National Habitat Network Maps

User Guidance v.2

May 2020

Natural England

National Habitat Network Maps

User Guidance v.2

Contents   Page

1. Introduction

Making Space for Nature, A review of England's Wildlife Sites and Ecological Network[1], published 2010, set out the essence of what needs to be done to enhance the resilience and coherence of England's ecological networks. The report proposed that this could be summarised in four key words: **more, bigger, better** and **joined**.

Theresa Villiers (Secretary of State for Environment, Food and Rural Affairs) speech[2] on the Environment Bill stated that this will "*require the preparation and publication of Local Nature Recovery Strategies mapping nature-rich habitats so that investment can be targeted where it will make the most difference. The Government will provide data, guidance, and support, but these local plans will embrace local knowledge to strengthen links between neighbouring communities and support the wider Network. These provisions will play a crucial role in protecting what we have and restoring nature that is in decline"*.

The Government's 25 Year Environment Plan[3] includes provision for a Nature Recovery Network (NRN) and states that it will deliver on the recommendations of the Lawton Report[1] and that recovering wildlife will require more habitat; in better condition; in bigger patches that are more closely connected. As well as helping wildlife thrive, the NRN could be designed to bring a wide range of additional benefits: greater public enjoyment; pollination; carbon capture; water quality improvements and flood management.

We have produced a series of habitat network maps to help address the challenges outlined in the Lawton report[1] and believe they should provide a useful baseline for the development of a NRN as required within the 25 Year Environment Plan and *Local Nature Recovery Strategies* as proposed within the Environment Bill.

This guidance provides an outline of the methodology we have used in the development of these habitat network maps and how we have combined these maps to create a combined habitat networks map for England[4]. ENRR081 'Nature Network Evidence Handbook - Creating Nature Networks for Wildlife & People'[5] identifies these habitat network maps as a valuable tool for use in the development of local ecological networks (see Section 5 of this guidance for more information). The habitat network maps are intended to be used to help identify areas for future habitat creation and restoration at a landscape scale but need to be considered alongside other local datasets and knowledge.

The maps have been created by the Habitat Networks Mapping Project Team consisting of Jeff Edwards, Michael Knight, Sarah Taylor & Ian Crosher with support and guidance from a range of Natural England Habitat Specialists including; Ruth Hall, Chris Mainstone, Richard Jefferson, Sue Reece, Emma Goldberg, Suzanne Perry, Iain Diack and many others. For further information on the approach and use of the maps please contact either: Jeff Edwards or Michael Knight.

---

[1] Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., Haddow, R.W., Hilborne, S., Leafe, R.N., Mace, G.M., Southgate, M.P., Sutherland, W.A., Tew, T.E., Varley, J., & Wynne, G.R. (2010) Making Space for Nature: *a review of England's wildlife sites and ecological network*. Report to Defra.

[2] https://www.gov.uk/government/speeches/leading-the-charge-for-the-environment 15 October 2019

[3] 25 Year Environment Plan

[4] This guidance is an update the earlier version we released in Nov 2018. We aim to continue to improve and develop these maps as new information and data becomes available

[5] Crick, H. Q. P., Crosher, I. E., Mainstone, C. P., Taylor S., Wharton, A., Langford, P., Larwood, J., Lusardi, J., Appleton, D., Brotherton, P. N. M., Duffield, S. J. & Macgregor N. A. (Feb 2020) '*Nature Network Evidence Handbook: Creating nature networks for wildlife & people'*. Natural England, York.

The main outputs available are;

- 23 individual Habitat Network Maps
- A combined habitat networks map (23 individual habitat network maps combined).
- A series of grouped habitat network maps[6]

We created these maps to provide a national overview of the distribution of habitat networks with suggestions for future action to enhance biodiversity. We hope that these maps will help to stimulate local engagement with partners and to agree local priorities and identify where action might help build more ecologically resilient ecosystems across landscapes.   Although the maps cover the whole of England the information we have used can be interpreted at a local scale.   The habitat network maps have been created using a bespoke GIS tool that follows a standard process as outlined in Sections 2 to 4. For some habitats the process has been modified as outlined in Section 5. Further information on the methodology is also provided in Section 7.   The current maps are a product of the data input and manipulation parameters used within our tool both of which may be amended to suit specific local situations. As such the maps should not be considered as NE's definitive advice on where an ecological network or NRN should be created or specifically where action needs to take place but we hope that they may act as a guide for local consideration taking full account of local opportunities and constraints. We suggest that the maps are used in conjunction with other datasets and with local knowledge to identify opportunities for action. If more precise local data exists it may be possible to re-run the mapping analysis to incorporate this[7].

These maps look specifically at habitat creation and restoration in the vicinity of existing habitat and are not designed to reflect the potential for naturally occurring ecosystems across landscapes, particularly in respect of natural hydrology as outline in Section 6 and more detailed explanation of the biodiversity importance of natural ecosystem function can be found in NERR 071 'Generating more integrated biodiversity objectives'.

The individual habitat network maps can be viewed individually or in combination with other network maps. However each individual habitat map may have a degree of overlap with other habitat network maps and to overcome the difficulties interpreting multiple maps we have prepared a single map that combines all 23 individual habitat network maps which we feel should help facilitate interpretation and understanding of how the networks operate together (see Section 3).

However with such a large number of network maps this combined map may not provide sufficient information to help guide a local project in terms of action to deliver against a specific objective. For this reason we will also be creating a set of grouped habitat network maps (see Section 4).

Accessing the Maps
- The combined map is available externally on MAGIC and both the combined map and all the individual network maps as GIS files from Here .
- Please contact NE data services for any other mapping product. Note: When accessing the GIS files we use 3 letter codes for each habitat, see Annex 1 for more details.
- For NE staff the map is available internally on WebMap2. A separate guide for WebMap2 users is available here.

---

[6] Coastal habitats completed with others to follow

[7] Note: Additional data on priority habitats first needs to be added to the PHI and all data must be supplied under an open data licence that allows NE to publish the Habitat Network Maps under an Open Government Licence.

2. Individual Habitat Network Maps

In this section we provide some details on the different components of the individual networks maps which we hope will help you better understand what the maps are showing and how they can be used. Further information on aspects of the maps may be found within Section 7 of this document.

We have prepared an individual habitat network map for each of the following 23 priority habitats:

Priority habitats
- Upland calcareous grassland
- Lowland calcareous grassland
- Reedbeds
- Lowland meadows
- Upland hay meadows
- Purple moor grass and rush pasture
- Lowland dry acid grassland
- Lowland heathland
- Upland heathland
- Upland fens, flushes & swamps
- Lowland fens
- Lowland raised bog
- Blanket bog
- Limestone pavements
- Coastal sand dunes
- Coastal vegetated shingle
- Maritime cliff and slope
- Saltmarsh
- Lakes
- Rivers
- Ancient woodland
- Wood-pasture & parkland
- Traditional orchards (draft map)

Notes:
- We have created a grouped coastal habitat network map for coastal habitats (see section 4 and 5 for more information)
- We have not produced a habitat network map for some priority habitats, e.g. coastal floodplain grazing marsh, and the reasons for this are explained in Section 7.

Mapping Components

We have developed a standard process for creating the individual habitat network map which include using the following 8 standard mapping components as shown in Figure 1 and Figure 2. The mapping components are divided into (A) 'Existing Habitat' and (B) 'Network Enhancement & Expansion' as outlined below.

A) **Existing Habitat** - We mapped existing habitat using the following four components: (see Figure 1)

1. **Primary Habitat**: The priority habitat [8]which is the focus of the individual habitat network e.g. lowland heathland.

2. **Associated Habitat**: Other priority habitat types that form a mosaic or an ecologically coherent group within the landscape and may, for example, be essential for some species associated with the primary habitat. See Annex 1 for more information.

3. **Habitat Creation/Restoration**: Areas where work is underway to either create or restore the primary habitat.

---

[8] Priority Habitat refers to the statutory lists of priority habitats as required under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 (England),

4. **Restorable Habitat:** Areas of land, predominantly composed of existing semi-natural habitat where the primary habitat is present in a degraded or fragmented form and which are likely to be suitable for restoration.

Figure 1: Components of the Existing Habitat
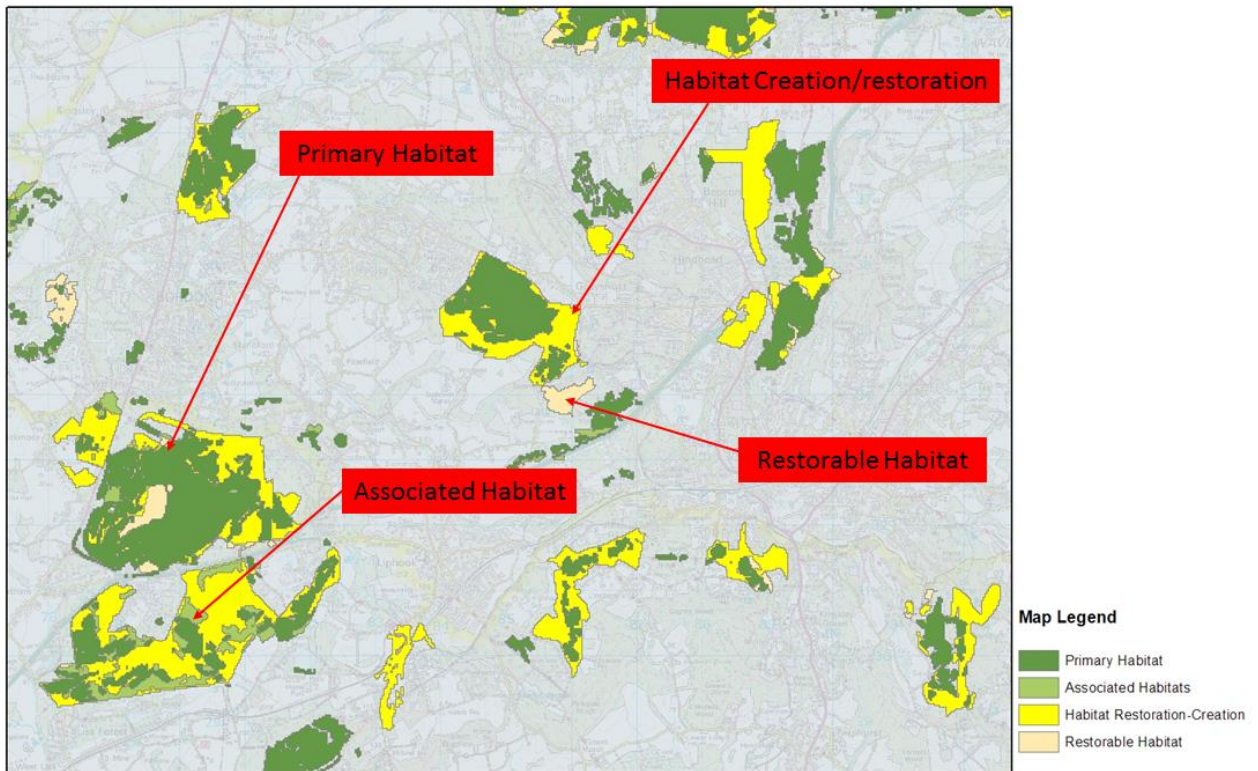
B) **Network Enhancement & Expansion** – We have mapped the following 4 network zones around the habitat components described above (see Figure 2):

5. **Network Enhancement Zone 1:** Land connecting existing patches of primary and associated habitats which is likely to be suitable for creation of the primary habitat. Factors affecting suitability include: proximity to primary habitat, land use (urban/rural), soil type, slope and proximity to coast. **Action in this zone to expand and join up existing habitat patches and improve the connections between them can be targeted here.**

6. **Network Enhancement Zone 2:** Land connecting existing patches of primary and associated habitats which is less likely to be suitable for creation of the primary habitat. **Action in this zone that improves the biodiversity value through land management changes and/or green infrastructure provision can be targeted here.**

7. **Fragmentation Action Zone:** Land within Enhancement Zone 1 that connects existing patches of primary and associated habitats which are currently highly fragmented and where fragmentation could be reduced by habitat creation. **Action in this zone to address the most fragmented areas of habitat can be targeted here.**

8. **Network Expansion Zone:** Land beyond the Network Enhancement Zones with potential for expanding, linking/joining networks across the landscape i.e. conditions such as soils are potentially suitable for habitat creation for the specific habitat in addition to Enhancement Zone 1. **Action in this zone to improve connections between existing habitat networks can be targeted here.**

Figure 2: Components of the Network Enhancement & Expansion Zones
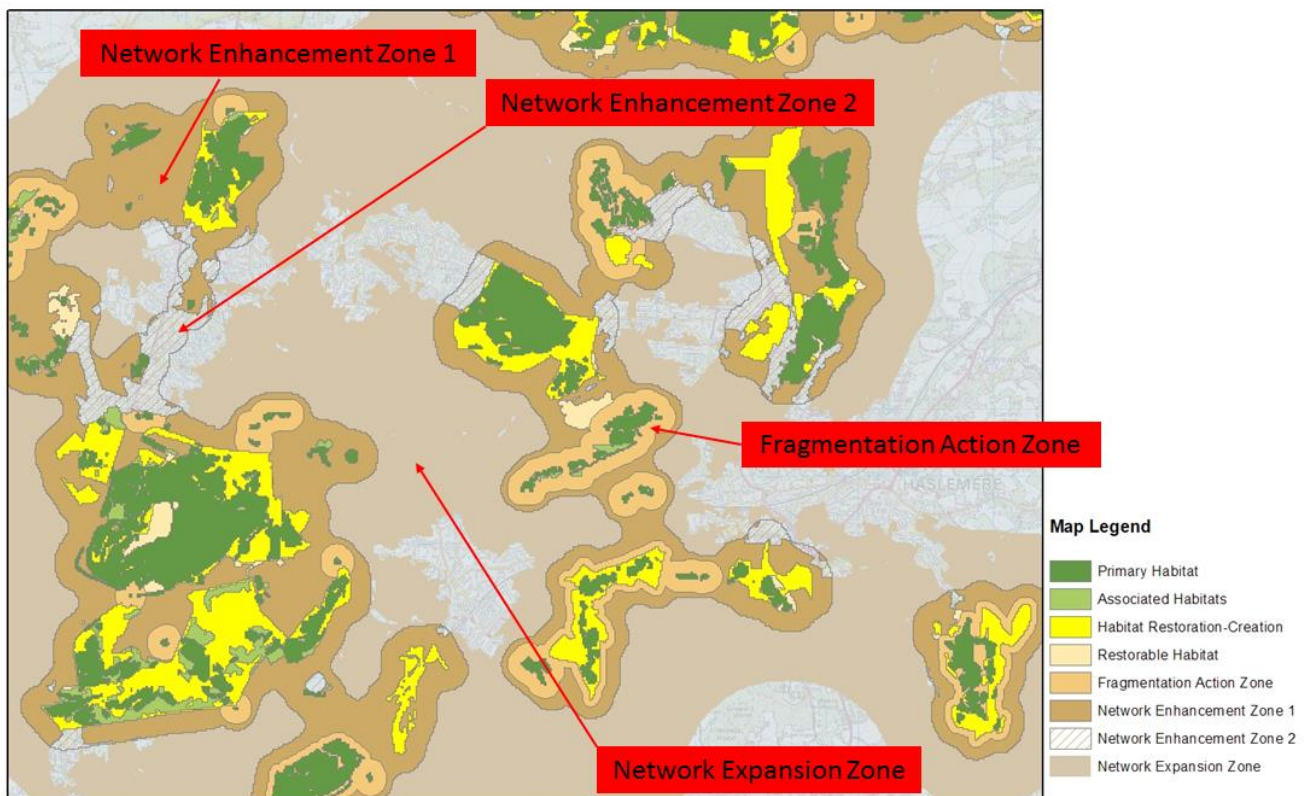
We have modified our standard process for some habitat network maps and Table 1 below provides a list of which components have been used in each map. More information is given in Sections 5 in relation to the Network Maps for Ancient Woodlands, Wood-pasture & parklands, Lakes and Rivers.

Table 1 List of Habitat Network Mapping Components against Habitat Network Map

Habitats Network Maps	Habitat Mapping Code	Habitat Components				Mapping Zones			
		Primary Habitat	Associated Habitats	Habitat Creation / Restoration	Restorable Habitat	Network Enhancement Zone 1	Network Enhancement Zone 2	Fragmentation Action Zone	Network Expansion Zone
Upland calcareous grassland	UCG	✓	✓	✓	✓	✓	✓	✓	✓
Lowland calcareous grassland	LCG	✓	✓	✓	✓	✓	✓	✓	✓
Reedbeds	RDB	✓	✓	✓	✓	✓	✓	✓	✓
Lowland meadows	LMW	✓	✓	✓	✓	✓	✓	✓	✓
Upland hay meadows	UHM	✓	✓	✓	✓	✓	✓	✓	✓
Purple moorgrass and rush pasture	PMG	✓	✓	✓	✓	✓	✓	✓	✓
Lowland dry acid grassland	LAG	✓	✓	✓	✓	✓	✓	✓	✓
Lowland heathland	LHL	✓	✓	✓	✓	✓	✓	✓	✓
Upland heathland	UHL	✓	✓	✓	✓	✓	✓	✓	✓
Upland fens, flushes & swamps	UFS	✓	✓	✓	✓	✓	✓	✓	
Lowland fens	LFN	✓	✓	✓	✓	✓	✓	✓	✓
Lowland raised bog[4]	LRG	✓	✓	✓	✓	✓	✓	✓	✓
Blanket bog[4]	BBG	✓	✓	✓	✓	✓	✓	✓	✓
Limestone pavements[4]	LSP	✓	✓				✓	✓	
Coastal sand dunes	CSD	✓	✓	✓	✓	✓	✓	✓	✓
Coastal vegetated shingle	CVS	✓	✓	✓	✓	✓	✓	✓	✓
Maritime cliff and slope	MCS	✓	✓	✓	✓	✓	✓	✓	
Saltmarsh	CSM	✓	✓	✓	✓	✓	✓	✓	✓
Lakes[4]	LAK	✓	✓		✓		✓		
Rivers[4]	RIV	✓	✓		✓[1]		✓		
Ancient woodland[4]	ASNW	✓	✓	✓[2]	✓		✓	✓	
Wood-pasture & parkland[4]	WWP	✓	✓	✓	✓	✓	✓	✓	✓
Traditional orchards	TRO	✓	✓	✓[3]	✓	✓	✓		

☐ = Not included within Map

[1] = see Section 2.3 for more information

[2] = it is hoped that information on deciduous woodland creation & restoration will be added within the next update to the maps.

[3] = AES data for this habitat has not been included but we hope to include this within the next update to the maps

[4] See Section 4 for more information

The aim of the habitat network maps is to help identify possible locations for actions to improve ecological resilience of the current habitat network in line with Lawton principles '***more*, *bigger*, *better* and *joined'*.** The zones for potential action are illustrated in Figure 2 above and include;

- **Decreasing habitat fragmentation** – we believe that reducing habitat fragmentation is a priority for action within the Enhancement Zone. The Fragmentation Action Zone, as identified on the habitat network maps, should be considered as a priority location for addressing this. We identify these by analysing;

  a) locations where smaller patches of the primary and associated habitats could be expanded to increase the patch size of the habitat or join up with other areas of habitat,

  and

  b)   locations where the habitat patch has a large boundary to patch size ratio. By identifying this, we seek to address potential adverse effects from adjoining land - known as the 'edge effect'. In these locations adjoining semi-habitat that is not mapped e.g. scrub or rough grassland, may currently be of ecological benefit and the habitat patch may therefore already be buffered against edge-effects.

- **Increase the extent of habitat -** we believe that the primary aim should be to deliver more priority habitat within Network Enhancement Zone 1 particularly to create bigger and better joined habitat patches but also that creating other semi-natural habitats or improving land management to increase landscape permeability would also be beneficial within both Network Enhancement Zones.

- **Restoring degraded habitat** – we have identified areas of 'Restorable Habitat' on the maps using data derived from a range of sources that suggest there is potential to restore the site to a primary habitat type. In some cases this may involve converting an existing semi-natural habitat type of some biodiversity value to one or more e.g. mosaic, which are more ecologically appropriate to the landscape/ecosystem. Care is required to ensure that the action proposed results in an appropriate net biodiversity gain. The Nature Networks Handbook provides further advice in relation to considering the restoration of more naturally functioning habitat mosaics using local knowledge to understand local issues.

- **Expanding, linking & joining the networks** – we have created the Expansion Zone as we recognise that the boundary for each habitat Network Enhancement Zone is drawn around the 4 habitat components it means that, at a landscape scale, these clusters of habitat, surrounded by their Network Enhancement Zone, can fall into a number of discrete but separated clusters. The spatial configuration of each network cluster depends upon the presence of the habitat, which itself is based on the landscape physical conditions e.g. geology, soils, hydrology, altitude etc. and, most importantly, the extent of habitat loss. The 'Network Expansion Zone' identifies potential locations to consider improving the links and joins and reduce fragmentation at a wider landscape scale.

3. Combined Habitat Networks Map

We have combined all 23 individual habitat network maps into a '**Combined Habitat Networks Map'**, (see Figure 3) as we recognised that, in many cases, to identify potential opportunities and to gain a fuller picture across a landscape, it is best to consider a wider mosaic of habitats rather than just focussing on a single priority habitat.

Figure 3: Combined Habitat Networks Map
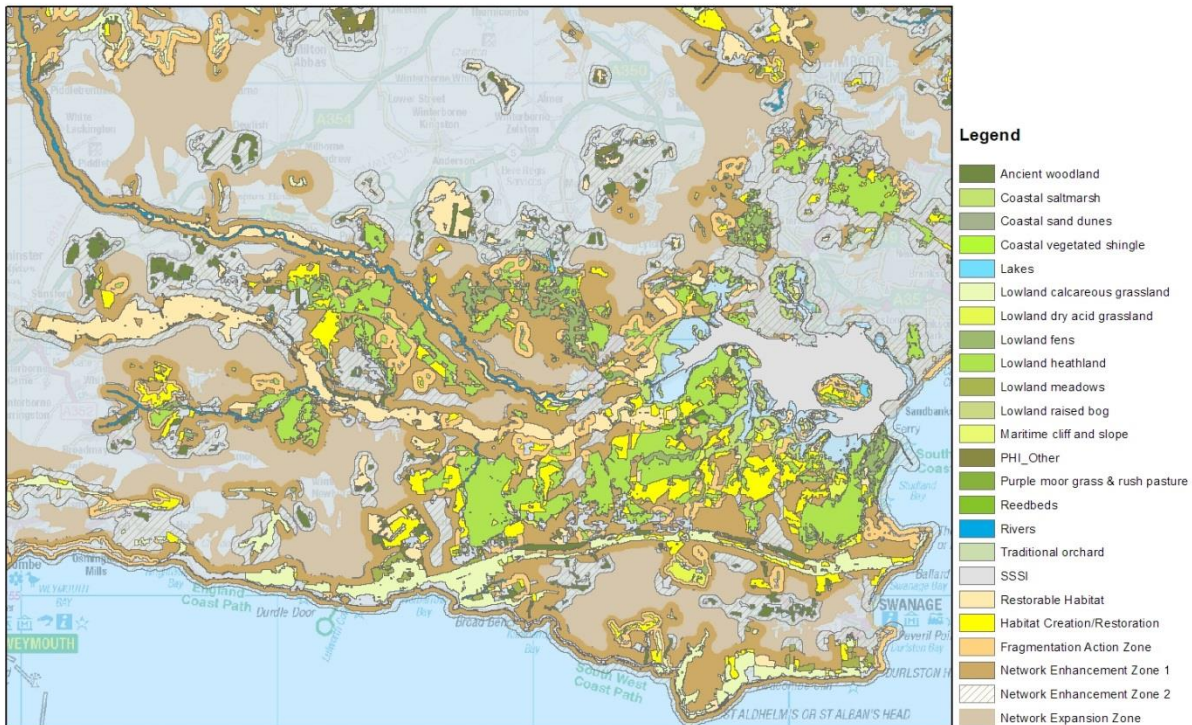
The combined habitat networks map includes some additional habitat information not included in the individual habitat maps but excludes some of the details found within the individual habitat maps. Below is a list of some of the key issues that we believe need to be understood when using this combined map.

- **Associated habitats** – these are not identified on the combined map as the vast majority of habitats listed as associated habitat on the individual habitat network maps will be identified on the combined map as a primary habitat. Any associated habitat that does not have an individual habitat network map plus all other priority habitat is shown on the combined map as 'PHI_Other'.

- **Restorable habitats** – In order to keep the processing of these maps as efficient as possible it means that the GIS process we have used to create the combined map does not allow us to specify which habitat this relates to. Some data used to identify restorable habitats e.g. 'semi-improved species rich grassland' may be used in a number of grasslands network maps as it is not possible to be specific as to the type of grassland. In addition Plantations on Ancient Woodland Sites (PAWS) have]also been classed as restorable but it is not possible for these to be identified.

- **Network Enhancement Zones** and the **Network Expansion Zone** are not specific to a particular habitat

- **Other priority habitat** – Any additional priority habitat, including deciduous woodland, not included within any individual habitat network map is shown on the combined habitat networks map where this occurs within the Enhancement Zone 1.

- **SSSIs** - The combined habitat networks map also incorporates the areas of SSSIs that sit outside any of the mapped habitat components (Section 2A & Figure 1) of the individual habitat networks. For this map we only identify the land that is designated not the habitat type. For coastal habitats this may extend into estuaries e.g. the Wash.

- **Wood-pasture & Parkland** – As Wood-pasture and Parkland is often found on sites also identified as another habitat e.g. lowland meadows or lowland heathland, it has not been possible to identify and annotate the combined map to show the areas of overlap. Where this habitat is likely to be of interest it is important to use the individual wood-pasture and parkland habitat network map to compliment the combined habitat networks map.

NOTE: We advise that if the combined habitat networks map appears not to identify important aspects relating to a specific habitat that the relevant individual habitat network map should be used.

4. Grouped Habitat Networks Maps

We intend to create some examples of grouped habitat network maps that we believe may be more meaningful in particular locations depending on the local objective and to better account for how such habitats occur naturally in landscapes.

The current example groupings we are considering are;

- **Coastal Habitats** - saltmarsh, sand dunes, shingle and maritime cliff and slope[9]
- **Lowland Grasslands** – lowland meadows, lowland calcareous grassland, lowland acid grassland and upland hay meadows
- **Lowland Wetland** – lowland fen, lowland raised bog and reedbed
- **Upland Habitats –** blanket bog, upland heathland and upland flushes fens and swamps

We do not intend to create grouped maps for other habitats e.g. lowland heath or deciduous woodlands as we believe that the individual habitat network map should be adequate as they take account of other habitats by incorporating 'associated habitats' into the network e.g. lowland acidic grassland and lowland fen are associated habitats within the lowland heathland habitat network map. The full list of associated habitats used within each habitat network map is provided within Annex 1.

The mapping tool we have used can create bespoke maps for any number of different habitats, please contact NE data services to request any additional grouped habitat maps.

---

[9] Please note that the grouped coastal habitats map has already been created - see Section 5 for more information on the use of this map

5. Woodlands, Open Water and Coastal Habitats

5.1 Woodland Habitats

Woodlands

We recognise that all woodlands can be important for biodiversity and/or for other reasons. We also recognise that the Forestry Commission (FC) have produced a range of guidance documents and maps in relation to woodlands including a map that specifically identifies locations for new woodland planting (CS Biodiversity - Priority Habitat Network note: it is 374MB). Please note when using this FC map that it does not identify areas of existing priority habitat as a constraint. It is also important that the guidance on 'Assess environmental impact before you create new woodland' is referred to. For projects seeking to convert woodland to open habitats the following FC guidance needs to be followed 'Consents required in relation to the conversion of woodland to open habitats'.

Ancient Woodland Network Map

We have focussed our Habitat Network Map on Ancient Woodland as this is considered a top priority for nature conservation. The Ancient Woodland Network Map has been prepared using the same approach as the other habitat network maps but with some minor modifications as outlined below.

Existing Habitat

- **Primary Habitat**: Ancient semi-natural Woodland as identified within the Ancient Woodland Inventory (AWI)[10].
- **Associated Habitat**: Other deciduous woodland, wood-pasture and parkland and traditional orchards.
- **Habitat Creation/Restoration**: Not identified as yet
- **Restorable Habitat:** Plantations on Ancient Woodland Sites (PAWS) as identified on the AWI.

Network Enhancement & Expansion

- **Network Enhancement Zone 2:** We have only included Network Enhancement Zone 2 on our map.   There is no Enhancement Zone 1 or Network Expansion Zone as potential locations for woodland planting are shown on other FC maps. For areas where woodland expansion, particularly through regeneration, would be particularly beneficial see Fragmentation Action Zone below. Actions that improve the biodiversity value and help develop habitat mosaics and/or increase green infrastructure provision would be beneficial within Enhancement Zone 2.
- **Fragmentation Action Zone:** As per all other habitat network maps. Action to address the most fragmented areas of habitat e.g. through increasing woodland extent (note: regeneration is preferred over planting) may be targeted here.

Please note: The most up to date version of the Ancient Woodland Inventory should always be used for clarification on the status of a woodland. We recognise that Plantations on Ancient

---

[10] Ancient Woodland (England) version dated 7/04/2020 – Note that much of the inventory does not record ancient woodlands under 2ha and is therefore not a true picture of the total resource.

Woodland Sites (PAWS) are Ancient Woodlands even though they are identified as 'Restorable Habitat' within the ancient woodland network map.

Wood-pasture & Parkland

The Wood-pasture and Parkland Network Map has been prepared using the same approach as the other habitat network maps. However, the following specific issues have had to be taken into account in terms of identifying the **Primary Habitat.** As there is no definitive inventory for this habitat we have used a combination of data sets has been used as the best available data to identity sites considered to support this habitat. The Provisional Wood-pasture & Parkland inventory contains attributes identifying locations where the habitat has been confirmed as well as where the presence still needs to be verified. We only used sites that had been verified as 'definitely being present' as representing the primary habitat for the network map. We have supplemented the sites selected from the draft inventory with additional information using the Ancient Tree Inventory[11] to verify the presence of wood-pasture and parkland. The remaining areas of the draft wood-pasture and parkland inventory identified as 'restorable habitat' where they occur in close proximity to the primary habitat.

A particular feature of this habitat is that on occasions it will overlap with sites recognised on the PHI as supporting other priority habitat, such as grasslands, heathland and woodland (termed 'allowable overlap'). In the Combined Habitat Map layer we have not been able to show sites that overlap with other habitats and we therefore recommend, when considering WP&P in the wider countryside that the wood-pasture and parkland network map is also used. As the features of importance for this habitat also occur outside of recognised wood-pasture and parkland sites, e.g. ancient trees within hedgerows or within ancient woodlands, we also recommend that the following map layers are used:

- NE's Provisional Wood-pasture & Parkland inventory (this will help show all other areas where wood-pasture and parkland may occur including sites that still need to be verified)

- PAWS and deciduous woodland (to provide an overview of woodland cover more generally)

- The Woodland Trust's Ancient tree inventory (this will identify locations of individual trees so far recorded within the wider countryside)

5.2 Lakes and Rivers

General Approach

The UK priority habitat definitions for lakes and rivers effectively encompass all lakes and the large majority of the river network. These definitions have been interpreted in England in order to generate a limited subset of the river and lake habitat resource that can be deemed priority habitat, involving identifying sites that meet requirements relating to the natural functioning of the habitat – hydrological, physical, chemical and biological. Report NERR064 provides more information on the

---

[11] Data set prepared in 2014 from Woodland Trust, more recent data will be used to update the maps in due course

natural functioning of these habitats, whilst a [new website](#) hosted by the FBA provides an easily accessible explanation of how the priority river and lake habitat maps have been generated.

The total extent of habitat on the priority river and lake habitat maps is relatively small compared to the extent of the wider habitat resource, such that much of the action needed on rivers and lakes relates to improving the natural functioning of sites that are not on the priority habitat maps. Rivers and lakes are key components of all landscapes and river corridors in particular provide important biological connectivity for all habitats. Their biodiversity value is strongly influenced by the type and quality of land management and other activities in the catchment, which makes their restoration very complex.

Key points in relation to generating network map for river and lakes are given below.

- We selected the majority of other habitats as an associated habitat for both network maps.

- We identified areas as 'restorable habitat' using a different method to that of other habitats,

- We recognised that these maps are not just focussing on habitat expansion but on improving the condition of degraded sites, which because of their degraded nature do not feature on the priority habitat maps. Relevant restoration measures can include any measure that helps restore the natural functioning (physical, chemical, hydrological and biological) of lakes and rivers either on site or in the catchment. To help ensure riparian habitats (which are considered an integral part of river and lake habitat) is of suitable quality, we have identified the area around river and lake priority habitat as Enhancement Zone 2 rather than Zone 1,

We have not included 'Fragmentation Action Zones' on either of these open water habitat network maps as the main focus is on improving the condition of the remaining habitat which is addressed through the 'restorable habitat' component of the map. The 'restorable habitat' component of these maps identifies river stretches or lakes where restoration action may take place to improve condition and connectivity. Whilst this is an important consideration for rivers and lakes as it is for other habitats, there are equally important consideration associated with the specific nature of impacts on a given site, the position of sites within catchments, and the scale and nature of constraints to restoration. For this reason sites identified by the river and lake habitat network maps constitute one strand in a wider process of identifying the best places to restore natural functioning in the river and lake network. A broader process of identifying priorities for restoring natural function within the river and lake network, to contribute to meeting priority habitat objectives, is being developed with stakeholders. The habitat network maps described here will be used to help populate these restoration priorities maps. For more information on this work see the [new website](#) on priority river and lake habitats.

More details of how the habitat network maps have been created is outlined below.

Priority Lakes Habitat Network Map

Lakes on the lake priority habitat layer along with other lakes considered to be worthy of further consideration, e.g. notified as SSSI lake habitat, were identified as the 'primary habitat' for this network map.

In order to identify further 'restorable habitat' the entire lake resource was assessed using the UK Lakes Database layer sourced from the [UK Lakes Portal](#) which identifies most lakes in England that are greater than 1 ha and some smaller water bodies. We have identified all lakes from this layer that fall within Enhancement Zone 1 of the Combined Habitat Networks Map as 'Restorable Habitat' within the Lakes Habitat Network Map. This is because lakes with catchments with semi-natural land use are likely to have better water quality and provide greater biodiversity benefit, if restored, due

to habitat connectivity with terrestrial habitats (see NERR064 'A narrative for conserving freshwater and wetland habitats in England').

We have created the individual priority lakes habitat network using the following components;

Existing Habitat

- **Primary Habitat**: Priority Lake habitat identified as described above
- **Associated Habitat**: Other adjacent priority habitats (see Annex 1)
- **Restorable Habitat:** All lakes contained within the Combined Habitat Network.

Network Enhancement & Expansion

- **Network Enhancement Zone 2:** (There is no Enhancement Zone 1 or an Expansion Zone as the priority is to restore the existing resource and not create new habitat). Within Enhancement Zone 2 actions that improve lake habitat such as; increase semi-natural habitat, develop more habitat mosaics, increase the extent of wildlife friendly land management or green infrastructure, may be targeted here.

Figure 4: Lakes Habitat Network Map
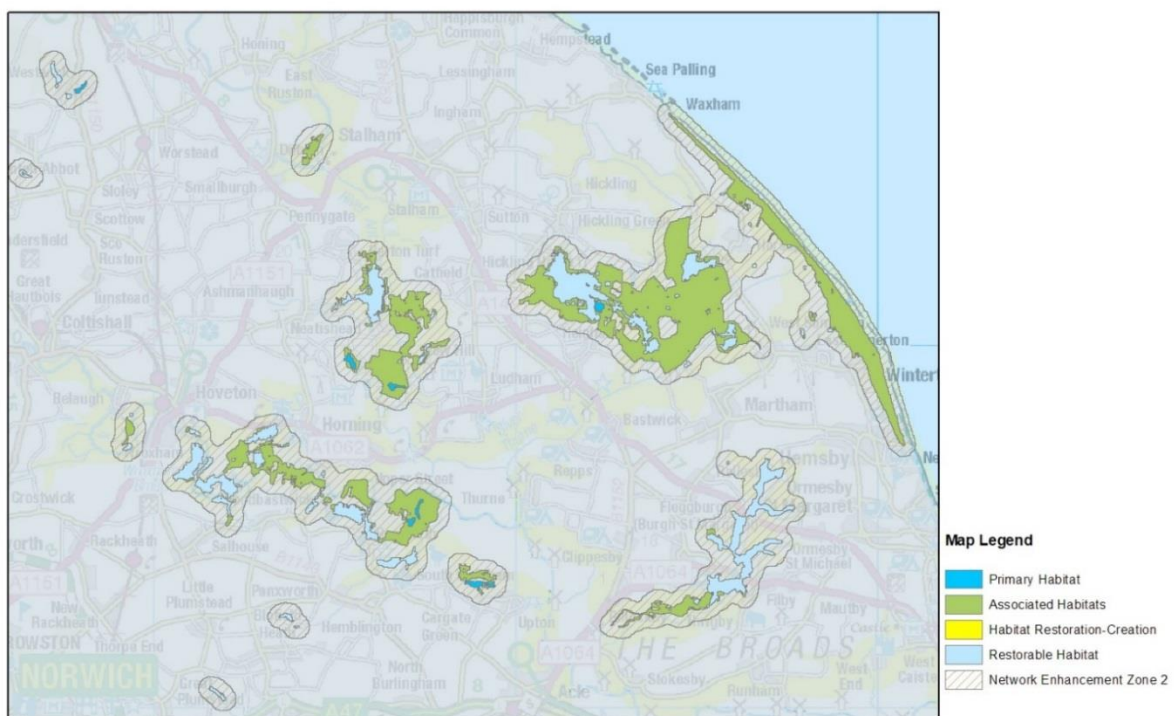
Priority Rivers Network Map

In addition to the general approach outlined above we have used the priority rivers habitat layers from NE open data portal as the primary habitat. We have also carried out a network analysis over all watercourses not recognised as priority river habitat to identify stretches of non-priority river habitat that connect and joins stretches of priority river habitat. We have labelled these sections as 'restorable habitat' and here action to improve the condition of the river in terms of natural function that would help extend and link up the current priority river habitat resource would be beneficial.

The Priority River habitat inventory also includes [priority river headwater areas](#) i.e. the headwater catchments most likely to support headwater streams that are sufficiently naturally functioning to be included on the priority habitat map. These are particularly important to the priority river habitat resource and this map would be useful to refer to when considering action to improve rivers. The combined habitat networks map will also provide information on the extent of priority habitats within most of the priority headwater areas.

We have created the individual priority river habitat network using the following components;

Existing Habitat

- **Primary Habitat**: Priority River Habitat.
- **Associated Habitat**: Other adjacent priority habitat (see Annex 1)
- **Restorable Habitat:** Sections of non-priority river habitat that link existing sections of priority river habitat.

Network Enhancement

- **Network Enhancement Zone 2:** (There is no Enhancement Zone 1 or an Expansion Zone as the priority is to restore the existing resource and not create new habitat). Enhancement Zone 2 includes all terrestrial land adjoining the existing stretches of priority river habitat. Action in this zone to improve the condition or extent of semi-natural habitat/habitat mosaics or increase extent of wildlife friendly land management or green infrastructure that improves river habitat functioning, may be targeted here.

Figure 5: River Network Map
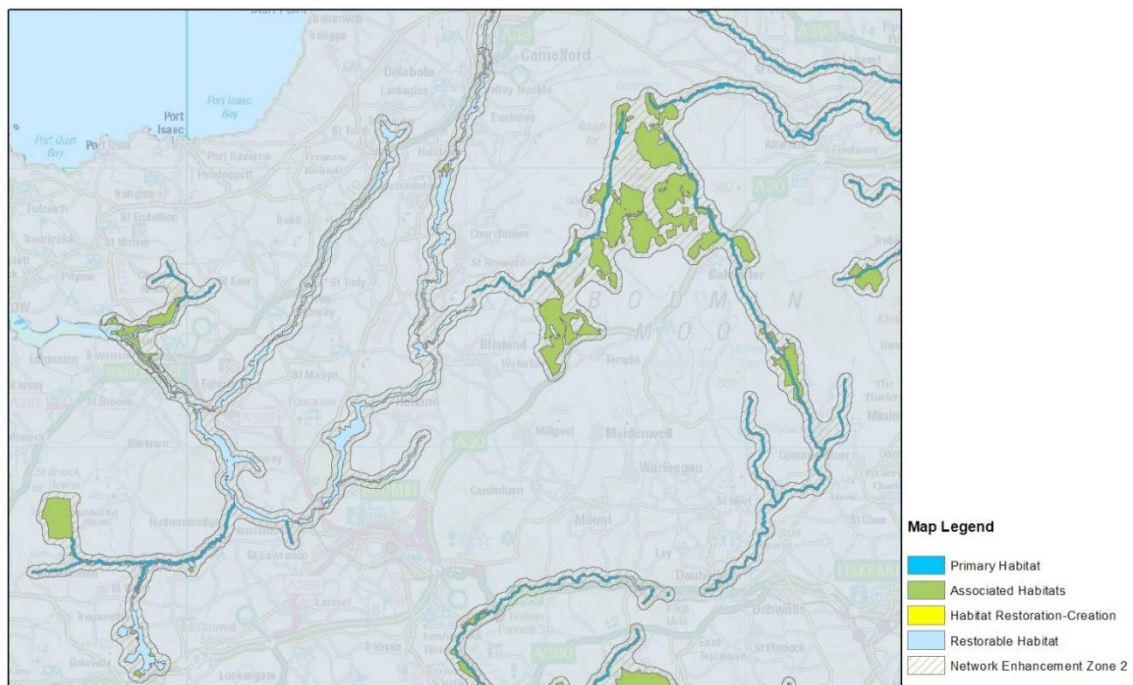
5.3 Coastal Habitats

We recognise that coastal habitats are dynamic systems which are shaped by coastal processes that influence the location, scale and ultimately the success of any management and/or proposed enhancement. Other factors that need to be considered when using the coastal habitat network map(s) include the current topography, the elevation of the land and the current land use. Shoreline Management Plans (SMPs) set out the future strategy for a stretch of coastline relating to issues of coastal defence which will also help identify potential locations for future action to increase the resilience of the existing habitat network. It is also important to consider all other local opportunities and constraints as these are not mapped on the habitat network maps.

The Marine Management Organisation has also published a useful document entitled 'Identifying sites suitable for marine habitat restoration or creation (MMO1135)' and a set of maps to support this.

As outline in Section 4 we have developed a grouped habitat network map of the 4 coastal priority habitat maps (saltmarsh, sand dunes, shingle and maritime cliff and slope). The individual maps may be viewed separately, but it is advised in the first instance that users should use the grouped 'coastal habitats map'.

Figure 6: Coastal Habitats Map
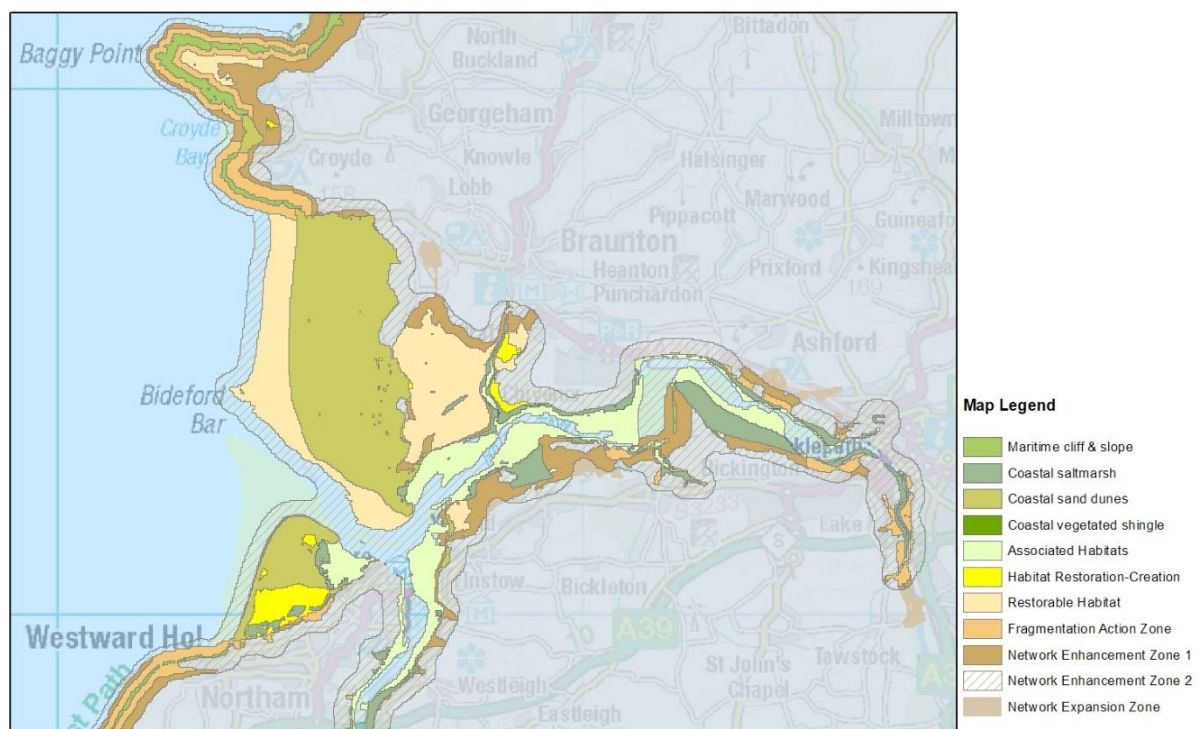
6. Relationship to the Nature Network Handbook

ENRR081 '**Nature Network Evidence Handbook** - *Creating Nature Networks for Wildlife & People*'[5] is intended to help our staff and external partners apply some of the objectives of the 25 Year Environment Plan when delivering or planning landscape scale projects for biodiversity and people.

The Handbook sets out 8 principles, including number 7, which is specifically about planning ecological networks:

*Think "networks": Networks need to be **planned at multiple spatial scales & address multiple issues,** with joined-up actions across adjacent landscapes, delivering integrated outcomes, ensuring the network acts as a coherent whole to deliver for all users (species, ecosystems and people) within the area.*

The Handbook includes a set of 'Rules of Thumb' for the design of ecological networks, building on the principles in Lawton *et al.* (2010), these include:

Bigger Sites
- Big enough to encourage natural processes – include areas that ensure functioning ecosystems.
- Provide space for ecosystem dynamism supporting mosaics and to encourage succession.
- Reduce edge effects by decreasing the *edge: area* ratio.
- Join habitat fragments; choose the ones that will create the biggest site.
- Restore degraded habitat surrounding the site.
- Enlarge sites to >40 ha (or >100 ha for wide-ranging species).

More sites
- Target areas of important habitat potential in the surrounding area.
- Target degraded areas with high ecosystem service delivery.

Stepping stones & permeable matrix
- Sites should be < 1km from each other and < 200m apart for highly specialised species within a habitat.
- Expand sites towards existing habitat to reduce space between patches.
- Increase the cover of semi-natural habitat in landscape to at least 20%.
- Reduce the intensity and increase the diversity of land use in the surrounding countryside.

The **Nature Network Evidence Handbook** provides guidance on how different habitats are naturally provided by landscapes, and how an understanding of this natural pattern of habitat provision should be used in building habitat networks to generate the most integrated biodiversity outcomes possible. The information needed to do this relates to factors such as natural hydrological regimes (in the absence of land drainage for example) and natural soil and sediment processes. Such information largely comes from local knowledge and data sources and is not very amenable to national mapping exercises of the type described in this guidance. The national habitat network maps will require careful interpretation to ensure that local decision-making is rooted in promoting biodiversity conservation through naturally functioning habitat mosaics as far as this is possible and desirable. More detailed explanation of the biodiversity importance of natural ecosystem function can be found in [Natural England Research Report 071](#) 'Generating more integrated biodiversity objectives'. The new [Climate Change Adaptation Manual](#) is also a good place to look for information on how to plan ecological resilience in the face of climate change, which is essential for all conservation planning.

7. Further information/Frequently Asked Questions

This section provides more information on the habitat data and the network tool and approach/methodology we used to create the maps.

Habitat Data used:

1. **What baseline habitat data is used?**
2. **Is it possible to improve the baseline habitat data?**
3. **Can local data be used in the approach?**
4. **Can I integrate additional data?**
5. **Are all habitats included, are there any missing?**
6. **Why have we focussed on priority habitats?**
7. **Why is coastal/floodplain grazing marsh not included?**

Habitat network tool & approach:

8. **What GIS tool has been used to create the maps?**
9. **Can you repeating the analysis easily?**
10. **Can I use the tool?**
11. **What evidence have you used to support the assumptions in the approach?**
12. **How does the variable buffering work?**
13. **Why is the Enhancement Zone different in some Habitat Network Maps?**
14. **How is information on soils used in the approach?**
15. **What Constraints and Opportunities are mapped?**
16. **How are urban areas treated in the approach?**
17. **What is the patch size threshold?**
18. **What is the associated habitat group**?
19. **What additional habitat information is included?**
20. **How is current habitat creation/restoration information included?**
21. **How do we know where the areas of restorable habitat are?**
22. **Why is there a combined map?**
23. **How is the combined map created?**

7.1 Habitat Data used:

1. What data is used in the national maps?
We have used the following data sources to build the components of this version of the National Habitat Network (version 2.1) mapping:

Component	Datasets used
Primary Habitat	• Priority Habitat Inventory (PHI v2_2)[1], • Alkaline Fen and Transition Mire and Quaking Bog Annex 1 habitats in England[1], • Ancient Woodland Inventory[1], • Priority Rivers Habitat Map[1], • CEH UK Lakes Portal, • Draft Wood-pasture & Parkland[1], • Woodland Trust Ancient Tree Inventory, • PTES Traditional Orchards HAP data layer. [1] = NE data is available from the Natural England Open Data Geoportal

Associated Habitat	A range of habitats that typically occur as a mosaic with the primary habitat, care is taken to avoid including habitats that simply lie adjacent to the primary habitat i.e. transitional habitats, particularly where the extent of such habitats overwhelms and/or distorts the network map for the primary habitat. The source of this is the PHI.
Restorable Habitat	Datasets of non-priority habitats e.g. Semi-improved species rich grassland, fragmented heathland, grass moor, 'No main habitat but priority habitat present' where the primary habitat is listed as present from the PHI. Plantations on Ancient Woodland (PAWS) NSRI Soilscapes data (26 & 27) used for blanket bog and lowland raised bog in combination with additional PHI data.
Habitat restoration or creation	All relevant Agri-environment scheme options where they lie in close proximity to existing habitat patches. Data from NE Green Infrastructure database, other data from partners on habitat creation where available (Dorset heathland project)
Network Enhancement Zone	NSRI Soilscapes data (see below for more information on soil types) A digital terrain model Urban Settlements EA Flood Risk Zone 3 tidal

2. Is it possible to improve the baseline habitat data?

We have used the Priority Habitat Inventory as the primary data source for the majority of the habitat network maps. We are aware this is not comprehensive or 100% accurate. We therefore encourage the improvement of the PHI dataset with better local data and promote the use of the Habitat Network maps alongside local knowledge and data. Data supplied to NE for inclusion within the network map should first be supplied for inclusion within the PHI and will therefore need to be supplied with the relevant metadata and under an open licence compatible with the Government Open Data Licence. Other mapping components such as restorable habitat and habitat creation can be supplied directly to the habitat network project but again this has to be under a licence compatible with the Government Open Data Licence.

3. Can local habitat data be used in the analysis?

Where available local, open source habitat data can be prepared for inclusion in the PHI and as such this can then be included in the analysis, to identify primary and associated habitat presence. In addition to this other local, open source data on the location of habitat creation and restoration happening in your area can be used in the habitat restoration or creation component of the analysis. We can also use data on sites with restorable habitat where this is known. We hope this project can facilitate the contribution of local data to the PHI to make the national dataset better for everyone.

4. Can I integrate additional data on other habitats?

You should be considering any additional habitat data in addition to these maps where this exists locally to improve any local network maps. When planning or designing the delivery of landscape scale ecological networks, it is important to ensure that all habitats present within the landscape are taken into account, as well as any local opportunities and/or constraints. This will include habitats that are not on the PHI or do not have an inventory. We therefore recommend that other data sets are also used to provide wider context and a more comprehensive picture of the ecological resource and opportunities (and potentially constraints) including,

National data such as:
- SSSIs
- Forestry Commission National Inventory of Woods and Trees

- Existing HLS or CS agreements

Local data such as:
- Existing Local Ecological Networks or Opportunity Maps
- Local Wildlife Sites
- Other local habitat creation projects
- External partners land holdings

5. Why have we focussed on priority habitats?

We have focussed on priority habitats and used the PHI or other inventories that we consider represent the best available habitat data at a national level. We have focussed the network maps around priority habitats as this is the current common classification used for conservation purposes and recognised in legislation i.e. Section 41 of the NERC Act 2006.

6. Are all habitats included, are there any missing?

The following habitats do not have a national habitat network:

Priority Habitat	Reasons for not compiling a Habitat Network Map
Saline lagoons	Habitats are adequately covered as an associated habitat within other habitat networks
Mountain heath & willow scrub	
Calaminarian grassland	
Coastal & floodplain grazing marsh	See below
Mudflats	A transitionary habitat between marine and terrestrial that was considered to require a different approach.
Arable Field Margins	No national inventory
Hedgerows	
Open Mosaic Habitats	Draft Inventory not of sufficient standard to be used at present
Ponds	Network Maps may be developed as part of future work

7. Why is there no network map for coastal & floodplain grazing marsh?

We recognise that coastal and floodplain grazing marsh may be an important component of many catchments but we have not prepared a habitat network map for this habitat as the biodiversity quality varies with much of it being of low biodiversity value. The habitat is essentially a drained version of other wetland semi-natural habitats including fens, reedbeds and wet woodland. The current habitat definition focusses on its importance for breeding waders, overwintering waterfowl and species rich ditch systems with little consideration for expanding the semi-natural wetland habitats and accommodating natural function. For this reason work is ongoing to investigate the potential to modify the habitat definition to take greater account of the needs for better natural functioning floodplains and coastal change.

We have included areas of the existing coastal and floodplain grazing marsh into other wetland habitat network maps as a restorable habitat in recognition of the potential for these habitats to develop in the floodplain. The current maps do not distinguish between areas of high or low biodiversity value or the level of constraint or opportunity to covert this habitat as we believe this is best determined at a local level. Work is currently on going to help define the areas of floodplain grazing marsh of biodiversity value and to define the potential functional boundary for defining any future floodplain wetland mosaic habitat.

7.2 Habitat network tool & approach:

8.   What GIS tool has been used to create the maps?
The spatial data analysis used to create the Habitat Network maps was undertaken using a data integration software tool called Feature Manipulation Engine (FME). The process has been built into an FME workspace designed to facilitate re-runs of the analysis, incorporating new data or varying the process parameters as required. This means that the national networks can be quickly and easily updated, and also provides for bespoke analysis of local habitat networks.

9.   Can you repeating the analysis easily?
These maps are not intended to be automatically adopted to form local ecological networks. Further local interpretation, including addition of local knowledge and data will be required before planning any action. However, it is anticipated that these maps will help inform local decisions about the development of local ecological networks.

As the process we have used to create the Habitat Networks is flexible and repeatable, it means that it is also possible to be re-run the analysis to include local data to help improve local accuracy and increase relevance to partners but any bespoke runs of local data that is not included in the PHI is extremely difficult and may not be possible due to staff resources.

10. Can I use the tool?
If you can use FME and if you can work with us on the analysis you are doing it may be possible to access the tool. Ideally this would be reciprocated by the exchange of habitat data to enhance the PHI and align any local maps with the national map.

11. What evidence have you used to support the assumptions in the approach?
Here are some extra details on the assumptions we have made in a number of the network components:

- **Individual habitat networks maps** – we have created habitat network maps on a habitat by habitat basis as we believe that this may be helpful when considering priorities for action within a certain location particularly if there are specific local or national objectives/targets to meet for specific species or habitats.
- **Associated habitats** – we recognise that an individual habitat will co-exist within a landscape with other habitats and that many function as an ecologically unit. We have used our practitioner judgement alongside specialist validation to decide which priority habitats should be treated as an 'associated habitat' within each of the habitat network maps. The habitats chosen are those that are ecologically connected with, and often exist together in a

matrix with, the primary habitat. The full list of Associated Habitat groups are listed in Annex 1.

- **Using Soils** choices – we have based the associations between soils and habitats in our mapping approach based on an assessment of the habitat requirements, the descriptions within the Soilscapes data base and the evidence from [EN Research Report 712 'Guidance on understanding and managing soils for habitat restoration projects'](#)
- **Habitat clusters**– We have not sought to identify ecological networks that are considered to be viable based on species movements and dispersal distances e.g. 200m, 500m or 1000m. Instead we have taken the evidence presented within the Lawton report and focussed our mapping on identifying locations where habitat clusters together within the landscape. Within the maps we have also sought to identify locations for action to improve the ecological resilience of the network.
- Lawton Approach - The Lawton report[12] (section 4.4) assesses whether the current extent and spatial distribution of the remaining habitat is adequate to form a coherent and resilient ecological network. This is judged against 5 key attributes and concludes that for 4 of the 5;
    > ***"there are serious short-comings in the network. Notably, many of England's wildlife sites are too small; losses of certain habitats have been so great that the area remaining is no longer enough to halt additional biodiversity losses without concerted efforts"***.
- We have developed the Habitat network Maps to focus on the current spatial distribution of habitat patches in a way that identifies how the habitat survives in clusters where positive action, such as creating more habitat or improving the connections and matrix between the patches and between the network clusters would help build a more coherent and resilient ecological network. We recognise that species loss from existing habitat patches will continue to occur over a long time and that for many species that currently survive within a habitat patch the population may no longer be viable (an effect called an extinction debt[13]). To help address this issue we have identified where the more vulnerable habitat patches occur, i.e. the smaller habitat patches or those with excessive edges, occur. We have identified these areas as Fragmentation Action Zones and consider that action may be focussed here as a priority. We also recognise that improving the links between the habitat clusters may also be important so we have identified potential locations where clusters occur in close proximity where action to improve connections between the habitat clusters may be beneficial and have identified an Expansion Zone to help facilitate planning for this action.

12. How does the variable buffering work?

The Network Enhancement Zone boundaries are drawn around the 4 habitat components (primary habitat, associated habitat, restorable habitat and habitat restoration or creation) – based on a standard, though variable, distance of 500m. The buffer is variable in that it is stretched where a slight extension would capture more habitat and/or present a more complete network, i.e. its reach is extended in the direction of another relevant habitat patch. It works in the following way (see also fig.7):

- Habitat patches are buffered by 500m.
- Any overlapping buffers are merged.
- Any holes (marked H in fig.7) left when buffers are merged within patches of >100ha are filled in.

[12] Lawton et.al 2010, Making Space for Nature

[13]   Tilman, D., May, R., Lehman, C. & Nowak, M. (2002) Habitat destruction and the extinction debt. *Nature*, *371*, 65-66.

- The buffers are then reduced to 250m in order to constrain them where they aren't meeting other buffers.
- The resulting buffer area shown in orange in the figure 7 below.
- This leads to a theoretical maximum buffer distance of around 1km. but in practice the vast majority of buffers will not exceed far beyond 500m.

This 500m distance between patches has been selected based on our review of the literature and evidence relating to other network mapping approaches. The Enhancement Zone drawn through this standard approach is intended as a guide only and seeks to show the location of habitat patches that are more clustered together within the landscape to focus action to build greater ecological resilience of existing habitat patches. The distance used may be varied within the tool to prepare bespoke network maps for specific species if there is sufficient evidence available to justify this. We have used a 1km buffer for the blanket bog habitat network map due to the extensive habitat patches and the aim to capture a more complete hydrological unit required for restoration.

NERR081 provides more information on this and states "*To ensure adequate connectivity between core sites or stepping stone sites, placement is important. Many studies have explored the effect of isolation on the likely colonisation rates of different taxa between patches of suitable habitat…….. It should be noted that dispersal will be moderated by the relative permeability of the intervening matrix. However, in can be concluded that **for highly specialised species within a habitat, adjacent sites need to be < 200m apart and for more generalist species < 1km apart"**.*

Figure 7: The variable buffering process
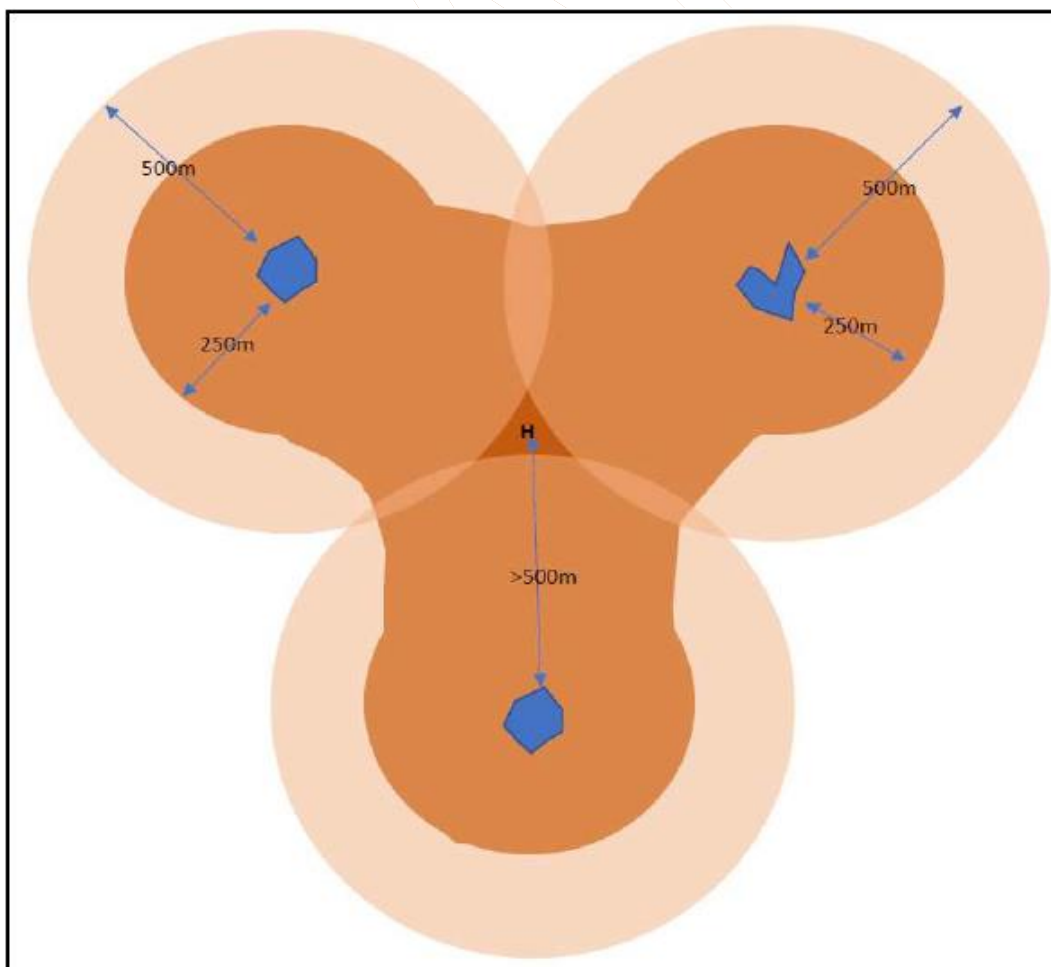
13. Why are the Enhancement & Expansion Zones different in some Habitat Network Maps?

The extract from Table 1 lists 7 habitats Network Maps where the approach used in the maps varies and the table below provides reason for modify the approach.

Type of modification	Reason for modifying our approach
No Network Enhancement Zone 1	
Limestone pavements	Habitat is impossible to recreate, the creation/restoration of relevant associated habitats should be the focus to building greater ecological resilience. For this reason the Habitat Network Maps only identify Enhancement Zone 2.
Ancient woodland	Habitat Network Maps identify Enhancement Zone 2 as the map is not intended to identifying all potential areas for woodland planting as FC's maps exist for this purpose. This habitat is also considered irreplaceable and the priority we have focussed to address is fragmentation and restoration of PAWS.
Lakes	Habitat Network Maps identify Enhancement Zone 2 only as creating new lake habitat to link and join existing habitat is not a priority. Priority is to improve the condition pf all habitat, restore natural function of the existing non-priority habitat rather than create more open water resource.
Rivers	
No Fragmentation Action Zone	**Reason for modifying our approach**
Lakes	Habitat Network Maps identify Enhancement Zone 2 only as creating new habitat to reduce fragmentation is not a priority. Priority is to enhance existing non-priority habitat, Lake Habitat Network Map identifies non-priority lakes for restoration as restorable habitat. Stretches of existing non-priority river habitat that join existing priority habitat are identified as restorable habitat.
Rivers	
Traditional Orchards	Draft Network Map, Further consideration is required in terms of identifying priorities for action.
No Network Expansion Zone	**Reason for modifying our approach**
Limestone pavements	This habitat is Irreplaceable and building greater resilience can best be achieved through the expansion of other habitats such as calcareous grassland.
Upland flushes fens and swamps	We consider that the Enhancement Zone 1 is sufficiently large to meet current priorities for this habitat. The habitat is most frequently found within a mosaic of other upland habitats and developing greater ecological resilience is probably best addressed through enhancing these habitats e.g. addressing issues of structure and function.
Maritime cliff & slope	A linear habitat dependent upon saline influences such as salt spray where expansion inland is dependent upon relatively slow natural

	processes. The extent of landward movement is sufficiently captured by the Enhancement Zone.
Lakes	Focus for developing greater resilience should focus on better land management of the catchment, including increasing the extent of semi-natural habitat, to improve natural function.
Rivers	
Ancient woodland	This habitat is Irreplaceable. We have mapped the Fragmentation Action Zone to reduce impacts on small woodlands and the restoration of PAWS as priorities for action. This map is not intended to identifying all potential areas for woodland planting and therefore no expansion zone is identified.
Traditional orchards	Draft Network Map, current proposal is to focus for developing greater resilience within and around the existing habitat patches which are generally small. We consider that the Enhancement Zone 1 is sufficiently large to meet current priorities for this habitat.

14. How is information on soils used in the approach?

NSRI Soilscapes data is a simplified version of the 1:250,000 scale Digital National Soil Map for England and Wales. It has been tailored to provide extensive, understandable and useful interpreted soil data for the non-soil specialist. Soilscapes defines 27 soil map units, each fully described with a range of valuable attributes. These were thought to be the most useful and practical classifications to use within the National Habitat Network mapping approach.

The soils data is used within the Habitat Network Maps to help determine the extent of Network Enhancement Zone 1 and the Expansion Zone only where soils and other conditions exist for habitat creation and restoration are more suitable. Network Enhancement Zone 2 extends over other areas e.g. areas without suitable soil types or over areas of urban development to identify where other actions, such as the provision of green infrastructure or changes in land management, might also be undertaken to improve resilience.

To select the soils for each habitat we referenced the Natural England Research Report 712 'Guidance on understanding and managing soils for habitat restoration projects' and compared their descriptions of habitat suitability.

15. What Constraints and Opportunities are mapped?

Other than the urban areas no constraints or opportunities are identified on the Habitat Network Maps as these are likely to vary according to the individual landscape and project objective.

16. How are urban areas treated in the approach?

Where the Enhancement Zone extends into urban area it becomes Network Enhancement Zone 2 due to the limited opportunities for habitat creation. However, we consider that there may be opportunities here for some action e.g. urban Green Infrastructure that may contribute towards building greater resilience

17. What is the patch size threshold?

Patch size is used as part of the calculation to carry out the fragmentation assessment used within the analysis. The patch size varies according to the habitat type so habitats that are largely made up of relatively smaller patches are not disproportionately selected for fragmentation action thereby ignoring habitats with generally larger patches (however they will be selected more frequently due to their high levels of fragmentation). Figure 8 below provides further information on this. The

primary and associated habitat patches are assessed together and the following conditions must be true for a patch of habitat to be included as part of a fragmentation action zone:

Smaller Patches

- Habitat patches must be less than a certain size based on fragmentation patch assessment threshold of 10%, 20%, 30% or 40% i.e. it is relatively small compared to the patch size range and total resource (see Figure 8)

OR

Medium Patches with excessive boundary

- This selects out habitat patches that are less than twice the size of the smaller patches, as outlined above, and identifies those with an extensive boundary compared to its area i.e. either it is long and thin or has an excessive undulating boundary. This is calculated using a Perimeter-Area Ratio assessment to identify patches with a Perimeter-Area Ratio 2.5 greater than the area i.e. the patch area is greater than an equivalent assessment of a true circle of same area.

AND

The patches identified above must be in close proximity to other patches

- Neighbouring patches are within 200m i.e. it could easily be joined with another patch of habitat.

Thresholds used for patch size assessment

Habitat	% of Habitat	Patch Size (ha)	
Blanket bog		165	**Larger less fragmented patches**
Upland heath		75	
Coastal sand dunes	10%	65	
Lowland raised bog		35	
Limestone pavement		20	
Coastal salt marsh		25	
Coastal vegetated shingle		25	
Maritime cliff & slope		35	
Lowland acid grassland		50	
Lowland heath	20%	50	
Lowland fen		20	
Upland calcareous grassland		25	
ASNW		50	
Lowland Calcareous grassland	30%	25	
Reedbed		15	**Smaller more fragmented patches**
Lowland meadows		20	
Purple moor-grass	40%	20	
Upland hay meadow		10	

18. What is the associated habitat?

Each individual Habitat Network has a list of associated habitats that are considered to be functionally related to the primary habitat i.e. they frequently co-exist within landscapes and form ecologically coherent mosaics that are used by a range of species associated with the primary habitat for that network. For example, for the Lowland Heathland Network the following associated habitats were selected; Dry Acid Grassland and Lowland Fens as these often occur in a functional

habitat mosaic. See Annex 1 for the full list of habitats included within each individual habitat network map.

19. How is habitat creation/restoration information included?
Data on sites where relevant habitat creation or restoration is underway is extracted from the Natural England database for AES schemes. Some other data sets have also be used but we recognise that what is represented on the maps is only a sub-set of the total extent of activity taking place and we would like to include more information from other sources where possible. We have included these sites in the habitat network maps as we believe that they are likely to be making some contribution towards the ecological integrity of the network and with appropriate management could make a greater ecological contribution.

20. How do we know where the areas of restorable habitat are?
The areas identified as 'restorable habitat' require local verification and should be considered as potential locations for restoration activity as the data used may be out of date and is likely to be less reliable than some of the other data sets. For this we have used a range of data sets including; areas considered to be non-priority habitat (e.g. semi-improved species rich grassland, fragmented heathland, grass moor, and areas from the 'No main habitat but additional habitat present') from the PHI. Plantations on Ancient Woodland (PAWS) from the Ancient Woodland Inventory. For each habitat a specific data set has been selected where we believe the information suggests there is an opportunity for restoration to the primary habitat. We only use this information where the sites exist in close proximity to the primary habitat.

21. Why is there a combined map?
As a result of feedback from consultation on the individual Habitat Network Maps, we recognised the need to produce a combined Habitat Networks Map to provide a clearer spatial representation of the way the habitat networks lie within the context of the wider landscape. The combined map helps to show where the full range of habitats exist in close proximity to each other and how they interact as functional mosaics beyond that shown within the individual habitat network. However, not all the detail of the individual network maps can be represented on the combined networks map and the individual maps are best used if where is a specific habitat focus.

22. How is the combined map created?
The data layers for the individual habitat networks are overlaid and resolved into a single data layer. Where elements of different networks overlap a priority hierarchy determines which takes precedence and is retained in the combined map.

The process of creating the combined map means that some detail specific to individual habitat networks is lost. In the individual habitat networks the Network Enhancement Zones and the Expansion Zone will be shaped by soils or other environment factors specific to the requirements of the habitat. In the combined map all the individual enhancement and expansion zones are merged and their link to specific habitats lost.

ANNEX 1 – Additional Information

Associated habitats & Restorable data layers

PRIMARY HABITAT NETWORK	Associated Habitats	Restorable Habitats
ANCIENT WOODLAND	DECIDUOUS WOODLAND, WOOD-PASTURE & PARKLAND, TRADITIONAL ORCHARDS	PAWS
BLANKET BOG	UPLAND FLUSHES FENS & SWAMPS, LAKES, UPLAND HEATHLAND (not on deep peat)	Fragmented heathland on deep peat, Grassmoor on deep peat, Upland heathland on deep peat, No main habitat with Blanket bog present
COASTAL SAND DUNES	COASTAL SALTMARSH, COASTAL VEGETATED SHINGLE, SALINE LAGOONS, LOWLAND ACID GRASSLAND, LOWLAND CALCAREOUS GRASSLAND, LOWLAND HEATH, REEDBED	Good quality semi-improved grassland, No main habitat with coastal sand dunes present
COASTAL SALTMARSH	COASTAL SAND DUNES, COASTAL VEGETATED SHINGLE, MUDFLATS, SALINE LAGOONS, REEDBED	Good quality semi-improved grassland, No main habitat with coastal saltmarsh present
COASTAL VEGETATED SHINGLE	COASTAL SAND DUNES, COASTAL SALTMARSH, SALINE LAGOONS, LOWLAND ACID GRASSLAND, LOWLAND CALCAREOUS GRASSLAND, LOWLAND HEATH, REEDBED	Good quality semi-improved grassland, No main habitat with coastal shingle present
LOWLAND ACID GRASSLAND	COASTAL SAND DUNES, COASTAL VEGETATED SHINGLE, LOWLAND CALCAREOUS GRASSLAND, LOWLAND FEN, LOWLAND HEATH, LOWLAND MEADOWS, MARITIME CLIFF & SLOPE	Good quality semi-improved grassland, No main habitat with lowland acid grassland present
LAKES	BLANKET BOG, CALAMINARIAN GRASSLAND, COASTAL SALTMARSH, COASTAL SAND DUNES, COASTAL VEGETATED SHINGLE, LIMESTONE PAVEMENT, LOWLAND CALCAREOUS GRASSLAND, LOWLAND ACID GRASSLAND, LOWLAND FEN, LOWLAND HEATH, LOWLAND MEADOWS, LOWLAND RAISED BOG, MARITIME CLIFF & SLOPE, MUDFLATS, PURPLE MOORGRASS & RUSH PASTURE, REEDBED, SALINE LAGOONS, TRADITIONAL ORCHARDS, UPLAND CALCAREOUS GRASSLAND, UPLAND FLUSHES FENS & SWAMPS, UPLAND HAY MEADOW, UPLAND HEATHLAND, WOOD-PASTURE & PARKLAND	Lakes within Enhancement Zones of all other priority habitat network maps
LOWLAND CALCAREOUS GRASSLAND	COASTAL SAND DUNES, COASTAL VEGETATED SHINGLE, LOWLAND ACID GRASSLAND, LOWLAND MEADOWS, LIMESTONE PAVEMENT, MARITIME CLIFF & SLOPE, UPLAND CALCAREOUS GRASSLAND, CALAMINARIAN GRASSLAND, LOWLAND FEN	Good quality semi-improved grassland, No main habitat with lowland calcareous grassland present
LOWLAND FEN	CALAMINARIAN GRASSLAND, LOWLAND ACID GRASSLAND, LOWLAND CALCAREOUS GRASSLAND, LOWLAND HEATH, LOWLAND MEADOWS, LOWLAND RAISED BOG, LIMESTONE PAVEMENT, PURPLE MOORGRASS & RUSH PASTURE, REEDBED, UPLAND CALCAREOUS GRASSLAND, UPLAND FLUSHES FENS & SWAMPS, UPLAND HAY MEADOW	Good quality semi-improved grassland, No main habitat with lowland fen present, coastal floodplain grazing marsh
LOWLAND HEATH	LOWLAND ACID GRASSLAND, LOWLAND FEN, MARITIME CLIFF & SLOPE, LOWLAND RAISED BOG, PURPLE MOORGRASS & RUSH PASTURE, LOWLAND MEADOWS, CALAMINARIAN GRASSLAND	Fragmented heathland No main habitat with lowland heath present
LOWLAND MEADOWS	LOWLAND ACID GRASSLAND, LOWLAND CALCAREOUS GRASSLAND, LOWLAND FEN, MARITIME CLIFF & SLOPE, PURPLE MOORGRASS & RUSH PASTURE, TRADITIONAL ORCHARDS, WOOD-PASTURE & PARKLAND, UPLAND HAY MEADOW, COASTAL SAND DUNES	Good quality semi-improved grassland, No main habitat with lowland meadows present
LOWLAND RAISED BOG	LOWLAND ACID GRASSLAND, LOWLAND FEN, LOWLAND HEATH, PURPLE MOORGRASS & RUSH PASTURE, REEDBED	Good quality semi-improved grassland, No main habitat with lowland raised bog present
LIMESTONE PAVEMENT	UPLAND CALCAREOUS GRASSLAND, UPLAND HAY MEADOW, UPLAND FLUSHES FENS & SWAMPS, CALAMINARIAN GRASSLAND, LOWLAND CALCAREOUS GRASSLAND, LOWLAND FEN	n/a
MARITIME CLIFF & SLOPE	LOWLAND ACID GRASSLAND, LOWLAND CALCAREOUS GRASSLAND, LOWLAND HEATH, LOWLAND MEADOWS	No main habitat with maritime cliff & slope present
PURPLE MOORGRASS & RUSH PASTURE	LOWLAND FEN, LOWLAND MEADOWS, LOWLAND RAISED BOG, REEDBED, LOWLAND HEATH, LOWLAND ACID GRASSLAND, UPLAND HAY MEADOW	No main habitat with purple moorgrass and rush pasture present
REEDBED	LOWLAND FEN, LOWLAND MEADOWS, LOWLAND RAISED BOG, PURPLE MOORGRASS & RUSH PASTURE, COASTAL SALTMARSH,	No main habitat with reedbed pasture present, coastal floodplain grazing marsh

	COASTAL SAND DUNES, COASTAL VEGETATED SHINGLE, SALINE LAGOONS, RIVERS, LAKES	
RIVERS	BLANKET BOG, CALAMINARIAN GRASSLAND, COASTAL SALTMARSH, COASTAL SAND DUNES, COASTAL VEGETATED SHINGLE, LIMESTONE PAVEMENT, LOWLAND CALCAREOUS GRASSLAND, LOWLAND ACID GRASSLAND, LOWLAND FEN, LOWLAND HEATH, LOWLAND MEADOWS, LOWLAND RAISED BOG, MARITIME CLIFF & SLOPE, MUDFLATS, PURPLE MOORGRASS & RUSH PASTURE, REEDBED, SALINE LAGOONS, TRADITIONAL ORCHARDS, UPLAND CALCAREOUS GRASSLAND, UPLAND FLUSHES FENS & SWAMPS, UPLAND HAY MEADOW, UPLAND HEATHLAND, WOOD-PASTURE & PARKLAND, LAKES	River connections (see section 5)
UPLAND CALCAREOUS GRASSLAND	LIMESTONE PAVEMENT, UPLAND FLUSHES FENS & SWAMPS, UPLAND HAY MEADOW, CALAMINARIAN GRASSLAND, LOWLAND CALCAREOUS GRASSLAND, LOWLAND MEADOWS, PURPLE MOORGRASS & RUSH PASTURE	Good quality semi-improved grassland, No main habitat with upland calcareous grassland present
UPLAND FLUSHES FENS & SWAMPS	LOWLAND FEN, BLANKET BOG, UPLAND CALCAREOUS GRASSLAND, UPLAND HEATHLAND, UPLAND HAY MEADOW	No main habitat with upland flushes fens and swamps pasture present
UPLAND HEATHLAND	BLANKET BOG, UPLAND CALCAREOUS GRASSLAND, CALAMINARIAN GRASSLAND, UPLAND FLUSHES FENS & SWAMPS, LOWLAND HEATH, LOWLAND ACID GRASSLAND, LOWLAND FEN, PURPLE MOORGRASS & RUSH PASTURE, LOWLAND CALCAREOUS GRASSLAND, LIMESTONE PAVEMENT	Fragmented heathland on shallow peat, Grassmoor on shallow peat, No main habitat with Upland heathland present
UPLAND HAY MEADOW	LIMESTONE PAVEMENT, LOWLAND MEADOWS, PURPLE MOORGRASS & RUSH PASTURE, LOWLAND ACID GRASSLAND, LOWLAND FEN, LOWLAND CALCAREOUS GRASSLAND, CALAMINARIAN GRASSLAND, UPLAND CALCAREOUS GRASSLAND, UPLAND FLUSHES FENS & SWAMPS	Good quality semi-improved grassland, No main habitat with upland hay meadows present
WOOD-PASTURE & PARKLAND	LOWLAND MEADOWS, LOWLAND CALCAREOUS GRASSLAND, LOWLAND ACID GRASSLAND, LOWLAND HEATH, LOWLAND FEN, PURPLE MOORGRASS & RUSH PASTURE, LIMESTONE PAVEMENT, UPLAND CALCAREOUS GRASSLAND, TRADITIONAL ORCHARDS, ANCIENT SEMI-NATURAL WOODLAND	PAWS, Draft WP&P inventory sites where the habitat has not be confirmed as definitely present
TRADITIONAL ORCHARDS	LOWLAND CALCAREOUS GRASSLAND, LOWLAND ACID GRASSLAND, LOWLAND FEN, LOWLAND MEADOWS, PURPLE MOORGRASS & RUSH PASTURE,	n/a

Priority habitat GIS Codes

- Upland calcareous grassland (UCG)
- Lowland calcareous grassland (LCG)
- Reedbeds (RBD)
- Lowland meadows (LMW)
- Upland hay meadows (UHM)
- Purple moor grass and rush pasture (PMG)
- Lowland dry acid grassland (LAG)
- Lowland heathland (LHL)
- Upland heathland (UHL)
- Upland fens, flushes & swamps (UFS)
- Lowland fens (LFN)

- Lowland raised bog (LRG)
- Blanket bog (BBG)
- Limestone pavements (LSP)
- Coastal sand dunes (CSD)
- Coastal vegetated shingle (CVS)
- Maritime cliff and slope (MCS)
- Saltmarsh (CSM)
- Lakes (LAK)
- Rivers (RIV)
- Ancient woodland (ASNW)
- Wood-pasture & parkland (WPP)
- Traditional orchards (TRO)