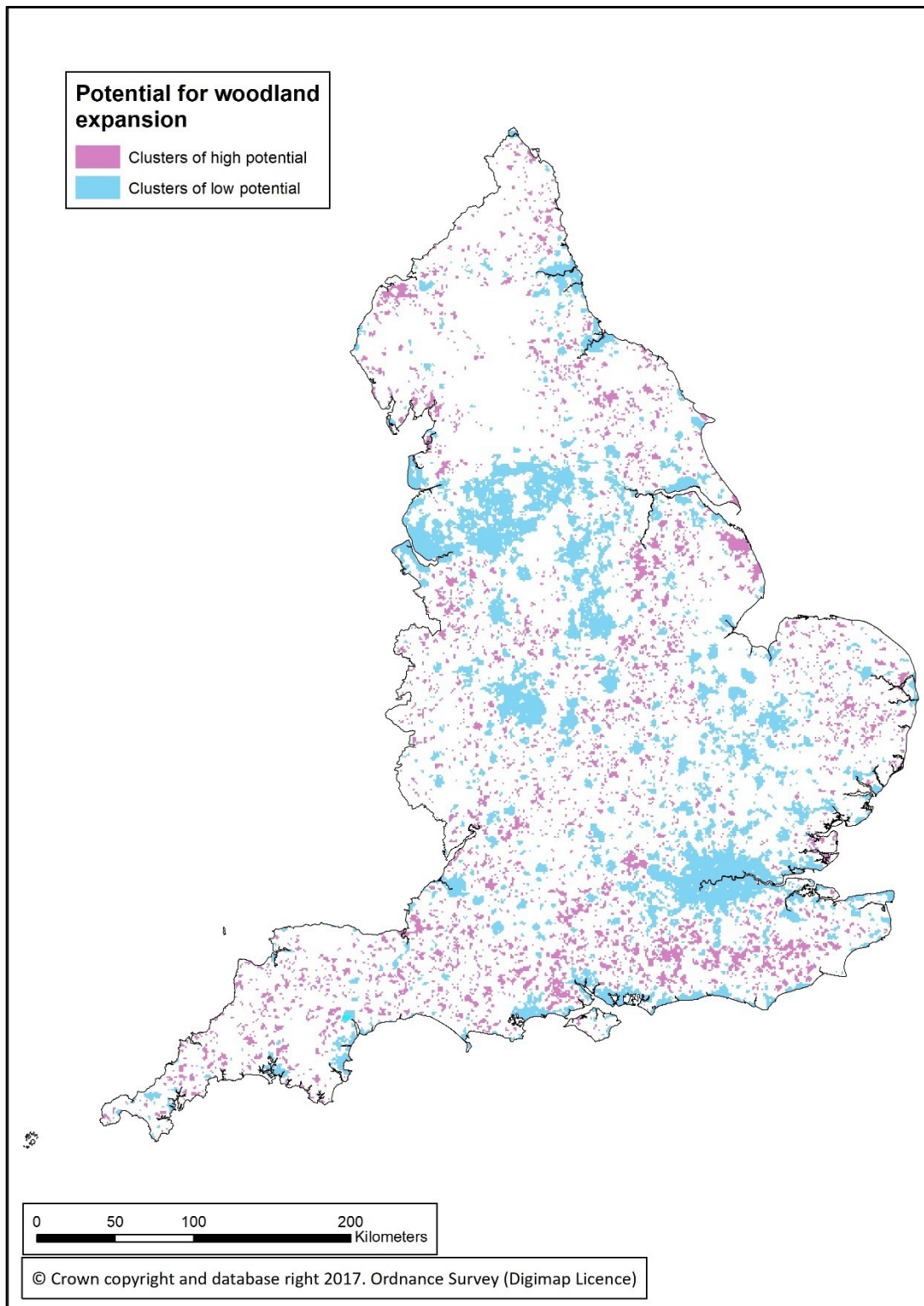


Figure 3. Results of cluster and outlier analysis, showing the clusters of high and low potential for new woodland across England

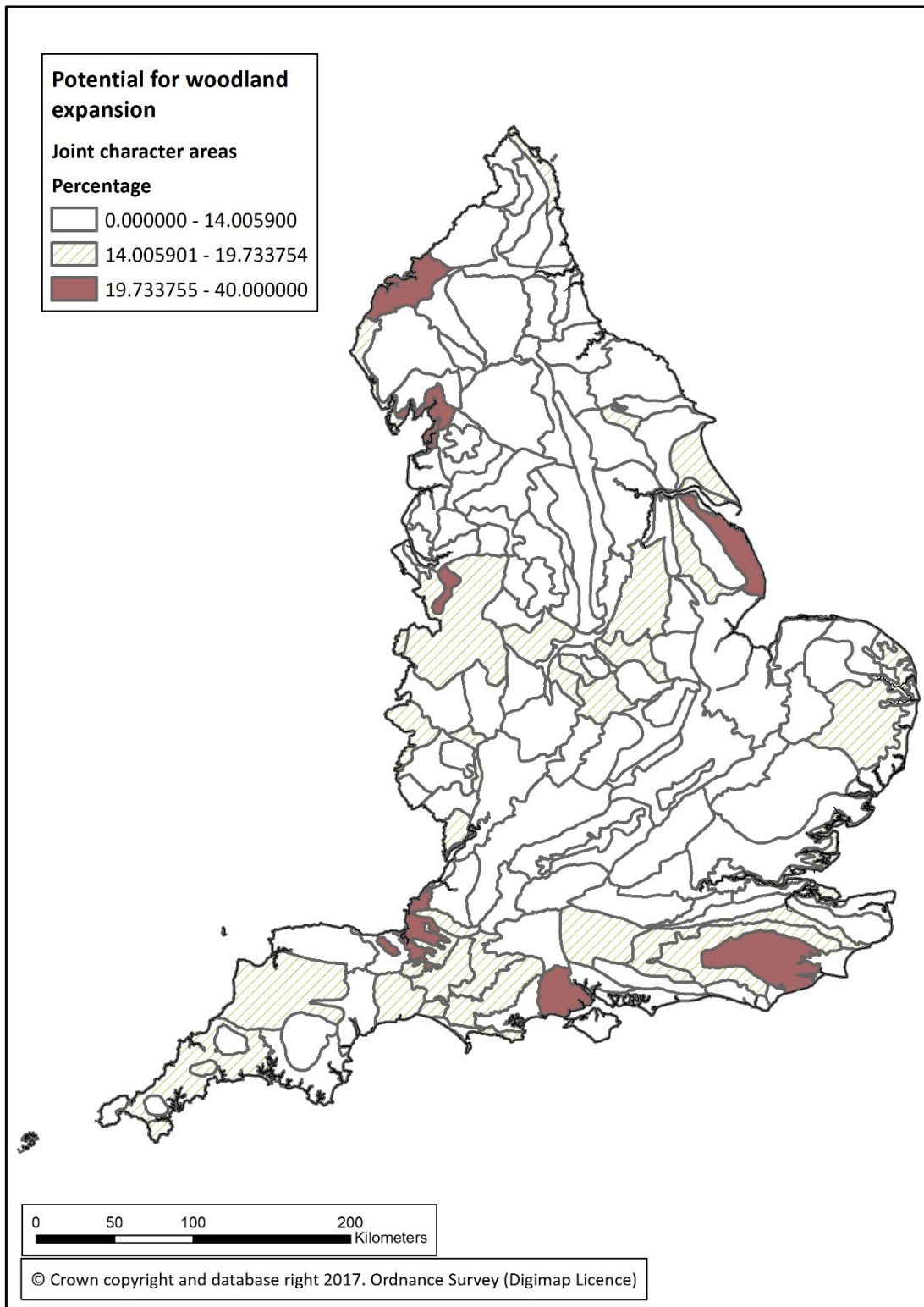


Figure 4. National Character Areas and their potential for woodland expansion

Appendix 1: Historic and Natural Environment Attributes

Attributes	Score: 0	Score: 1	Score: 2
Woodland	Existing	Woodland fringe	Non-woodland
Scheduled monuments	Yes	No	
Registered battlefields	Yes	No	
Registered park and garden	Yes	No	
World heritage site	Yes	No	
Agricultural land classes	Grade 1-2	Grade 4-5	Grade 3
Urban/rural	City/town; city/town in sparse setting; major conurbation	Rural town & fringe; dispersed rural town fringe	Rural village; dispersed rural village
Priority habitats (one field):	Blanket bog	Mountain heaths & willow scrub	Deciduous woodland
	Calaminarian grass	Upland heath	No main habitat
	Coastal & flood plain grazing marsh		
	Coastal saltmarsh		
	Coastal sand dunes		
	Coastal vegetated shingle		
	Fragmented heath		
	Good quality semi-improved grassland		
	Grass moorland		
	Limestone pavement		
	Lowland calcareous grassland		
	Lowland dry acid grassland		
	Lowland fens		
	Lowland heath		
	Lowland meadows		
	Lowland raised bog		
	Maritime cliff & slope		
	Mudflats		
	Purple moor grass & rush		
	Reedbeds		
	Saline lagoon		
	Traditional orchard		
	Upland calcareous grassland		
	Upland flushes, fens & swamp		
	Upland hay meadow		
Moorland line	Above	Below	

0 = most sensitive to new woodland 2 = least sensitive to new woodland

Appendix 2: Woodland Expansion Framework Assessment Template

The following sets out a suggested template to be used at a strategic and site-based level for woodland planting schemes. The framework is aimed at helping users identify the historic landscape character, significance and sensitivity to change of areas at the earliest stage of woodland expansion schemes. It is also designed to help identify the key issues to inform woodland/forest design and long-term future management. The suggested template is as follows:

1. Introduction

1.1. Location.

- Locational information, including grid reference, parish, county, etc;
- Is the land within a National Park or Area of Outstanding Natural Beauty?

1.2 The nature of forestry operations, proposed size and intensity of expansion.

2. The historical character and archaeological potential of the proposed area and its wider setting

2.1 Identify the historic character, use and condition of the area intended for woodland expansion. Use maps, aerial photography and other evidence such as historic landscape characterisation, modern and historic Ordnance Survey maps. Consider:

- What elements make up the landscape (e.g. field boundaries, routeways, trees and woodland, settlements and buildings)?
- How has the landscape changed, e.g. more or less woodland, development?
- How do landscape elements and topography affect views to and from the proposed area for planting?

2.2 Identify designated and undesignated non-heritage assets, public access and key wildlife sites within and around the area. Consider:

- Natural environment statutory and non-statutory designations, such as nature reserves, Sites of Special Scientific Interest, Special Areas of Conservation, Heritage Coast, etc;
- What public access is there, including public rights of way, National Trails, National Cycle Network, access land, etc.

2.3 Identify all forms of recorded and previously unrecorded heritage assets.

- Heritage assets may include earthworks, buildings, sub-surface archaeology;
- Place-name evidence should also be considered, particularly evidence for former areas of woodland (e.g. wood, hag, hurst, spring, frith, etc);
- Designated statutory and non-statutory heritage assets such as Scheduled Monuments, Listed Buildings, Parks and Gardens, Battlefields;
- Non-designated assets such as historic environment records, archaeological events (e.g. excavations etc);
- Previously unrecorded sites recorded on historic Ordnance Survey maps, tithe maps and enclosure maps, estate maps, secondary sources such as county histories, etc. Site identification should include the recording of historic hedgerows as shown on historic maps;
- Previously unrecorded sites noted from walkover surveys and from aerial photographs, etc.

3. Summary and significance of the heritage assets

- 3.1 Provide a summary of the heritage and natural environment assets within the area of proposed planting and its wider setting.
- 3.2 Assess the significance of the assets (international, national, regional, local).
- 3.3 Assess the vulnerability and potential of the proposed area of planting and its wider setting for the type and level of woodland expansion being considered.
- 3.4 Provide a map or maps showing the location of the assets and their significance. A separate map of historic landscape character may be produced, with an assessment of the significance of the relevant landscape on a regional and/or national scale. Significance may include consideration of its rarity and vulnerability.

4. Potential impacts of woodland expansion

- 4.1 The potential impacts and effects of any proposed planting on heritage assets and on the historic landscape character should be set out clearly. Impact may be beneficial as well as detrimental. Consider the following:
 - The current land use and historic character of the area, including consideration of how woodland has ebbed and flowed across the landscape;
 - Heritage assets and archaeological potential identified in sections 2 and 3;
 - What opportunities there are to link woodland to surrounding boundaries, routeways and settlements;
 - The value of woodland expansion for people and as habitat, both the site itself and potential connections to the surrounding landscape.
- 4.2 Provide a map showing areas where woodland planting should not be carried out (e.g. areas with designated heritage assets and their settings), and areas where woodland planting would be beneficial.
- 4.3 Where open areas have been defined, consideration should be given to how these will be managed once woodland planting has been undertaken. Small areas within woodland and on woodland margins, for example, must be actively managed either through grazing or regular cutting to maintain a grass sward and prevent natural regeneration of trees, scrub and bracken. Where open areas are defined in order to protect historic environment assets, for example, lack of active management may be detrimental to the asset in the longer term, through encroachment of woodland and/or bracken.

5. Planting and design issues

- 5.1 Based on the results of the assessment of historic landscape character and heritage assets, consideration should be given to the planting design and trees species. Reference should be made to the National Character Area profiles (Natural England 2017) for information on appropriate tree species and on current woodland character, particularly within the sections on statements of environment opportunity. Where identified by the local authorities, reference should also be made to any finer-grained local landscape area.
- 5.2 Woodland design, including natural regeneration, may include the expansion of existing woodland edges into open areas, and consideration should be given to how this may retain, enhance or change historic landscape character.
- 5.3 The design of new planting, and the extension of existing woodland needs to be considered in relation to protecting and integrating identified heritage assets,

significant viewpoints, areas of high archaeological potential and the habitats and biodiversity within it.

- 5.4 Consideration should also be given to the future management of both new woodland areas and extensions to existing woodland. In many cases, the NCA profiles places a strong emphasis on promoting sustainable woodland management practices, such as coppicing, pollarding and wood fuel production. Proposals for new woodland should integrate woodland management at the earliest stages of planning. The reintroduction or continued practice of traditional woodland management can support the use of woodland products and fuels, increase carbon substitutions and sequestration and the resilience of tree species to climate change and disease.