Wansbeck Nature Recovery Plan

Habitat Restoration and Creation Plan

Environment Agency and Natural England

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Quality information

Prepared by	Checked by	Verified by	Approved by
Kirstin Aldous Principal Ecologist	Stephanie Peay Associate Ecologist	Rob Pilcher Technical Director	Omar Sholi Technical Director

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Prepared for:

Environment Agency and Natural England

Prepared by:

AECOM Infrastructure & Environment UK Limited
One Trinity Gardens, First Floor
Quayside
Newcastle-upon-Tyne NE1 2HF
United Kingdom

T: +44 (191) 224 6500
aecom.com

Table of Contents

Figures

Tables

Photographs

Executive Summary

AECOM was instructed by the Environment Agency in January 2022 to prepare a Nature Recovery Plan for the River Wansbeck Catchment. The purpose of the Nature Recovery Plan is to inform future project work and investment in the Wansbeck Catchment and to integrate freshwater habitat and terrestrial habitat restoration and creation projects.

Whilst the work was carried out by an integrated project team, it has been split into two distinct components in accordance with the brief:

1) a Wansbeck River Restoration Plan; and
2) a Wansbeck Habitat Restoration and Creation Plan.

This report is the Habitat Restoration and Creation Plan and aims to identify areas which could become of particular importance for nature recovery and nature-based solutions within the Wansbeck Catchment. To establish baseline conditions and identify priorities for habitat restoration and creation, a review of online information and existing reports was completed. The aim of the desk study was to assess habitat condition within the catchment and highlight areas where there is limited data or further study may be required. GIS information relevant to catchment was collated and used to undertake ecological network modelling using Natural England's Habitats Network modelling tool (Natural England, 2020). Two stakeholder engagement events were held and feedback from the events was used to inform the opportunities identified.

With reference to the priorities outlined within the NLNRS Pilot (2021) and including information from the review of existing data and previous studies, a series of base maps was created to show the most valuable 'primary habitats' within the catchment based on available data. Primary habitats were grouped into the following themes:

- Peatland and heathland;
- Semi-natural grassland;
- Watercourses and wetlands;
- Woodland, Trees and Scrub; and
- Coastal and Marine.

Peatland and heathland habitat are present within the west of the catchment area and predominantly comprises upland heath, bog and blanket bog, often forming a mosaic of habitats with acid grassland (refer to Figure 4-1).

Semi-natural grassland habitats within the catchment are small and fragmented. Within the west of the catchment, semi-natural grassland is acid and forms a mosaic of habitats with peatland and heathland. Within the centre of the catchment, there are small parcels of neutral grassland and meadows. There is very little calcareous grassland mapped within the catchment (refer to Figure 4-2).

Watercourses within the Wansbeck catchment range from springs and ditches, to small streams, burns and main rivers. The two largest waterbodies within the catchment are Sweethope Lough, which is at the source of the River Wansbeck, and the Fontburn Reservoir which drains into the River Font (refer to Figure 4-3).

Within the Wansbeck catchment most of the best quality woodlands are located along the steep river valleys (refer to Figure 4-4). It is likely that woodland has been retained in these locations as the land is too steep for agricultural improvement. There are areas of parkland associated with some of the estates within the catchment such as Wallington, Kirkharle and Meldon Park.

Northumberland's coast is internationally recognised for the diversity of its marine and coastal habitats. The coast and estuaries contain important intertidal habitats. Where the River Wansbeck meets the sea the habitats present include intertidal mudflats, coastal sand dunes, coastal saltmarsh and maritime cliffs and slopes, flanked by urban development (refer to Figure 4-5).

Threats and pressures within the catchment are summarised in Section 5 of this report and include land management, recreational pressures, climate change, agriculture, invasive non-native species, habitat fragmentation and pollution.

Habitat network models were created for peatland and heathland, semi-natural grassland and woodland (refer to Figures 8-1 to 8-3). Nature network models were not created for watercourse and wetland data as the model was not designed to work with linear features such as rivers. Instead, the method used in the river restoration plan provides a more detailed and targeted analysis which has identified a range of opportunities in the sub-catchments. A coastal habitat network model was not created due to the constrained nature of habitats at the mouth of the Wansbeck (opportunities are limited due to the presence of the amenity barrage and existing development).

Opportunities for restoration and enhancement of terrestrial habitats identified through the modelling are summarised in Table 10-1 of this report and summarised for each WFD catchment. Figures 10-1 to 10-3 show the habitat network models and the WFD areas combined. The opportunities for restoration and enhancement include:

- extension of broadleaved semi-natural woodland along watercourses and broadening out from them by planting and natural regeneration
- restoration of grassland by reduced intensity of management, mainly in the middle and upper catchment
- restoration of peatland in the upper catchment by extending drain-blocking and modifying management.

There was little scope for restoration and enhancement in the coastal zone, except the amenity barrage. The barrage is the subject of separate studies which were not available during this project.

The habitat network maps will require careful interpretation and opportunities for habitat creation may overlap (i.e. the same area could be identified as an opportunity for peatland and heathland or semi-natural grassland). More detailed consultation with stakeholders is recommended before opportunities are pursued, and sites visit to verify conditions should be completed. The habitat network maps could help to prioritise action in the catchment, but the areas of opportunities are probably not the only ones where there could be beneficial action for biodiversity. It should not be assumed that the aim is to create the modelled habitat of the type shown on the entire area shown. Some of the opportunity maps overlap and local surveys would need to be carried out to identify the preferred options and the constraints.

1. Introduction

Study Aims

1.1 AECOM was instructed by the Environment Agency in January 2022 to prepare a Nature Recovery Plan for the River Wansbeck Catchment. The purpose of the Nature Recovery Plan is to inform future project work and investment in the Wansbeck Catchment and to integrate freshwater habitat and terrestrial habitat restoration and creation projects.

1.2 The project has been split into two distinct components:

1) a Wansbeck River Restoration Plan; and
2) a Wansbeck Habitat Restoration and Creation Plan.

1.3 This report is the Habitat Restoration and Creation Plan and aims to identify areas which could become of particular importance for nature recovery and nature-based solutions within the Wansbeck Catchment.

1.4 The preparation of this Habitat Restoration and Creation plan covered the tasks:

- A review of existing reports to inform baseline conditions;
- Compilation of Geographic Information System (GIS) information relevant to the catchment;
- Habitat network modelling using Natural England's Habitat Network modelling tool;
- Consultation with stakeholder groups; and
- Identification of remaining data gaps.

1.5 With reference to existing reports, GIS data analysis, consultation and habitat network modelling, the plan provides an assessment of options for habitat restoration and creation within the Wansbeck Catchment.

1.6 This report should be read with reference to the Wansbeck River Restoration Plan prepared by AECOM (2022). Figures are included within the report and Appendices at the end of the report.

Catchment Overview

1.7 The River Wansbeck (Figure 1-1) drains a 330 km^2 catchment in Northumberland, north-east England, discharging to the North Sea at Ashington. The catchment comprises around 750 km of mapped watercourses that fall within 11 Water Framework Directive (WFD) waterbodies (subcatchments). Tributaries include the Bothal Burn, Delf Burn, Ray Burn, Hart Burn and River Font. The character of the catchment has been defined both by natural and anthropogenic influences; the retreat of glaciers around 17,000 years ago gave rise to a distinctive landscape, with a thick veneer of till material covering most of the catchment, within which the surface water network has eroded deeply incised valleys. Extensive de-forestation and, more recently, intensive arable and pastoral farming, upland land management (such as coniferous plantations), coal mining, and water resource management have, in combination, significantly impacted the watercourse within the Wansbeck catchment.

1.8 Habitats of Principal Importance within the catchment include blanket bog, upland and lowland heathland, moorland, rivers and streams, ponds, hedgerows, lowland mixed deciduous woodland, coastal and grassland habitats.

1.9 Upland habitats surrounding the Wansbeck support breeding waders and raptors. The riparian habitats along the Wansbeck and its tributaries support a wide range of bird species including kingfisher *Alcedo atthis*, grey wagtail *Motacilla cinerea* and dipper *Cinclus cinclus*. The river supports white clawed crayfish *Austropotamobius pallipes*, a European protected species, populations of which are in decline within the UK. Other notable species within the catchment include red squirrel *Sciurus vulgaris*, otter *Lutra lutra*, bats, fish (including European eel *Anguilla Anguilla*, bullhead *Cottus gobio*, river lamprey *Lampetra fluviatilis*, Atlantic salmon *Salmo salar* and brown trout *Salmo trutta*) and invertebrates (including mayflies *Ephemera* sp., stoneflies *Diura* sp., caddisfly *Trichoptera*).

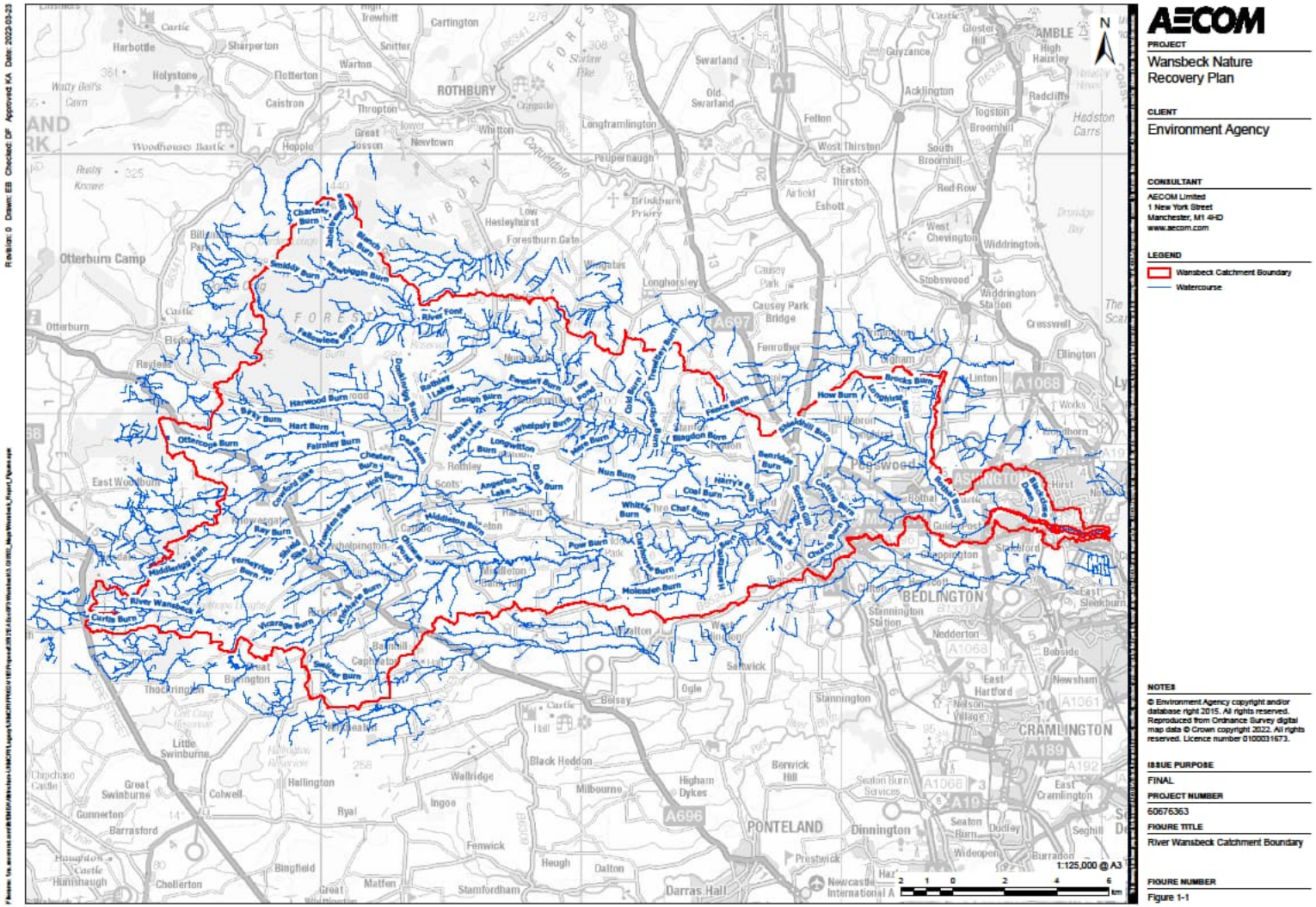

Figure 1-1 The River Wansbeck Catchment

1.10 Threats to biodiversity include the potential introduction of non-native invasive species (such as the signal crayfish *Pacifastacus leniusculus*), excessive agricultural run-off and intensive grazing regimes. Excessive agricultural run-off leads to the pollution of rivers and streams, which impacts the river ecosystems. Intensive grazing leads to denuded vegetation while the use of fertilizers and herbicides on permanent grasslands threatens sward diversity and impacts the wider ecosystem as a result.

Land Use

1.11 Catchment land use is dominated by agriculture, with arable farming and agriculturally improved grassland accounting for over 60% of land use types (18.7% and 42.6% respectively). Deciduous woodland occupies around 11% of the catchment area but is generally confined to deep and steep-sided river valleys where potential for farming is low. This, however, is closely followed by managed coniferous woodland which dominates the north-west corner of the catchment and accounts for over 10% of the catchment area. Urban and sub-urban areas cover a relatively small proportion of the catchment (about 4% combined) but this is concentrated in the lowermost areas of the catchment in the urban centres of Morpeth and Ashington, although there are numerous villages and hamlets within the catchment.

1.12 Land use types which are natural or managed at low intensity are predominately acid grassland (5.5%), heather grassland (4.5%) and heather (1.6%), with very small proportions of bog, neutral grassland and saltmarsh each occupying significantly less than 1% of catchment land use. These broadly occur in the uppermost south-west reaches of the catchment (other than saltmarsh at the coastal areas), but are still interspersed with artificial land use types (plantations, improved grassland etc.)

1.13 In summary, over 75% of the catchment area has been significantly altered by human activity – principally agricultural practices, but also water resource management and urbanisation. Areas that have remained natural or semi-natural are not conducive for farming – particularly the steeply incised river valleys in the central region of the catchment – and, therefore, have avoided degradation, though these areas are somewhat fragmented. A summary of land use proportions is provided in Figure 1-2 and the distribution of land use across the catchment is shown in Figure 1-3.

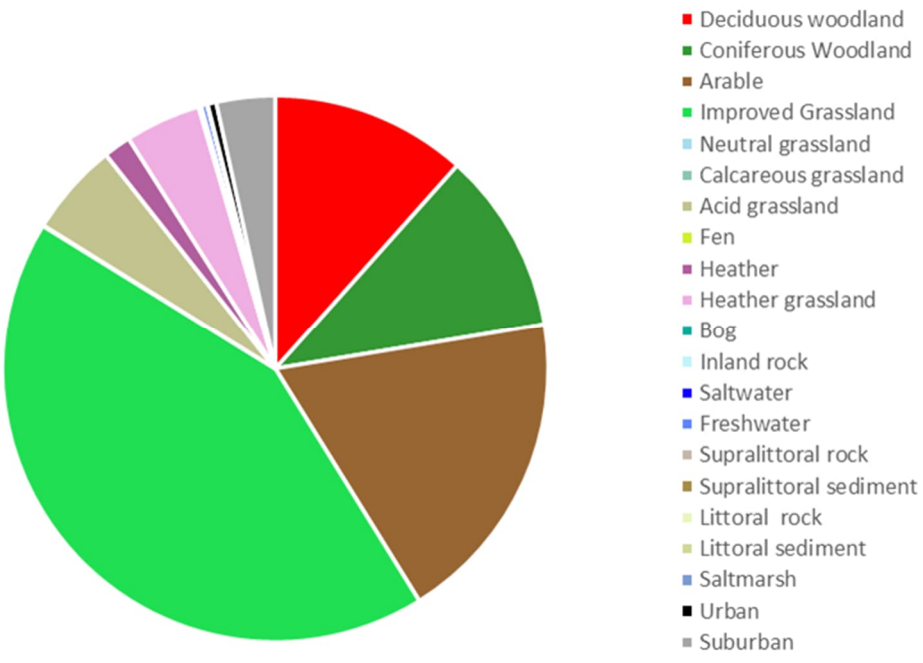

Figure 1-2 Proportions of land use types in the Wansbeck catchment

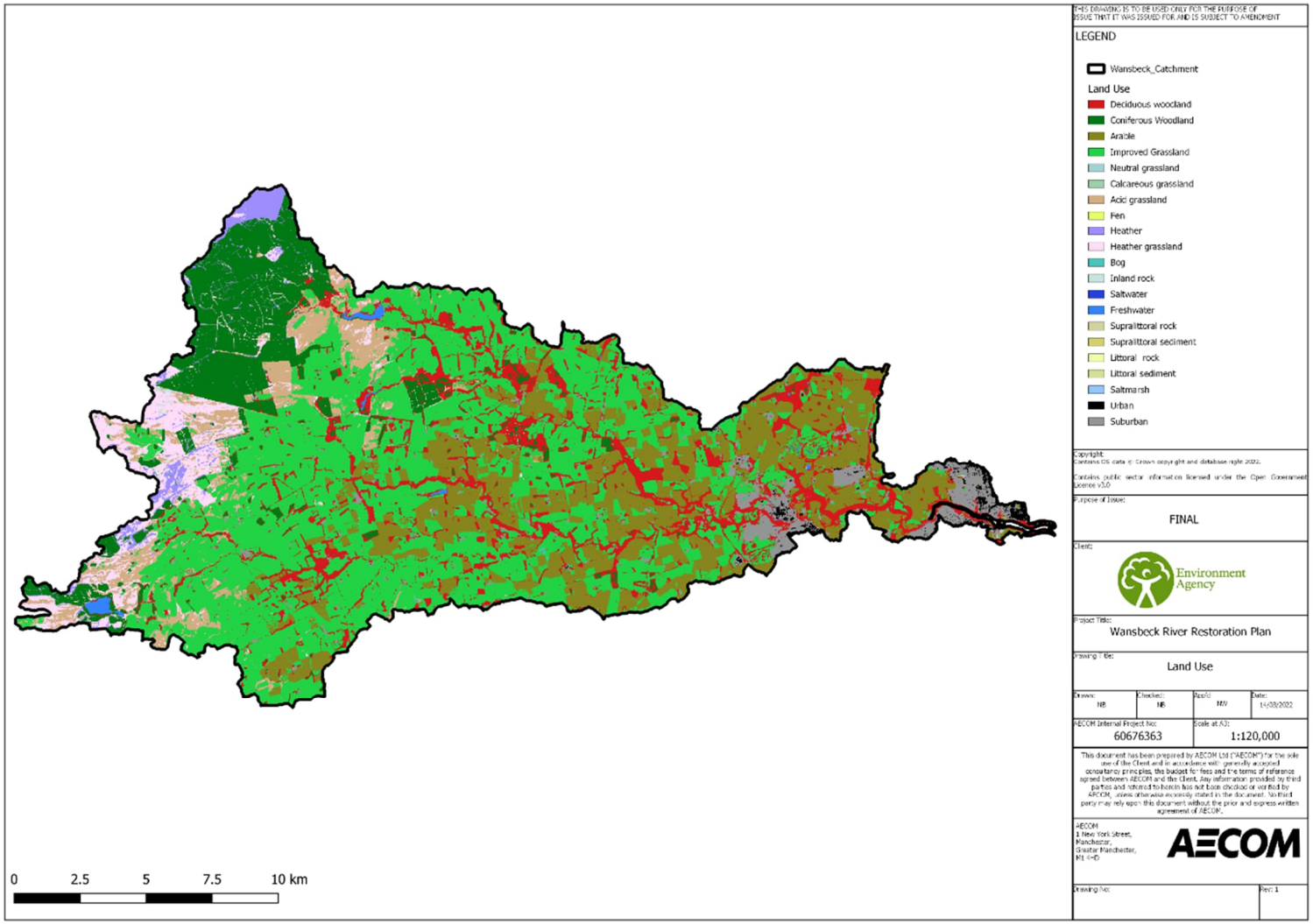

Figure 1-3 Land use within the catchment

Water Framework Directive Status and Objectives

1.14 The Wansbeck catchment comprises 11 Water Framework Directive (WFD) waterbodies, of which just two are presently meeting their objectives, but remain sensitive to adverse impacts derived from agriculture, the water industry and climate change. A summary of current WFD status is provided in Table 1-1 and a map of waterbodies is shown in Figure 1-4.

Table 1-1 WFD status of WFD waterbodies in the Wansbeck catchment

Water Body	Ecological Status 2019	Status Objective
Font from Source to Wansbeck	Moderate	Good by 2027
Wansbeck from Source to Ray Burn	Good	Good by 2015
Ray Burn Catchment (trib of Wansbeck)	Poor	Good by 2027
Wansbeck from Hart Burn to Font	Good	Good by 2015
Wansbeck from Ray Burn to Hart Burn	Poor	Good by 2027
Hart Burn from Delf Burn to Wansbeck	Moderate	Good by 2027
Hart Burn from Source to Delf Burn	Poor	Good by 2021
Bothal Burn Catchment (trib of Wansbeck)	Poor	Moderate by 2027
Delf Burn Catchment (trib of Hart Burn)	Poor	Good by 2027
Wansbeck from Font to Bothal Burn	Moderate	Good by 2027
Wansbeck from Bothal Burn to North Sea	Moderate	Good by 2027

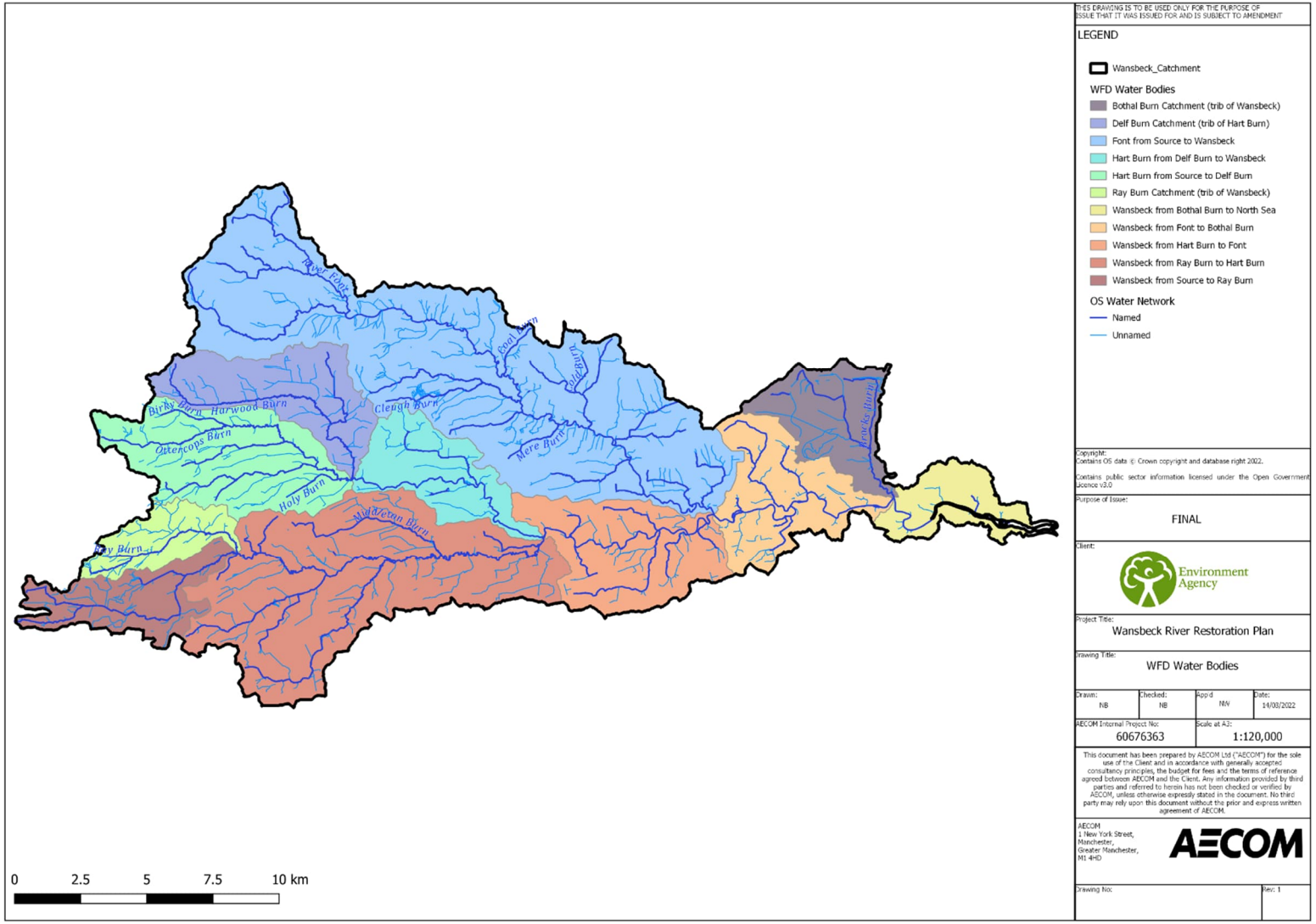

Figure 1-4 WFD Waterbodies in the Wansbeck Catchment

2. Method

Desk Study

2.1 To establish baseline conditions and identify priorities for river restoration and creation to promote nature recovery within the Wansbeck catchment, a review of online information and existing reports was completed. The aim of the desk study was to assess habitat condition within the catchment and highlight areas where there is limited data or further study may be required.

2.2 The following reports relevant to the catchment were reviewed:

- The Northumberland Local Nature Recovery Strategy (LNRS) Pilot (2021);
- Mansley and Hudspeth (2021) The Northumberland Local Nature Recovery Strategy Pilot Story Map;
- Northumberland Wildlife Trust (2020) Northumberland Local Nature Recovery Strategy Pilot Biodiversity Statement;
- Skinner and Coulthard (2021) Evaluating Flushing of Accumulated Sediment in the Wansbeck Estuary using Numerical Modelling;
- EcoNorth (2020) Preliminary Ecological Appraisal: Wansbeck Barrage;
- Groundwork (2021) Wilds of Wanney WEIF Programme 2020-2021. Delf Burn Sub-catchment;
- Garside and Kennedy (2010) Ecological Impacts of the Wansbeck Semi-tidal Amenity Weir;
- Royal Haskoning (2009) Wansbeck Amenity Weir Study;
- National Trust (2019) A vision for Wallington: Restoring a healthier, more beautiful, natural environment;
- AECOM (2012) Morpeth Northern Bypass – Crayfish Survey 2012;
- (Northumberland County Council (2011) Northumberland Green Infrastructure Strategy;
- Horrill *et al*. (2020) North East Invasive Non-native Species Strategy and Action Plan; and,
- Northumberland Rivers Catchment Partnership (2019) Northumberland Crayfish Conservation Strategy.

Data Gathering for GIS

2.3 GIS information relevant to the habitat restoration and creation within the catchment was collated on habitats and other information to inform the ecological network modelling and river restoration analysis, including:

- Statutory designated sites:
  - Special Protection Areas (SPA);
  - Special Areas of Conservation (SAC);
  - Sites of Special Scientific Interest (SSSI); and
  - Local Nature Reserves (LNR).
- Habitats:
  - Priority Habitat Inventory Habitats;
  - Phase 1 habitat data; and

    - Local datasets with information on habitat types or quality.
- Land Management:
    - Countryside Stewardship Woodland Boundaries;
    - Countryside Stewardship Scheme 2016 Management Options;
    - Crop Map of England; and
    - UK Centre for Ecology and Hydrology (CEH) Land Cover Map 2019.
- Topography:
    - Slope elevation;
    - Valley depth; and
    - Elevation.
- Access:
    - Countryside Rights of Way (CRoW) Access Land; and
    - Public Rights of Way.
- Species:
    - 1 Km Grid Wader Zonal Map; and
    - National Trust datasets on species distribution.
- Heritage:
    - Listed buildings;
    - Conservation areas;
    - Scheduled monuments;
    - Registered Parks and Gardens; and
    - Disused Railway Lines.
- Soils:
    - Peaty Soils Locations; and,
    - National Soil Maps – Soilscapes.
- Hydrology:
    - Water Framework Directive Rivers;
    - Water Framework Directive Catchments;
    - Flood risk; and
    - OS Water network.
- Geology:
    - Linear geology;
    - Superficial geology; and
    - Bedrock Geology.
- OS data:
    - Roads and urban areas.

2.4 In addition, the following organisations were contacted to obtain GIS information on habitats relevant to the study area. These included:

    - Northumberland County Council;

- The Environment Agency;
- Natural England;
- The Rural Payments Agency;
- The National Trust;
- The Woodland Trust;
- Northumberland Wildlife Trust; and
- Northumberland Water.

2.5 Northumberland County Council provided a wide range of GIS information, including GIS layers which had been used to prepare the Northumberland Local Nature Recovery Strategy (NLNRS) Pilot. The National Trust provided habitat data and heritage information relevant to the catchment. The Woodland Trust provided Ancient Tree Inventory data. Northumberland Wildlife Trust provided relevant phase 1 habitat data where available.

2.6 The full list of the GIS information obtained, and associated metadata is included in Appendix A.

2.7 A list of designated sites within the catchment is provided in Appendix B.

2.8 The information was used to build a web GIS system allowing more detailed analysis of opportunities within the catchment.

Habitat Network Modelling

2.9 The Natural England Habitats Network modelling tool (Natural England, 2020) was used to create ecological networks based upon the themes identified within the NLNRS Pilot (2021). Additional information on the Habitat Network Modelling process is provided in section 8 below.

Consultation

2.10 Two stakeholder engagement events were held on the 2nd and 3rd of March 2022 to introduce the project, outline progress to date and to obtain feedback.

2.11 The format of the stakeholder engagement events was as follows:

- 2nd March 2022 – Online presentation to Catchment Based Approach (CaBa) Group with an opportunity for questions. Stakeholders included representatives from Natural England, the Environment Agency, the National Trust, Groundwork North-east, Northumbria Rivers Trust and Northumberland County Council.
- 3rd March 2022 – Nature Recovery Workshop at Greenside Farm, Hartburn, NE61 4EN. Stakeholders included approximately 30 landowners and farmers.

2.12 Feedback from the stakeholder engagement events was used to inform opportunities identified Further details on this are provided in section 6.

Gap Analysis

2.13 A gap analysis exercise was completed to identify gaps in data or opportunities for further work. Results of this are summarised in section 7 and are also relevant to the Limitations identified in section 9.

Assessment of Opportunities

2.14 Opportunities for habitat restoration and creation within the catchment were identified based upon experience and expertise, the desk study information, GIS information, stakeholder engagement, local knowledge, Habitat Network Modelling, and the Wansbeck River Restoration Plan (AECOM, 2022).

3. Review of Existing Reports

3.1 Local Nature Recovery Strategies (LNRS) were introduced through the Environment Act 2021 as a means of establishing priorities and mapping proposals for specific actions to drive nature's recovery and provide wider environmental benefits (Defra, 2021a).

3.2 The LNRS aim to:

- Agree priorities for nature's recovery;
- Map the most valuable existing areas for nature; and
- Map specific proposals for creating or improving habitat for nature and wider environmental goals.

3.3 In preparation for the implementation of the Environment Act 2021, five local authorities were identified to participate in a piloting project preparing their LNRS; these were Cornwall, Buckinghamshire, Greater Manchester, Cumbria and Northumberland. The project aimed to explore the process of producing a LNRS rather than produce a finished strategy.

3.4 The Northumberland LNRS Pilot was reviewed to identify habitat themes, key features and pressures within the Wansbeck catchment. In addition, a number of other reports relevant to the catchment were reviewed to inform restoration and creation opportunities.

3.5 Table 3-1 summarises the reports which were reviewed to inform this study and the key findings.

Table 3-1 Summary of Existing Reports

Reference	Summary
The Northumberland Local Nature Recovery Strategy Pilot (NLNRS Pilot, 2021)	The NLNRS pilot set out priorities for nature recovery in Northumberland, grouped around 5 main themes reflecting the main habitats found within the county. These were: • Peatland and heathland; • Semi-natural grasslands; • Rivers and wetlands; • Woodland, trees and scrub; and • Coastal and marine. The project aimed to explore the process of producing a Local Nature Recovery Strategy rather than produce a finished strategy.
The NLNRS Pilot Story Map (Mansley and Hudspeth, 2021).	A Story Map showing the distribution of different habitat types using a combination of national and local datasets. Habitats were organised according to six categories: • Coastal; • Important Grassland; • Peat and Heathland; • Wetland; • Woodland; and • Geological - sites that are designated for their rock interest.
Northumberland LNRS Pilot Biodiversity Statement (Northumberland Wildlife Trust, 2020).	This Biodiversity Statement describes the habitats within the county, identifies key species, threats to nature recovery and opportunities for habitat restoration and creation.
Skinner and Coulthard (2021) Evaluating Flushing of Accumulated Sediment in the Wansbeck Estuary using Numerical Modelling. University of Hull.	Between 1974 and 1975, a barrage was constructed near the mouth of the estuary close to the A189 road bridge. The impounded estuary reaches 4 km inland to the former tidal limit at Sheepwash. Water quality and sedimentation issues have resulted in degradation of the amenity value of the impoundment. A model was used to determine the feasibility of reinstating the sluice gate to maintain an effective management of sediment and ecological function via flushing of water and sediment from the impoundment.

	Results showed that a flushing strategy could be successful in removing sediment that has accumulated above the barrage.
EcoNorth (2020) Preliminary Ecological Appraisal: Wansbeck Barrage.	Habitats along the riverbank were dominated by tall ruderal vegetation and scattered trees. The estuary was dominated by intertidal mud with little vegetation. A small area of saltmarsh was identified on the northern bank towards the eastern end of the estuary.
Groundwork (2021) Wilds of Wanney WEIF Programme 2020-2021. Delf Burn Sub-catchment.	The project aimed to identify a future program of works in waterbodies within the catchment that are rated currently as River Not Achieving Good (RNAGs). The focus was on two sub-catchments; the Delf Burn and the Wansbeck from Raby Burn to Hart Burn subcatchment which are both currently classified as poor WFD status. The study found that Natural Capital Mapping and modelling of opportunities may be useful at a landscape scale to inform planning of catchment management, however in this study, farm site visits and liaison with land managers gave a greater understanding of what measures are practicable and likely to be compatible with current land use. River walkovers by experts in fish and river habitat provided detailed guidance on the source of impacts on the river system. The over-riding issue was found to be stock access, especially cattle watering points, where the downstream river habitat was seen to be significantly impacted with high levels of algal growth, compared with upstream. While factors such as polluting wastewater discharge and forestry operations also have an impact, stock access was identified as the principal contributor to deteriorating water quality within this part of the catchment.
Garside and Kennedy (2010) Ecological Impacts of the Wansbeck Semi-tidal Amenity Weir. Environment Agency. A&R Investigative Report 27pp.	This study aimed to investigate the effects of the semi-tidal amenity barrage located in the River Wansbeck estuary through data collected via invertebrate and sediment sampling, salinity profiling, and fish surveys. The report showed the barrage had an adverse effect on ecology: • Saline pools remained in the estuary when the tide had ebbed due to the barrage and remain either through reduced velocities of freshwater and natural bathymetry. This has created anoxic conditions in areas of the amenity lake where the freshwater does not mix with the higher density seawater during neap tidal cycles and over time has a negative influence on the benthic ecology; • The species caught during the fish seine netting surveys at site were very similar in species composition and were primarily pollution tolerant, able to tolerate a wide range of habitats, dissolved oxygen concentrations and salinities; • One location (site 5), below the barrage, had a regular tidal cycle and had a different community structure compared to the other sites. It also had the highest species diversity and highest species evenness; • *Capitella capitata* (a polychaete worm) is frequently found in polluted or disturbed areas and were only found at Site 4 directly upstream of the barrage; • Ammonia in the lake in July increases downstream from Site 1 towards the barrage. Ammonia is hazardous due to its toxic and sub-lethal impacts on fish and macro-invertebrates. Concentrations can enter the water course under anaerobic conditions; • The removal of the amenity barrage as a means for habitat creation would enhance the entire area of the estuary (~64ha) and create ~31ha of intertidal area; and • Increased sediment deposition is taking place within the amenity lake and estuary. The accumulation of sediment and organic material within the impoundment is leading to a progressive shallowing of the lake. Resulting in reduced available area for recreation in turn reducing the value of the lake.

Royal Haskoning (2009) Wansbeck Amenity Weir Study.	The Environment Agency, in partnership with the Regional Climate Change Partnership and Natural England, commissioned the Wansbeck Amenity Weir Study to: (i) investigate the feasibility of removing the weir at the mouth of the River Wansbeck estuary; and (ii) scope the implications that this would have on the future resilience of the coast to erosion and sea flooding. With reference to ecology, the report notes that the impounded lake post-weir construction has been found to be dominated by opportunistic species which are able to withstand a high degree of salinity fluctuation. Some species have been displaced to downstream of the weir, whilst fauna and flora characteristic of the upper estuary are found throughout the body of the lake. The impoundment has also reduced the available inter-tidal area by around 80%, impacting upon the feeding opportunity for wading bird species. The report concludes that it is technically feasible to remove the amenity weir. Removal of the amenity weir would fully reinstate tidal functioning to the River Wansbeck estuary, and have numerous associated geomorphological and environmental benefits. There would, however, also be potential adverse effects linked to historic landfill, mine water discharges and release of contaminated sediments. With regards to the second principal objective of the study, it was concluded that removal of the weir would have a positive effect on future resilience of the coastline immediately at the mouth of the River Wansbeck estuary.
National Trust (2019) A vision for Wallington: Restoring a healthier, more beautiful, natural environment.	The report notes that Wallington still has many iconic species and special wildlife habitats, but they are small and isolated. More vulnerable habitats such as species rich grassland and river corridors have massively declined over the last 20 years. The strong hold for biodiversity continues to be the “upland” areas of the estate where wet heath and blanket bog can still be found, and this habitat accounts for nearly 70% of all priority habitats on Wallington. The vision for Wallington is to develop an integrated farm management system that will see people, farming and wildlife all thrive. Farming systems will be less intensive on the environment, but farming will be the main driver for change. Existing key habitats will be maintained, expanded and linked together. The carbon storage capacity of the land will be improved by restoring peatland soils and ensuring water quality is improved. Restoration of habitats and wildlife connectivity will be fundamental as will be allowing natural water processes to develop - a more joined up approach.
AECOM (2012) Morpeth Northern Bypass – Crayfish Survey 2012.	AECOM was commissioned by Northumberland County Council to undertake an assessment of the status of white clawed crayfish *Austropotamobilus pallipes* at the location of the proposed Morpeth Northern Bypass, Morpeth, Northumberland. Cotting burn, Ful Beck and How Burn did not appear to support white clawed crayfish in proximity to the proposed works. However, white clawed crayfish were identified at their confluences with the River Wansbeck in 2007.
Northumberland County Council (2011) Northumberland Green Infrastructure Strategy	The Northumberland Green Infrastructure (GI) Strategy (Northumberland County Council, 2011) aims to identify the strategic importance and value derived from the creation of a network of multi-functional green space. The GI strategy was produced to protect and enhance the County’s GI assets, both now and in the future. It provides the strategic framework to ensure the provision of good quality, well-managed, readily accessible and multifunctional green infrastructure across the Northumberland sub region and beyond. The following key recommendations within the GI strategy are particularly relevant to the Wansbeck Nature Recovery Strategy: • *“Important green spaces within, or close to, settlements need to be protected and conserved, and potentially to include some ‘green’ buffering that will preclude any development that would damage or deter usage of GI directly adjacent to settlements.*

- *The role and function of Registered Parks and Gardens needs to be recognised and where possible the network of these often historic estates need to be extended to those estates not on the register, which have potential to extend the greenspace network.*
- *There is a need to protect and conserve the distinctive character of the County's river valleys.*
- [There are opportunities] *to enhance and improve the river corridors using best practice sustainable land and water management to protect the nature and character whilst also enhancing the recreational potential and biodiversity value.*
- *Enhance existing water environment habitat to benefit wildlife and protect rare and endangered species that occur especially in the more remote uplands and at the river mouth where they enter the coastal zone.*
- *Support land management schemes which seek to provide opportunities to contribute to the management of flood risk and the role of sustainable urban drainage systems.*
- *Encourage existing enterprises to adopt 'green' practices that are specifically designed to promote biodiversity, especially those with a direct relationship to GI (e.g., agriculture, woodland management, leisure, tourism).*

Northumberland Rivers Catchment Partnership (2019) Northumberland Crayfish Conservation Strategy 2019-2023	Northumberland is one of the most significant remaining UK locations for native freshwater crayfish, but populations face threats from disease, competition and habitat changes. This Strategy and associated Delivery Plan seek to provide a basis for positive action to reduce this risk. The document includes the following strategic aims: 1) To improve our knowledge and better understand the current distribution and status of freshwater crayfish in Northumberland. The partnership will collate existing data and commission surveys to fill gaps in current knowledge and to monitor changes in distribution/ status of native and alien species. 2) Identify and encourage actions to protect and enhance populations of white clawed crayfish (WCC). This will improve understanding of threats to remaining populations of WCC, help agree priorities and take appropriate actions. 3) Identify and implement actions to reduce the impact of existing signal crayfish (SC) populations in Northumberland. The partnership will identify and confirm locations where SC populations may be significantly impacting on habitat, biodiversity and/or water quality. Based on evidence, they will implement measures to restrict, reduce or remove SC from relevant locations. 4) Inform and engage the public, stakeholders on crayfish conservation issues. The partnership will proactively highlight the threats to WCC populations and promote key conservation measures such as biosecurity and habitat protection.
Horrill, C. Taylforth, J. and Thompson, M. (2020) North-east Invasive Non-native Species Strategy and Action Plan 2020 - 2024	The aim of the north-east invasive non-native species (INNS) strategy is "*to develop and maintain cost-effective strategic approaches to prevent, detect, control and eradicate specified INNS in North East river catchments through coordinated action of river catchment partnerships*". The regional strategy has four objectives: 1) Increased coordination of strategic and sustainable approaches to key aspects of INNS management in the North East; 2) Reduce the risk of the introduction and spread of freshwater and riparian INNS in the North East through increased awareness and biosecurity. 3) Establish a multi-catchment framework for the detection and surveillance of INNS linked to agreed protocols to ensure appropriate rapid management responses.

4) Strategic and sustainable implementation of longer-term local control and eradication programmes.

4. Assessment of Biodiversity Priorities

Identification of Primary Habitats

4.1 With reference to the priorities outlined within the NLNRS Pilot (2021) and including information from the review of existing data and previous studies, a series of base maps were created to show the most valuable 'primary habitats' within the catchment. Natural England's Habitat Network model (Crick et al, 2020a) uses UK Priority Habitats as a basis for identifying opportunities to enhance, restore and expand existing areas. Relatively few areas of UK Priority Habitats remain in the catchment and there is limited detail available on habitat condition. A wider group of habitats was included in 'primary habitats' within the catchment, including semi-improved grassland.

4.2 Primary habitats were grouped into the following themes:

- Peatland and heathland;
- Semi-natural grassland;
- Watercourses and wetlands;
- Woodland, Trees and Scrub; and
- Coastal and Marine.

4.3 Table 4-1 summarises the data sets used to create the base maps for each theme. Each theme is discussed in further detail below.

Table 4-1. Data sets used to create catchment specific primary habitat maps

Theme	Peatland and Heathland	Semi-natural Grassland	Watercourses and Wetlands	Woodland, Trees and Scrub	Coastal and Marine
Data Sets	• Lowland dry acid heath • Lowland heathland • Upland heathland • Upland fens, flushes and swamps • Lowland raised bog • Lowland fens • Blanket bog • Heath Grassland • Dry Heath • Dry heath and acid grassland mosaic	• Upland calcareous grassland • Lowland calcareous grassland • Lowland meadows • Upland hay meadows • Purple moor grass and rush pasture • Lowland dry acid grassland • Species rich grassland • Restoration towards species rich grassland • Semi-natural grassland • Meadows • Species rich grass verges	• OS Water Network • CEH 2019 Land cover – Freshwater • Priority Habitat Inventory North – Rivers and Wetlands • South-east Northumberland Ponds • Swamp • Reedbeds • Upland fens, flushes and swamps • Lakes	• Broad-leaved woodland • Deciduous woodland • Ancient semi-natural woodland • Woodpasture and parkland	• Coastal sand dunes • Coastal vegetated shingle • Maritime cliff and slope • Saltmarsh

Peatland and Heathland

4.4 The locations of peatland and heathland within the catchment are shown in Figure 4-1 below.

4.5 Peatland and heathland habitat are present within the west of the catchment area and predominantly comprises upland heath, bog and blanket bog, often forming a mosaic of habitats with acid grassland. Figure 4-1 indicates that there are two small patches of lowland heath within the south and north-west of the catchment.

Bog / Blanket Bog

4.6 Bog is a wetland habitat on deep, wet, acidic peat which receives most of its water from rainfall. Bog vegetation is a mixture of grasses grasses, sedges, dwarf shrubs and mosses, and includes good quantities of one or more of the following plant species: hare's-tail cottongrass *Eriophorum vaginatum* and the mosses *Sphagnum papillosom* and *Sphagnum magellanicum* (Averis, 2013). The term blanket bog strictly applies only to that portion of a blanket 'mire' which is exclusively rain-fed. Peat depth is variable, with an average of 0.5 - 3 m being fairly typical, but depths in excess of 5 m not unusual. There is no agreed minimum depth of peat which can support blanket bog vegetation (Peak District National Park, 2011).

4.7 Figure 4-1 maps indicates that bog habitat is present within the catchment at the following locations:

- Greenleighton (south of Fontburn Reservior);
- Boddle Moss (north of Harwood Forest);
- Steng Moss (adjacent to Harwood forest);
- Ottercops Moss (north of the A696);
- Whaup Moss (south of the A696);
- Dawes Moss (south of the A696);
- Great Wanney Crag;
- Hartsridge/ Green Rigg (west of Sweethope Lough); and
- Sweethope Moss (south of Sweethope Lough).

Photograph 4-1: Steng Moss in the north-west of the catchment (AECOM, 2022a)

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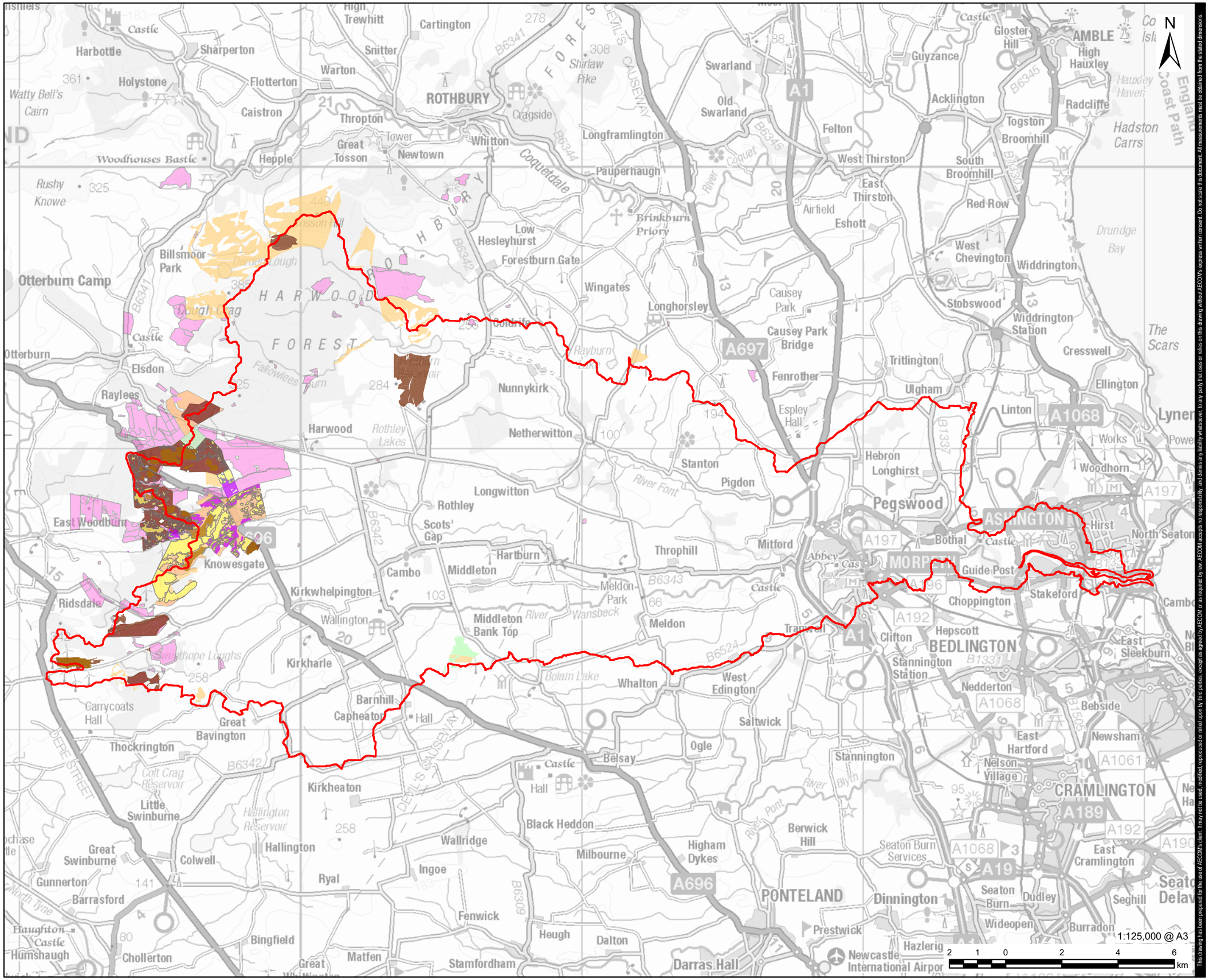

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LEGEND

- Wansbeck Catchment Boundary

Phase 1 Habitat Survey
- Bog
- Dry Heath
- Dry Heath & Acid Grassland Mosaic

Priority Habitat Inventory
- Blanket bog
- Lowland heathland
- Upland heathland

UK CEH 2019 Land Cover Map
- Heather grassland

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FIGURE TITLE

Peatland and Heathland Habitat wiithin the Wansbeck Catchment

FIGURE NUMBER

Figure 4-1

Heathland

4.8 Heathland is vegetation in which dwarf shrubs such as ling heather *Calluna vulgaris*, bell heather *Erica cinerea* and bilberry *Vaccinium myrtillus* are abundant or dominant. Wet heath occurs on moist or wet peat and is represented by species such as cross-leaved heath *Erica tetralix*, purple moor-grass *Molinia caerulea*, deergrass *Trichophorum germanicum* or bog-myrtle *Myrica gale*. Dry heath differs in that these four species are rare or absent and the vegetation is mostly dominated by heather or bilberry (Averis, 2013).

4.9 Heathland (mapped as upland heath, lowland heath, dry heath and dry heath / acid grassland mosaic) is mainly present in the west of the catchment near Steng moss, Ottercops / Wolf Crag, Ray fell, Sweethope Lough, Sweethope Crags and Shaftoe Crags.

4.10 Lowland heath is generally found below 300 m in altitude and is a priority habitat within the Northumberland Biodiversity Action Plan (BAP) (Northumberland Biodiversity Partnership, 2008). The Northumberland BAP states that there is approximately 25 hectares of lowland heathland in Northumberland, which represents less than 0.05% of the UK total. The peatland and heathland habitat map indicates that lowland heath is present at Shaftoe Crags and to the north of Ottercops Moss.

Photograph 4-2: Heathland habitat at Shaftoe Crags (AECOM, 2022b)

Semi-natural Grasslands

4.11 The locations of semi-natural grassland within the catchment are shown in Figure 4-2.

4.12 The main divisions within grasslands are based on the acidity of the soils. Acid grasslands are characterised by swards of bent grasses *Agrostis* sp., sheep fescue *Festuca* ovina., sweet vernal grass *Anthoxanthum odoratum*, wavy hair grass *Deschampsia flexuosa*, mat grass *Nardus stricta* and heath rush *Juncus squarrosus*, often with herbs such as heath bedstraw *Galium saxatile*, tormentil *Potentilla erecta* and sheep's sorrel *Rumex acetosella* also present. They can be very mossy. Mat grass and heath rush can become dominant in the upland areas, especially where grazing reduces more palatable grasses. Soft rush *Juncus effusus* is common in some acid grasslands where soils have impeded drainage grading into rush pasture. Purple moor-grass *Molinia caerula* can also occur and is particularly common in mire vegetation on peat soils where it is associated with upland heath and bog. Acid grasslands are common and extensive on acid soils in grazed uplands, forming mosaics with heathland, but also occur more patchily in the lowlands on thin sandy soil or rock outcrops. Most of the acid grasslands occur in the upland parts of the catchment and the type and distribution is influenced by soil type, drainage and especially by grazing management.

4.13 Neutral grasslands have varied swards of grasses such as false oat-grass *Arrhenatherum elatius*, cocksfoot *Dactylus glomerata*, crested dog's tail *Cynosurus cristatus* and tufted hair grass *Deschampsia cespitosa* with a range of vegetation types depending on soil nutrient status and drainage.

4.14 There are very few traditional hay meadows remaining in the catchment. Where present, these are characterised by crested dog's-tail, fescues, sweet vernal grass and a wide range of herb species. Traditional management is with low use of manures, with grass grown for hay and mowed in summer, usually followed by grazing with sheep or cattle. Unimproved grasslands which have not been enriched by fertiliser have the greatest diversity of species.

4.15 Most of the semi-natural grasslands in the catchment are permanent pastures. Grasslands which are long established but remain untreated by fertiliser may support communities of fungi such as waxcaps. Such 'waxcap grasslands' are increasingly rare in the UK and Northumberland is considered to retain some of the most important locations in western Europe. The desk study identified little information about the distribution of these grasslands within the Wansbeck catchment.

4.16 Neutral grassland also occurs along road verges, disused railway lines and some watercourses, typically with little management. Tall coarse grasses such as false oat-grass tend to predominate, with tall herbs such as hogweed *Heracleum sphondylium* also present. Whilst these don't usually have the diversity of herbs found in species-rich hay meadows, the tussocky structure and flowering herbs can provide important areas for feeding and shelter by terrestrial invertebrates and small mammals. This is of particular value in areas where most grassland is intensively grazed by sheep or horses creating a uniform short sward.

4.17 Heavily grazed grasslands have a short sward height, however small, unpalatable herbs can be abundant. Lightly grazed grasslands are usually characterised by taller vegetation; plants flower well but shorter species can be outcompeted by taller plants or smothered by mats of dead grass leaves which build up over time.

4.18 Pastures with impeded drainage or seasonal flooding are often dominated by Yorkshire fog *Holcus lanatus*, typically with soft rush and tufted hair-grass, although some wet grassland may be more diverse, with species such as devil's-bit scabious *Succisa pratensis* and sneezewort *Achillea ptarmica*. Wet grasslands and grazing marshes can be found on floodplains; these sometimes contain a low diversity of plant species but can be important breeding sites for wading birds such as curlew *Numenius arquata* and lapwing *Vanellus vanellus*. There is some floodplain grazing marsh present within the catchment, adjacent to the River Wansbeck near Mill Greens.

4.19 Calcareous grasslands have a limited distribution in Northumberland, but important examples can be found associated with limestone outcrops. There is some lowland calcareous grassland near the River Wansbeck at Kirkwhelpington.

4.20 Agriculturally improved grasslands have generally been treated with fertilisers and herbicides, with many re-seeded periodically. These productive grasslands are often bright green with a species-poor sward

dominated by rye grass *Lolium* sp., although sometimes with white clover *Trifolium repens*, rough meadow grass *Poa trivialis* and timothy *Phleum pratense*. Some are cut two or three times a year for silage. The thick growth of grass and the early timing of mowing tends to make these areas unsuitable for breeding waders. Improved grassland is the predominant land use in catchment. The majority of the grassland within the catchment is likely to be agriculturally improved.

4.21 Unimproved grasslands have not been enriched by fertiliser and tend to have an increased diversity of species. There are unimproved acid grasslands in the west of the catchment.

4.22 Semi-natural grassland habitats within the catchment are small and fragmented. Within the west of the catchment, semi-natural grassland is acid and forms a mosaic of habitats with peatland and heathland. Within the centre of the catchment, there are small parcels of neutral grassland and meadows. There is very little calcareous grassland mapped within the catchment. This is due to the limited extent of limestone geology in the west of the catchment, much of it overlain by peat or glacial till and because the calcareous soils can be readily agriculturally improved.

Photograph 4-3 Semi-natural grassland near Kirkwhelpington. This parcel has been grazed by sheep (AECOM, 2022c)

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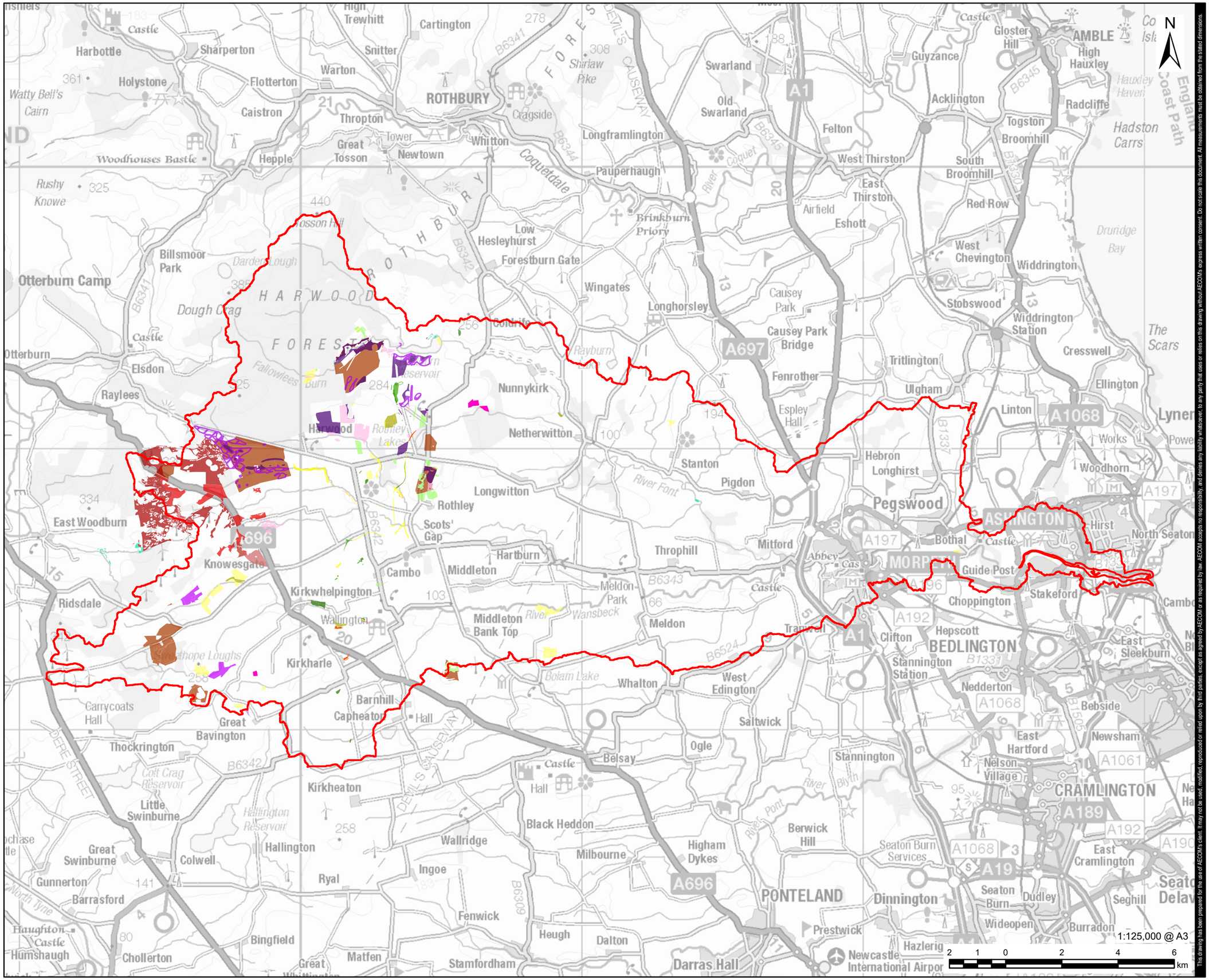

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LEGEND

- Wansbeck Catchment Boundary
- HK6 - Maintenance of Species-Rich Grassland
- GS7 - Restoration towards Species-Rich Grassland

National Trust - Wallington Habitat Survey

- Acid grassland
- Lolium-Cynosurus neutral grassland
- Lowland calcareous grassland
- Lowland dry acid grassland
- Lowland meadows
- Neutral grassland
- Upland acid grassland

Phase 1 Habitat Survey

- Marshy grassland
- Semi-improved acid grassland
- Semi-improved calcareous grassland
- Semi-improved neutral grassland
- Unimproved acid grassland
- Unimproved calcareous grassland

Priority Habitat Inventory

- Good quality semi-improved grassland
- Grass moorland
- Lowland calcareous grassland
- Lowland dry acid grassland
- Lowland meadows
- Purple moor grass and rush pastures
- Upland calcareous grassland

NOTES

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FIGURE TITLE

Semi-natural Grassland Habitat within the Wansbeck Catchment

FIGURE NUMBER

Figure 4-2

Watercourses and Wetlands

4.23 Watercourses within the Wansbeck catchment range from springs and ditches, to small streams, burns and main rivers. Figure 4-3 shows the locations of mapped watercourses and wetland habitats within the catchment.

4.24 Rivers contain a mosaic of features such as riffles, pools, exposed shingle, and marginal or bankside vegetation which are used by a range of plants and animals. Notable species associated with rivers in Northumberland include otter *Lutra lutra*, water vole *Arvicola amphibius*, white-clawed crayfish, river jelly lichen *Collema dichotomum*, salmon *Salmo salar* and lamprey *Lampetra* spp. (NLNRS Pilot, 2021).

4.25 The two largest waterbodies within the catchment are Sweethope Lough, which is at the source of the River Wansbeck, and the Fontburn Reservoir which drains into the River Font. There are small flushes, fens, swamps and ponds mapped within the catchment, however it is likely that many small wetland areas are not either not mapped or are not visible on the maps at a catchment scale. The south-east Northumberland ponds GIS layer provided by Northumberland County Council identifies a small number of ponds within the east of the catchment – including ponds to the east of Bothal and to the east of Morpeth. A review of OS maps indicates that there are more ponds within the catchment that have not been recorded.

Photograph 4-4: Sweethope Lough (AECOM, 2022d)

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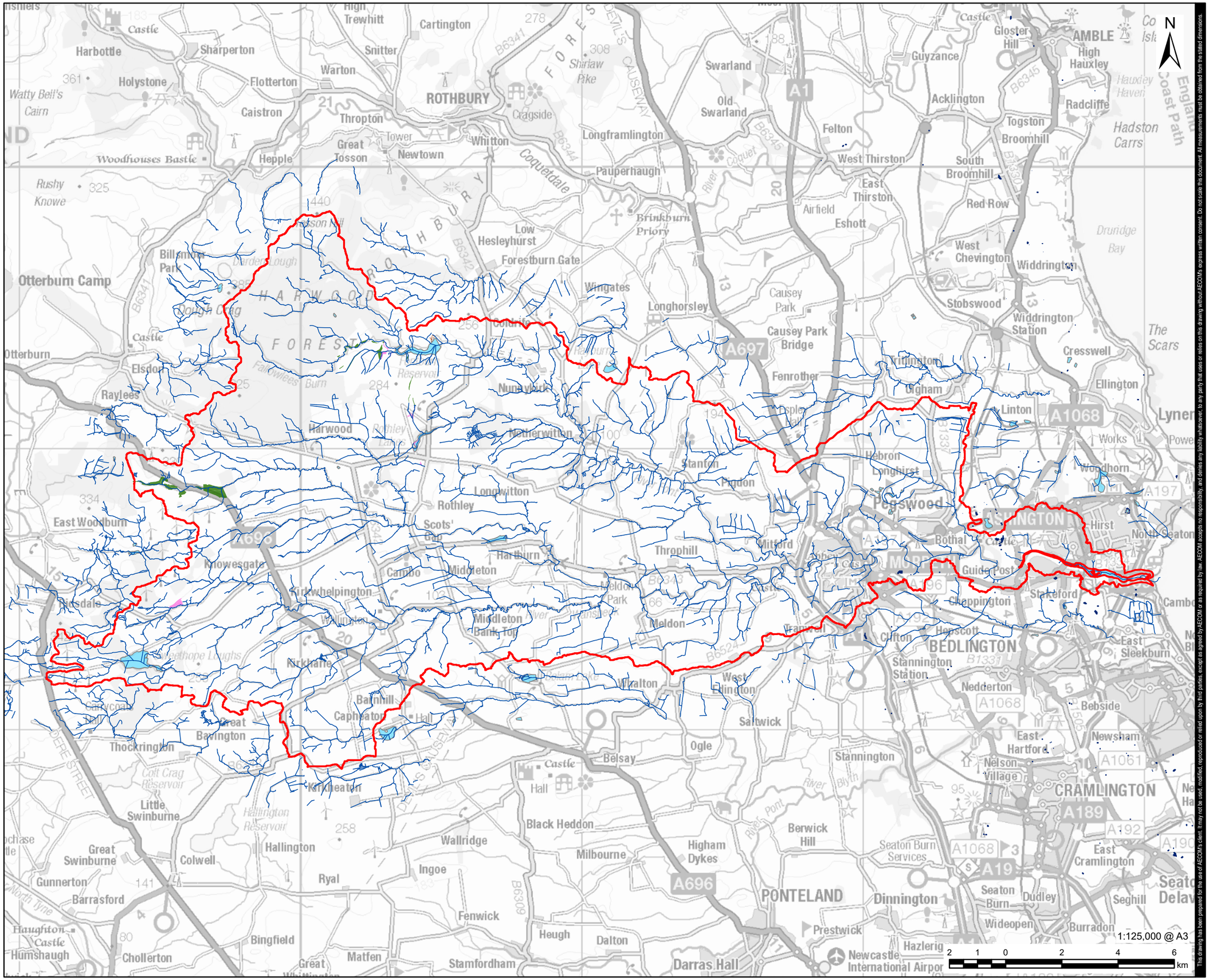

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LEGEND

- Wansbeck Catchment Boundary
- Watercourse
- Southeast Northumberland Ponds

Priority Habitat Inventory

- Lowland fens
- Upland flushes, fens and swamps

Phase 1 Habitat Survey

- Swamp

UK CEH 2019 Land Cover Map

- Freshwater

NOTES

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PROJECT NUMBER

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FIGURE TITLE

Rivers and Wetland Habitat within the Wansbeck Catchment

FIGURE NUMBER

Figure 4-3

Woodland, Trees and Scrub

4.26 Native semi-natural woodland is found throughout Northumberland and represents a significant asset for wildlife. Ancient woodlands are of greatest conservation significance, are defined as those areas which have had continuous woodland cover for at least 400 years and are considered to be an irreplaceable natural resource. Ancient woodlands where the original tree cover has been felled and replanted these areas are described as a Plantation on an Ancient Woodland Site (PAWS). Whilst the replanted woodlands may have less botanical diversity and are usually lacking in old trees and dead wood, the continuity of woodland soils and cover potentially allow some of the species typically associated with ancient woodland to survive.

4.27 Most of the remaining semi-natural woodland is predominantly composed of oak (*Quercus* spp.) with other broadleaved species present depending on soil type. Along valley bottoms and spring lines alder *Alnus glutinosa* is predominant, with willows *Salix* spp. in some areas.

4.28 Individual trees are an important part of the landscape and townscapes and provide a valuable habitat for wildlife. Mature and veteran trees may be found in parkland and hedgerows; they contain holes and crevices that can be important for birds, insects, fungi and bats.

4.29 Figure 4-4 shows the locations of woodland, trees and scrub within the catchment.

4.30 Mixed and plantation woodland is not included on Figure 4-4, although it is recognised that these woodland types can be of value to nature and provide both environmental and social benefits such as a landscape asset and to people for recreational use.

4.31 Hedgerows provide food and shelter for many species. They often form linkages between woodlands and other habitats, acting as corridors for wildlife. Some hedgerows and lines of trees within the catchment are associated with historical boundary features such as stone and earth casts and walls.

4.32 Within the Wansbeck catchment most of the best quality woodlands are located along the steep river valleys. It is likely that woodland has been retained in these locations as the land can be too steep to farm. There are areas of parkland associated with some of the estates within the catchment such as Wallington, Kirkharle and Meldon Park. Woodpasture and parkland are mosaic habitats valued for their trees, especially ancient and veteran specimens.

Photograph 4-5: Broadleaved woodland adjacent to the River Wansbeck at Wallington (AECOM, 2022e)

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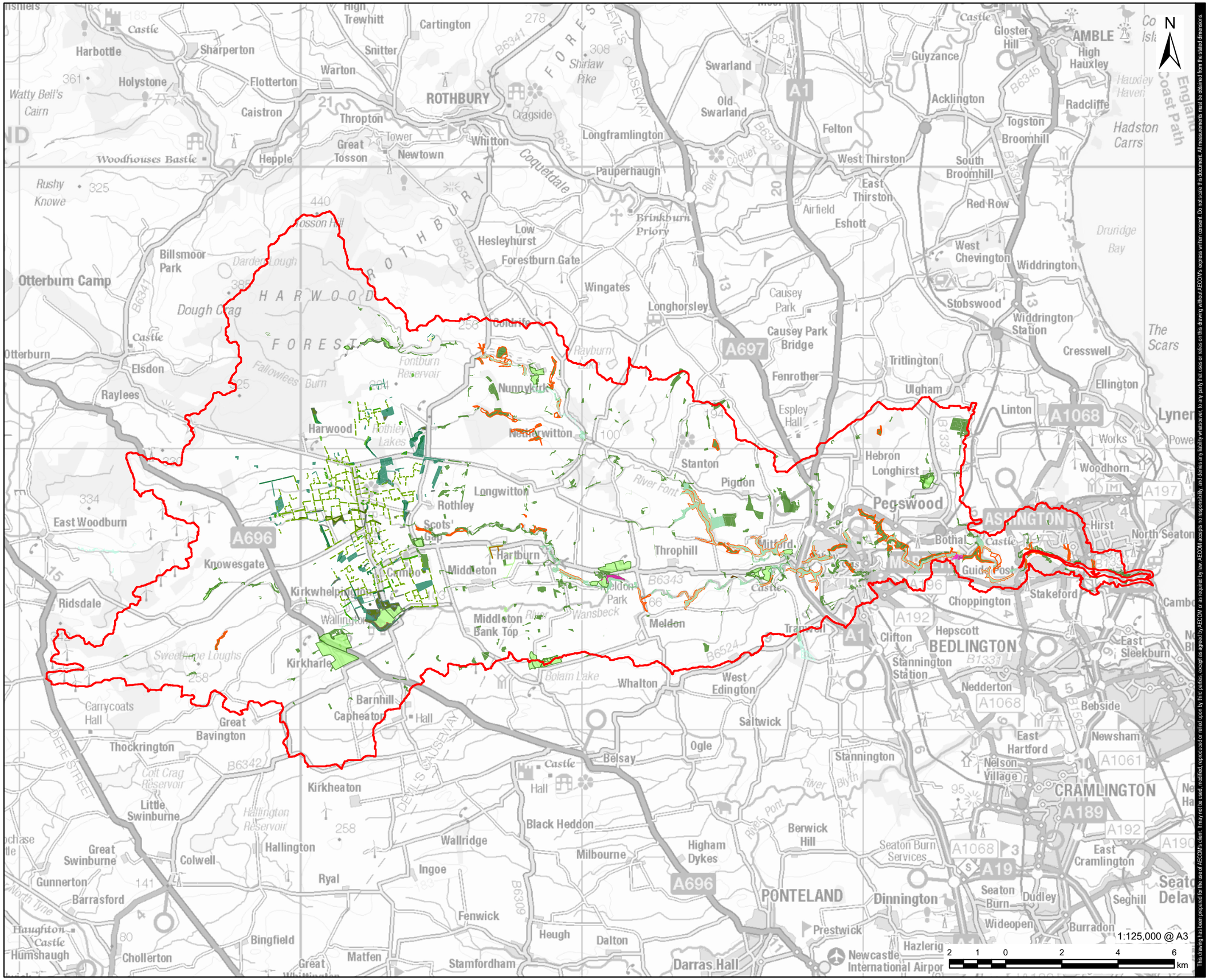

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LEGEND

- Wansbeck Catchment Boundary
- New Hedges on Middleton N Farm (line)
- New Hedges on National Trust Land
- New Woods on Middleton N Farm (area)
- New Woods on National Trust Land
- Ancient Semi-Natural Woodland
- Wood Pasture and Parkland

Priority Habitat Inventory

- Deciduous woodland

National Trust - Debois Survey

- Hedges (line)
- Hedges (area)
- Woods

National Trust - Wallington Habitat Survey

- Broadleaved mixed and yew woodland
- Dense scrub

Phase 1 Habitat Survey

- Broadleaved plantation
- Dense scrub
- Felled broadleaved woodland
- Scattered broadleaved trees
- Scattered scrub
- Semi-natural broadleaved woodland

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PROJECT NUMBER

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FIGURE TITLE

Woodland, Trees and Scrub Habitat within the Wansbeck Catchment

FIGURE NUMBER

Figure 4-4

Coastal and Marine

4.33 Northumberland's coast is internationally recognised for the diversity of its marine and coastal habitats. The coast and estuaries contain important intertidal habitats. Where the River Wansbeck meets the sea the habitats present include intertidal mudflats, coastal sand dunes, coastal saltmarsh and maritime cliffs and slopes.

4.34 Figure 4-5 shows the locations of coastal and marine habitats within the catchment. Figure 4-5 indicates that there are small areas of saltmarsh habitat at the mouth of the Wansbeck. There are also areas of coastal grassland and dunes to the south of Sandy Bay Holliday Park and at Cambois.

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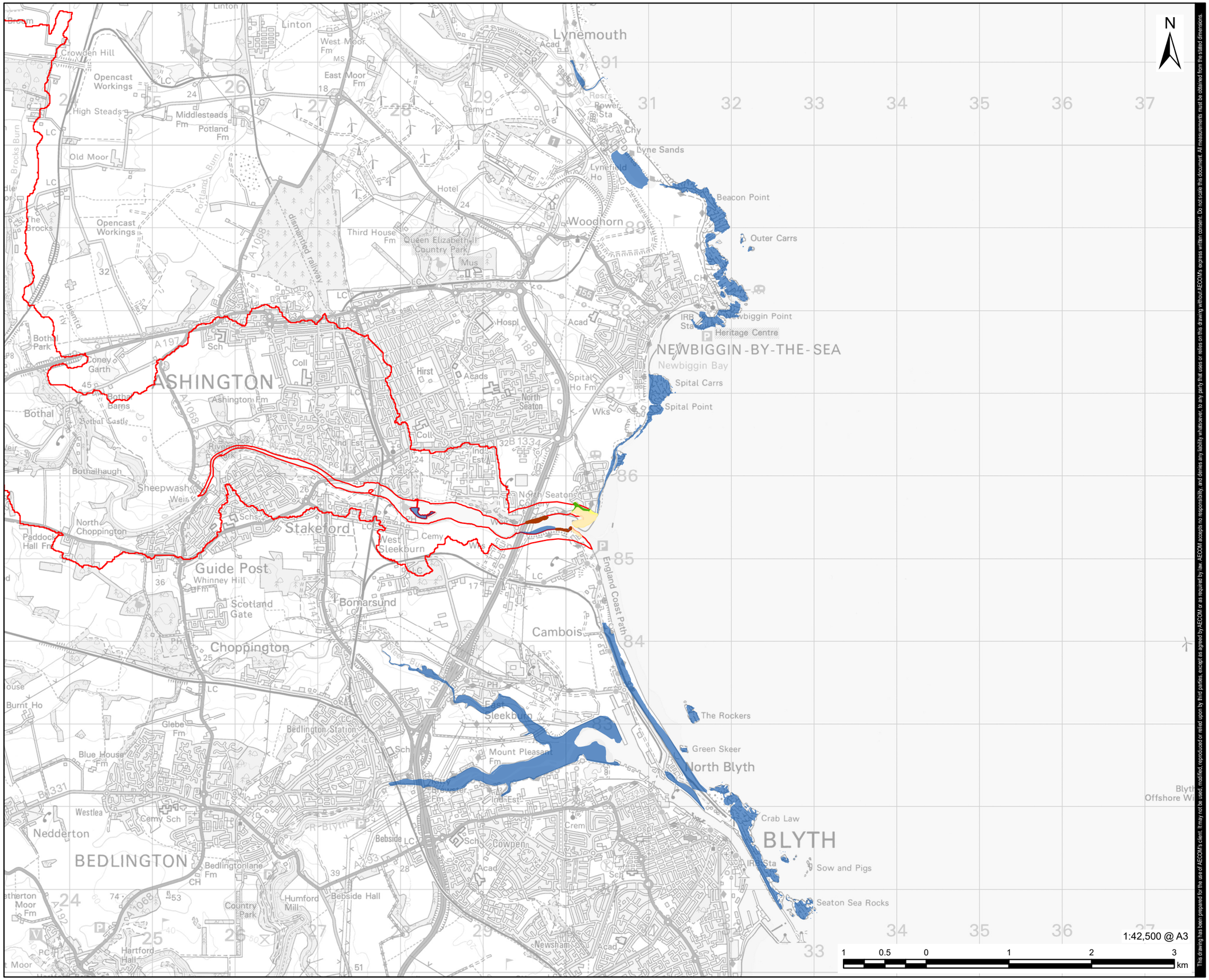

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LEGEND

- Wansbeck Catchment Boundary
- Saltmarsh Extents and Zonation
- Northumberland County Council - Coastal Habitat Mapping

Phase 1 Habitat Survey

- Coastal grassland
- Open dune
- Saltmarsh

Priority Habitat Inventory

- Coastal saltmarsh
- Coastal sand dunes

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FIGURE TITLE

Coastal & Marine Habitats within the Wansbeck Catchment

FIGURE NUMBER

Figure 4-5

5. Threats and Pressures

Peatland and Heathland

5.1 The Northumberland LNRS pilot identified that peatlands were under pressure from both historic and current land management. These included past drainage of peatlands leading to degradation and drying, past tree planting on deep peat, and intensification of agricultural or sporting management. These pressures have led to a loss of diversity of vegetation age, structural and plant composition on which many species rely. Some peatlands have suffered from past peat extraction, while lowland heaths have been lost to historic agricultural intensification with those that remain are often threatened by lack of active management (NLNRS Pilot, 2021).

5.2 On some heaths, heather is burned periodically to create structural diversity for commercial grouse shooting (burning small patches to produce short and tall mosaics favourable to red grouse). After burning, the vegetation regrows, but with a more even, uniform structure within the burned area and a less diverse moss, liverwort and lichen flora (Averis, 2013). Depending on whether there is grazing by sheep as well as burning this can change the vegetation, with increased hare's-tail cotton grass *Eriophorum vaginatum*, mat grass and/or purple moorgrass. Climate change may increase pressures upon peatland and heathland habitats due to changes in rainfall patterns / hydrology and increased risk of wildfire (NLNRS Pilot, 2021).

5.3 Table 5-1 below summarises the key features and pressures upon peatland and heathland habitat, as identified within the NLNRS Pilot (2021). There is limited publicly available information regarding the condition of peatland and heathland within the catchment. It is possible that all of the threats and pressures identified as part of the NLNRS Pilot are relevant to the Wansbeck Catchment. Maps indicate that Harwood Forest in the north of the catchment is on shallow peaty soils. Some of the peatland and heathland areas within the catchment are managed as windfarms. There is some recreational pressure around Shaftoe Crags and the Wannies as these areas are popular with climbers.

Table 5-1. Summary of key features and pressures (Peatland and Heathland)

Key Features	Associated Species Interest	Pressures
Blanket Bog Intermediate Bog Valley Mires Flushes Upland Heathland Lowland Heath Raised Bogs (including Lowland raised Mires)	Large heath butterfly Mountain bumblebee Breeding waders Black grouse Raptors Baltic bog moss Important plant communities	Peatland degradation due to erosion, drying, overgrazing, burning, and/or ongoing past drainage Intensification of upland management for agriculture or shooting Invasive non-native species – e.g. *Rhododendron ponticum*, Gaultheria sp. Raptor persecution Afforestation on peat Restocking on deep peat Recreational pressure Wildfire and arson Development of species monocultures on heathland Lack of structure and age diversity on heathlands Scrub and bracken encroachment and lack of appropriate grazing on some lowland sites Climate change and changes to rainfall patterns

Source: NLNRS Pilot (2021)

Semi-natural Grasslands

5.4 Intensive grazing regimes, drainage and the application of fertiliser and herbicides can reduce the diversity of grassland habitat. Even comparatively small inputs of fertiliser can lead to a reduction in plant species diversity by favouring more competitive grasses. Semi-natural grassland communities within wooded mosaics may need to be managed periodically to reduce encroachment by scrub and trees. Wet grasslands may be replaced by other habitats such as though succession to scrub or woodland or drainage improvement, such as through the installation of under-drainage and by the straightening and deepening of small watercourses.

5.5 Table 5-2 below summarises the key features and pressures upon semi-natural grassland, as identified within the NLNRS Pilot. It is considered that the pressures identified as part of the NLNRS Pilot are relevant to the Wansbeck Catchment, however it is not clear if any semi-natural grassland habitats have been lost due to development / quarrying or mining subsidence. The main pressures upon semi-natural grassland habitats within the catchment are likely to be intensive farming methods (increased nutrient inputs, drainage and stocking levels) which have led to loss, fragmentation and isolation of grassland habitat of good quality for biodiversity within the catchment.

Table 5-2. Summary of key features and pressures (Semi-natural Grassland)

Key Features	Associated Species Interest	Pressures
Species rich hay meadows and pastures – upland and lowland, including good semi-improved grassland. Calcareous grassland Calaminarian grassland Whin grassland Rush pasture and upland allotments Coastal and floodplain grazing marsh Wood pasture Waxcap grassland Early successional grassland on previously developed land.	Rare flora and plant communities Breeding waders Important invertebrate communities Important fungal communities	Inappropriate management through either intensification (such as increased nutrient inputs, ploughing, drainage, increased stocking levels etc. or neglect) Fragmentation, small patch size and isolation Eutrophication due to nitrogen deposition leading to loss of N-sensitive species Important sites lacking protective designation Loss of sites through tree planting Lack of water management on some wet grasslands / grazing marshes Losses to development / quarrying Losses in extent to wetland formation due to mining subsistence. Climate change

Source: NLNRS Pilot (2021)

Watercourses and Wetlands

5.6 Riparian and wetland habitats are sensitive to a range of impacts including from changes to both water regimes and water quality. Diffuse and point source pollution from agriculture or urban sources can increase the nutrient levels watercourses and lead to the development of algal blooms or rank vegetation. Access to riverbanks by grazing animals can increase bankside erosion and add to silt loads in rivers and streams, which can raise nutrient levels and be detrimental to those aquatic species which are sensitive to changes in water quality and habitat loss. Wetlands are also sensitive to water quality issues derived from point-source and diffuse pollution, such as drainage from silage clamps and farmyards. Water abstraction and flow regulation by reservoirs or private companies / individuals can lead to low river levels and to wetland habitats drying out, which can affect the plants and animals which live there. The River Font is regulated by Fontburn Reservoir, although there is a compensation flow released from the reservoir. Climate change is expected to alter weather patterns, including more frequent intense rainfall and higher water temperature in summers, which will influence the species composition. Riverside trees will become increasingly important for shade to keep rivers cool for fish and crayfish.

5.7 Physical modifications such as weirs and reservoir dams can act as a barrier to fish passage, impede sediment transfer and alter flow regimes. Raising of flood banks to reduce flooding of farmland can disconnect rivers from their natural floodplain, which can adversely affect biodiversity.

5.8 Public access adjacent to watercourses lead to problems with antisocial behaviour, habitat degradation, and biosecurity and pollution risks. Biosecurity is a particular concern in the Wansbeck catchment due to the presence of white-clawed crayfish. Water users visiting other catchments or sites with non-native signal crayfish could transfer the lethal crayfish plague on wet clothing or equipment. Diffuse pollution from agriculture and point sources risk impacts on aquatic ecology, including on white-clawed crayfish, which are slow growing and so take longer to recover from pollution incidents than most other aquatic macro-invertebrates.

5.9 Wetlands such as fens and grazing marsh may require active management, such as grazing or cutting, to maintain their value for wildlife. In the absence of such management, they can lose their value for wetland species. Invasive non-native species such as signal crayfish and American mink or Himalayan balsam, can lead to the loss of native species in rivers and wetlands and alter habitat composition.

5.10 Table 5-3 below summarises the key features and pressures upon rivers and wetlands, as identified within the NLNRS Pilot. The main pressures upon river and wetland habitat within the catchment are trampling by livestock, agricultural run-off and sediment accumulation.

Table 5-3. Summary of key features and pressures (Watercourses and Wetlands)

Key Features	Associated Species Interest	Pressures
Rivers and Streams Lakes and Loughs Wet woodland Reedbeds Upland flushes Fens Swamps Grazing marsh Ponds	Otter *Lutra lutra* Water vole Arvicola amphibius Lamprey Salmonids Osprey Great-crested newt *Triturus cristatus* White-clawed crayfish Freshwater pearl-mussel *Margaritifera margaritifera* Breeding and wintering birds, wildfowl and waders River jelly lichen *Collema dichotomum* Invertebrate communities including those associated with exposed gravels and shingle.	Agricultural run-off (such as fertilisers, pesticides, silt etc.) Trampling by livestock causing bank erosion Sediment accumulation Pollution from former mine workings Barriers to fish migration Invasive non-native species, e.g. signal crayfish, Himalayan balsam *Impatiens glandulifera* etc. Drainage and water level management Sewerage discharges Hydro-electric schemes Lack of grazing on some habitats (e.g. grazing marsh, some fen sites) Succession and scrub encroachment Climate change

Source: NLNRS Pilot (2021)

Woodland, Trees and Scrub

5.11 Small, fragmented areas of woodland are vulnerable to impacts from adjacent land uses. Grazing from livestock and browsing by deer can prevent regeneration, damage newly planted trees and reduce the diversity of woodland ground flora. A lack of management can reduce structural diversity of woodlands. Older trees are often felled for safety reasons leading to a loss of wildlife habitat. Storm damage can result in the loss of trees and woodland, for example storm Arwen in 2021 resulted in the loss of thousands of trees within Northumberland (Northumberland County Council, 2021), including trees within the Wansbeck Catchment.

5.12 Invasive species such as *Rhododendron ponticum* which was widely introduced into woodland for amenity or game cover can smother native ground flora and prevent the regeneration of native tree species. Grey squirrel *Sciurus carolinensis* may cause problems through bark stripping and lead to declines in our native species the red squirrel. New tree diseases such as ash dieback *Hymenoscyphus fraxineus* or *Phytophthora* species which affect alder and other tree species threaten the health of some trees and will affect decisions on planting and restocking.

5.13 Table 5-4 below summarises the key features and pressures upon woodland, trees and scrub, as identified within the NLNRS Pilot. It is considered that all the pressures identified as part of the NLNRS Pilot are relevant to the Wansbeck catchment.

Table 5-4. Summary of key features and pressures (Woodland, Trees and Scrub)

Key Features	Associated Species Interest	Pressures
Deciduous woodland Orchards Woodpasture and parkland Ancient woodland (including PAWS) Wet woodland Mixed woodlands Scrub Veteran trees Urban trees	Woodland birds, including willow tit *Poecile montanus* Goshawk *Accipiter gentilis* Osprey *Pandion haliaetus* Bats Red squirrel Pine marten *Martes martes* Woodland invertebrate communities (including dead wood invertebrates) Wood ants *Formica* sp.	Fragmentation of woodland patches Upland woods largely constrained to gills of tributary streams Invasive non-native species – such as grey squirrel of Rhododendron Excessive grazing by livestock in unfenced woods and browsing by deer of naturally regenerating trees and the shrub layer required by declining woodland bird species. Felling of veteran trees and standing dead wood for safety reasons Plant diseases such as ash dieback and Phytophthora Loss of urban trees to development

Key Features	Associated Species Interest	Pressures
	Important higher and lower plant communities Important fungal communities, including soil mycorrhiza Juniper *Juniperus communis*	Climate change Wildfire

Source: NLNRS Pilot (2021)

Coastal and Marine

5.14 Threats to coastal habitats include diffuse pollution and eutrophication of coastal waters, inappropriate grazing regimes and lack of grazing, invasive non-native species such as pirri-pirri bur *Acaena novae-zelandiae*, coastal infrastructure and development, fisheries, recreational damage, climate change, plastic pollution and lost fishing nets and other 'ghost gear' (NLNRS Pilot, 2021).

5.15 Table 5-5 below summarises the key features and pressures upon coastal and marine habitats, as identified within the NLNRS Pilot. It is considered that development, recreational disturbance and effects from the Wansbeck amenity weir have the greatest effects on coastal habitat within the catchment.

Table 5-5. Summary of key features and pressures (Coastal and Marine)

Key Features	Associated Species Interest	Pressures
Sand dune complexes Dune slacks Saline lagoons Coastal heath Saltmarsh Reedbeds Mudflats and sandflats Coastal grazing marsh Maritime cliff and slope Seagrass beds Subtidal sand and gravels Rocky reefs Sea caves	Wintering waders and wildfowl Breeding shorebirds and seabirds Coastal plants Migratory and commercial fish and shellfish Petalwort *Petalophyllum ralfsii* Grey seal *Halichoerus grypus*	Loss of habitat caused by coastal squeeze Diffuse pollution and eutrophication of coastal waters Point source pollution, including from former mine workings and eroding landfill Inappropriate grazing regimes and lack of grazing Invasive non-native species – e.g. pirri-pirri burr *Acaena novae-zelandiae*, Pacific oyster *Crassostrea gigas* etc. Coastal infrastructure and development Fisheries Recreational disturbance Climate change Plastic pollution and 'ghost gear'

Source: NLNRS Pilot (2021)

6. Consultation

6.1 A summary of the main discussion points and feedback received is provided in Appendix C.

Technical Stakeholder Group

Peatland and Heathland

6.2 Stakeholders discussed and agreed that new woodland should not be created on peat 30 cm or deeper or on shallower peat which is hydrologically connected to deep peat of 30 cm depth or more. It was highlighted that current mapping may miss some areas of peat. There is potential for habitat restoration of some deep peat areas which won't be re-forested. There is still debate regarding restocking on peat - it will depend on the expected yield class for forestry on the site. There are two new proposals for forestry in the Wansbeck catchment and there may be more. Proposals may be in line with woodland creation options identified as part of this project, or in conflict.

6.3 All peat areas are excluded from woodland planting for the Great Northumberland Forest project. It was noted that there might be a case for beneficial exceptions, e.g. riparian planting or natural regeneration of broad-leaved woodland, for example along watercourses. It was considered that the default position should be no woodland planting on peat or peaty pockets, but individual cases should be reviewed where applicable.

6.4 It was discussed whether the GIS system would be kept up to date as habitats change on the ground along with information about them. It would be advantageous to know where new areas of habitat are being created or enhanced within the catchment or where woodland has been felled as it may present opportunities for habitat creation.

Grassland

6.5 Stakeholders agreed that there wasn't enough information on grassland condition within the catchment, and that more information was required regarding nutrient status. This could be addressed through soil sampling in addition to surveys of grassland condition.

6.6 It was mentioned that it can be difficult to see the potential of grassland for restoration if it is heavily grazed. It was further noted that it may be necessary to take grazing off or reduce it in order to assess the potential.

6.7 Valley bottoms were suggested as potentially offering opportunities for either grassland or woodland creation. However, as these areas can often have the most fertile soils and may be in productive agriculture, consultation with landowners and stakeholders would be required before any options were considered in more detail. Some soils may be too fertile for species-rich grassland. Steeper valley sides might have more potential for habitat creation and a mosaic of different types of habitats could be beneficial.

Woodland

6.8 The Natural England habitat network modelling tool uses buffers around 'primary habitats' to identify opportunities of habitat creation or enhancement. The technical stakeholder group discussed the size of buffer zones that could be applied to woodland areas for use in the habitat network model. It was discussed that for general planting of new woodland, an expansion zone of 200-300 m from the woodland may be appropriate, however if a project was more focused on creating woodland with woodland flora (which are poor colonisers) a narrower buffer may be better. It was agreed that the habitat network model buffer would be reduced to 100 m in this study to avoid the model suggesting large areas for woodland creation which may not be useful.

6.9 Creation of woodland along stream and river sides would be positive, especially where this could join up existing high quality woodland areas, however there still needed to be consideration of farming needs and some of the bast areas kept for growing crops.

6.10 Soil maps should be considered when assessing suitability for habitat creation, but also soil grades. Farmers and landowners generally prefer habitat creation on less productive land although it was agreed there is a need to consider potential for conflicts on less productive land, such as woodland planting proposals on grassland which is already of value or which is potentially restorable.

6.11 Climate should be considered when planting woodland; some species are more climate resilient than others. Also consider pest susceptibility/resistance and a mix of species would be desirable.

Watercourses and Wetlands

6.12 It was highlighted that there had already been watercourse improvement work undertaken within the catchment and future consultation with the Rivers Trust was required to share latest information.

6.13 It was noted that fencing / grazing has been identified as is a key issue affecting water quality throughout the catchment.

6.14 It was suggested that as the maps reviewed showed many watercourses as straight lines and hence probably historically straightened, there is scope to change this through watercourse re-meandering in some cases.

6.15 It was recognised that woody debris dams/leaky dams need to be correctly positioned to avoid exacerbating flooding. Any changes proposed also need to consider fish passage. Fallen trees following Storm Arwen could be a potential source of material for well-placed dams.

Coastal and Marine

6.16 Studies have shown that the ecology of the River Wansbeck is adversely influenced by the presence of the amenity barrage near the mouth. The impounded lake post-weir construction has been found to be dominated by opportunistic species which are able to withstand a high degree of salinity fluctuation (Garside and Kennedy, 2010 and Royal Haskoning, 2009). Although the preferred option from a biodiversity perspective would be to remove the barrier, the area upstream has become popular for water-based recreation and is of amenity value. There may be the possibility of reintroducing a partial tidal range. Another study is underway to assess the feasibility of changing the barrage, but it is not currently published.

6.17 A field immediately south of the estuary has been developed as a mitigation site for wetland birds, so that area will stay in management for conservation. North of the estuary the area is already built up and the field remaining between the coastal caravan park and the rest of the urban area is under development pressure. Furthermore, that area would be subject to heavy disturbance and risk of predation (cats) so not suitable for birds.

6.18 Overall, it was agreed that opportunities for coastal / marine habitat creation and restoration were limited due to existing land uses and pressures.

Farmer and Landowner Group

6.19 The farmer and landowner group generally reacted positively to the project and welcomed opportunities to deliver nature-based solutions within the catchment.

6.20 Where reviewing the primary habitat maps, landowners felt there was still too much ‘white space’, and the maps did not capture all of the habitat creation and enhancement work that was already being completed. It was discussed that some landowners (such as the National Trust) have more resources available to them to map their land (i.e. volunteers) and the abundance of data around the Wallington Estate may not indicate that the habitats were in better condition. Many farmers have already made management plans for their land which seek to identify the best areas to make improvements for wildlife.

6.21 Farmers and landowners indicated that they would like a greater understanding of how biodiversity improvements might be funded. Farmers who were already making such improvements on their farms should not miss out. Whilst the strategic approach to the project was understood, landowners wanted to have a say in how the land might be managed in the future and preferred a ‘bottom up’ rather than ‘top-down’ approach.

6.22 Farmers felt that mapping the quality of the habitats present was a useful exercise, and that ‘knowledge is power’. It was noted that Information on land condition is already collected as part of agri-environment scheme applications, but this is not publicly available.

6.23 The abundance of ridge and furrow fields within the catchment was discussed – these have historic value and the topographical variation provides a microclimate of wet and dry areas that can be botanically more diverse. There are more areas of wet, marshy grassland within the catchment than are showing on the maps.

6.24 Habitats such as woodland require a commitment over a long period of time. There is a focus on the environment currently, but this could switch to food production depending upon politics / world events. There was frustration with current schemes – there were many comments suggesting that these were administration heavy, and farmers often don’t get paid on time.

6.25 It was suggested that where farmers have made improvements to their land, they could hold workshops or training sessions to demonstrate what is possible to others.

7. Gap Analysis

Key Data Required

7.1 The gap analysis process identified the following issues:

- Data may be missing locations of semi-natural grassland (particularly in the east of the catchment);
- There is a lack of hedgerow information outside of the Wallington Estate;
- There may be ancient and veteran trees within the catchment which have not been recorded;
- Information on ponds and wetland habitats may be missing (such as small ponds, marshy grassland, flushes and small wetland areas);
- Peat depth information within the catchment may be inaccurate in some areas, relevant to whether new forestry may be allowed;
- Some data may be out of date and changes may not be captured (i.e. recent planting or felling of woodland or changes in grassland management);
- Different survey methods have been used to capture information on habitat condition which may lead to inaccuracies; and
- Some information on habitat condition may be captured through agri-environment schemes but is not publicly available. It is not clear whether the data collected for schemes will be suitable for assessment of all the habitat types.

7.2 The primary habitat map for grassland indicates there is limited known semi-natural grassland within the catchment. The stakeholder groups both felt that there was more semi-natural grassland within the catchment than was showing on the maps.

7.3 The NLNRS Pilot also identified gaps in grassland data. The NLNRS Pilot found that Phase 1 habitat data was not available in parts of the county. Priority habitat inventory data had missing parcels or incorrect parcels. Lowland Northumberland was surveyed in stages in the late 1990s and early 2000's, however the paper maps were not scanned or digitised. In all, 75 out of 209 local wildlife sites had no habitat data (Mansley, A, Northumberland County Council, email to Kirstin Aldous 10th March 2022).

7.4 The National Trust has mapped many of the hedgerows and boundary features on the Wallington Estate. Some of these are associated with historical features including stone casts, earth casts, and stone walls (Debois Landscape Survey Group, 2011). Although from the mapping and modelling exercise there appears to be more hedgerows present in this area, it reflects availability of survey data rather than an absence of hedgerows elsewhere in the catchment. Aerial photography and Google Streetview indicate that there are hedges in the catchment which are gappy, heavily managed or grazed and some are reduced to lines of trees. There may be opportunities to obtain hedgerow information from agri-environment scheme data. If this is not possible, surveys could be undertaken to identify species-rich hedgerows within the catchment and those on old boundaries.

7.5 Ancient and veteran trees have been mapped within the Wallington Estate and the data shared with the Woodland Trust for its Ancient Tree Inventory. There may be opportunities to map ancient and veteran trees present in other parts of the catchment.

7.6 Some ponds within the catchment may not be mapped, or not visible, on catchment scale models. The Freshwater Habitats Trust are creating a Priority Ponds Map (Freshwater Habitats Trust, 2022), and there are opportunities for Nature Networks to use or share information from / with this project. A provisional map with the locations of priority ponds has been produced, based on the location of ponds which have been shown to be free from nutrient pollution. The Freshwater Habitats Trust data shows no priority ponds within the Wansbeck Catchment Area. This could indicate a lack of available data rather than an absence of priority ponds. Priority ponds include some rare habitat types, such as dune slacks and ponds which are important for species assemblages or populations. The majority of field ponds would not meet the criteria but are of importance for wildlife at local scale.

7.7 Consultation with stakeholders highlighted that information on peat depths within the catchment may not be accurate so a peat depth survey may be required to validate baseline data for peatland and heathland habitats.

7.8 Some data on land use and / or condition may not be accurate. Sites change over time and historic data collected over 3 years ago may no longer be accurate. The Chartered Institute of Ecology and Environmental Management (CIEEM) advises that after 3 years, ecology reports are unlikely to still be valid and most, if not all, of the surveys are likely to need updating (CIEEM, 2019).

7.9 Data has been collected using a variety of survey methods. This means there may be inconsistencies in how habitats are valued. Cherrill and Maclean (1999) assessed the reliability of Phase 1 habitat mapping in the UK, reviewing the extent and types of observer bias. Maps of the same upland area in northern England produced by six experienced ecologists were compared. The study found that agreement between pairs of maps averaged only 25.6% of the study site's area. The majority of differences were due to differing interpretations of the types of vegetation present, rather than spatial errors - although the latter were also detected. The range of vegetation types which were confused with each other was great, but ecologically related vegetation types were most often confused. Where data collected using different methods are compared, there is greater risk of inconsistencies.

7.10 This study focussed on identifying of known value or potentially so – grouped here as primary habitats (the term used in the Habitat Network model). There may be areas within the catchment that are not identified as primary habitats, although they may support protected or notable species assemblages. Joining up habitats will have a positive effect upon the species that they support. However, where species have poor dispersal mechanisms or are present in isolated populations, a more targeted approach may be needed. There are opportunities for further study looking at how habitat network enhancements could provide benefits to species such as white clawed crayfish, red squirrel or upland waders.

7.11 There may be opportunities to update baseline data using aerial photography or use of drones. These tools could be used to confirm broad habitat types, although field surveys would be required to assess condition. A detailed botanical survey (using UK Habs or NVC) should be completed during the optimum survey season.

Table 7-1 Suggested Surveys to Improve Baseline Data

Action	Timescales	Relevant Subcatchments
Review age of existing data to check it is still relevant. Where data is over 3 years old or has not been collected using a standard survey methodology, an updated field survey may be required.	Anytime	All
Compare aerial photography of habitats with existing mapping to identify changes (e.g., new woodland creation or recently felled woodland).	Anytime	All
Identify opportunities for Government organisations to share baseline data (Natural England, Environment Agency, Rural Payments Agency).	Anytime	All
Peat depth survey to validate baseline data	Anytime	Font from source to Wansbeck Delf Burn Catchment (tributary of the Hart Burn) Hart Burn from Source to Delf Burn Ray Burn Catchment (tributary of the River Wansbeck) Wansbeck from source to Ray Burn Wansbeck from Ray Burn to Hart Burn
Botanical survey to assess condition of grassland	May – July	All

Botanical survey of woodland habitat to assess condition	April – June	All
Botanical survey of peatland / heathland to assess condition	April – June	Font from source to Wansbeck Delf Burn Catchment (tributary of the Hart Burn) Hart Burn from Source to Delf Burn Ray Burn Catchment (tributary of the River Wansbeck) Wansbeck from source to Ray Burn Wansbeck from Ray Burn to Hart Burn
Hedgerow survey	May - September	All
Ancient and veteran tree survey	Anytime	All
Priority pond mapping and survey	April to September	All
Waxcap fungi survey of semi-natural grasslands	October – November	Font from Source to Wansbeck Delf Burn Catchment (tributary of the Hart Burn) Hart Burn from Source to Delf Burn Hart Burn from Delf Burn to Wansbeck Ray Burn Catchment (tributary of the River Wansbeck) Wansbeck from source to Ray Burn Wansbeck from Ray Burn to Hart Burn

8. Habitat Network Modelling

8.1 Using the Natural England Habitat Network Modelling tool, habitat network maps were developed using the following standard mapping components developed into (A) 'Existing Habitat' and (B) 'Network Enhancement and Expansion':

A) Existing Habitat – existing habitats were mapped using the following four components:

1) Primary Habitat: The habitats which are the focus of the individual habitat network e.g. peatland and heathland;

2) Associated habitat: Other 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;

3) Habitat Creation/Restoration: Areas where work is underway to either create or restore the primary habitat; and

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.

B) Network Enhancement and Expansion – the following 4 network zones are created around the habitat components described above:

5) Network Enhancement Zone 1: Land adjacent to or 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 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; and

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.

8.2 Habitat Network Models for peatland and heathland, grassland and woodland groups are provided as Figures 8-1 to 8-3 below.

8.3 Table 8-1 below summarises the data sets which have been used to create each map. In addition to priority habitat inventory data, local data sets were used where available to identify good quality habitats within the catchment.

8.4 The habitat network model uses existing habitats of value and uses those as nodes for expanding a network. The tool does not use associated habitats as nodes if there are not any primary habitats present. Furthermore, the tool does not suggest new habitats or restorable habitats where there are no primary habitats nearby. Therefore, the tool does not show all habitats which have potential for restoration or creation within the catchment, only a subset of areas which could be linked to existing known primary habitats. This should be taken into account when interpreting the models, especially where there are known data gaps in baseline data.

Table 8-1. Data sets used to create habitat models

NLNRS Pilot Theme	Primary Habitats	Associated Habitats	Restorable Habitats	Constraints
Peatland and Heathland	Lowland dry acid Lowland heathland Upland heathland Upland fens, flushes and swamps Lowland raised bog Lowland fens Blanket bog Heath Grassland Dry Heath Dry heath and acid grassland mosaic	Purple moor grass and rush pasture Acid Grassland Unimproved Acid Grassland	Coniferous woodland – where planted on peaty soil Any grassland on peaty soil	Urban areas Ancient woodland Broadleaved / deciduous woodland Neutral grassland, calcareous grassland, meadows Scheduled ancient monuments and historic grassland, Lakes / other still waters Marine habitats Other priority habitats
Semi-natural grasslands	Upland calcareous grassland Lowland calcareous grassland Lowland meadows Upland hay meadows Purple moor grass and rush pasture Lowland dry acid grassland Species rich grassland Restoration towards species rich grassland Semi-natural grassland Meadows Species rich grass verges	Upland flushes, fens and swamp Lowland fens Heather grassland Wood-pasture Traditional Orchard	Poor semi-improved grassland Neutral grassland Historic parkland	Urban areas Ancient woodland Broad-leaved / deciduous woodland Lakes / other still waters Marine habitats Other Priority habitats
Woodland, Trees and Scrub	Ancient woodland Ancient semi-natural woodland Wood pasture and parkland Traditional Orchards Scrub	Hedgerows	Plantation on Ancient Woodland Sites Mixed woodland Coniferous woodland	Urban areas Priority habitats other than woodland Scheduled ancient monuments and historic parkland Peaty soils Marine habitats Lakes and other still water

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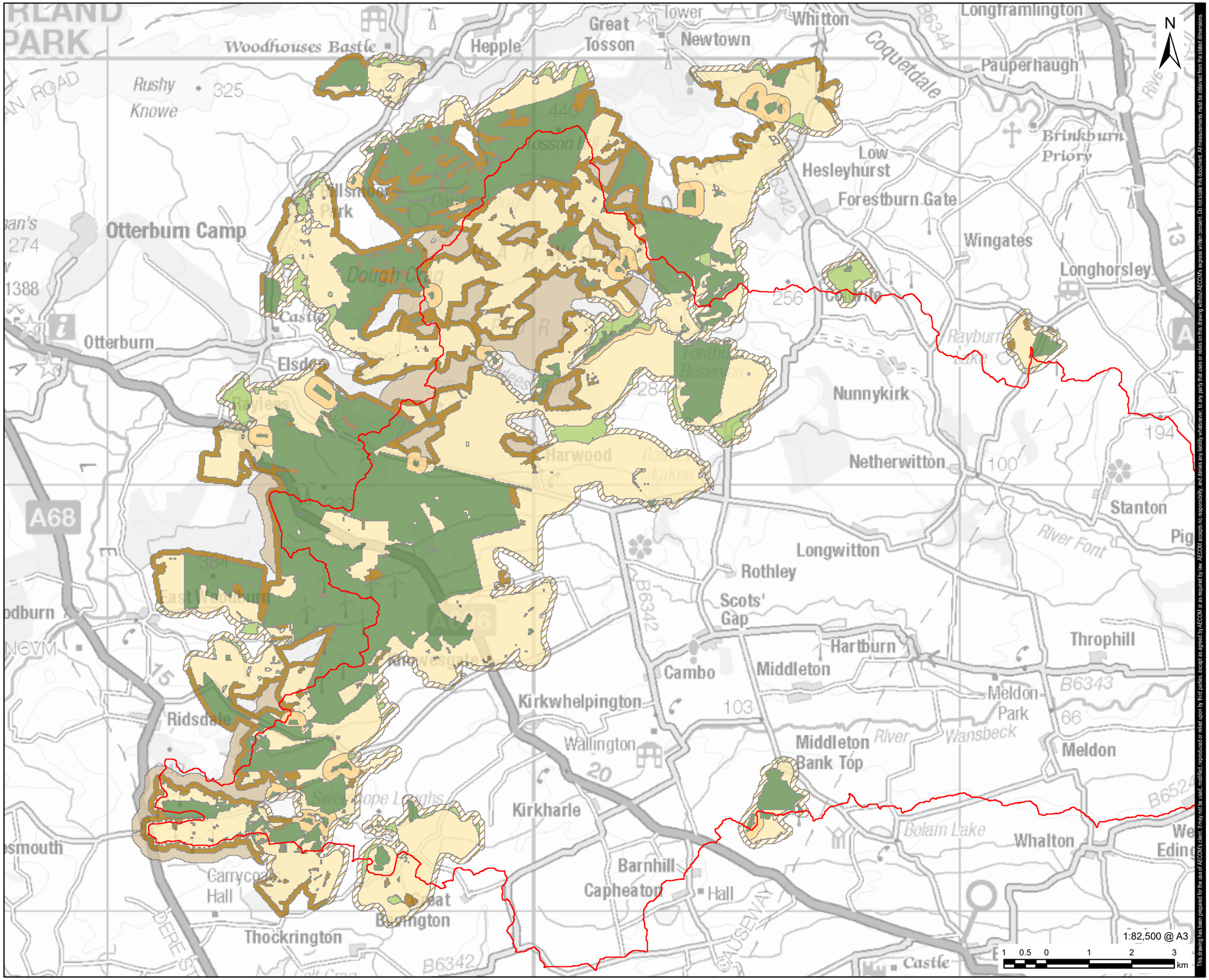

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LEGEND

- Wansbeck Catchment Boundary

Peatland & Heathland Habitat Network

- Primary Habitat
- Associated Habitats
- Restorable Habitat
- Fragmentation Action Zone
- Network Enhancement Zone 1
- Network Enhancement Zone 2
- Network Expansion Zone

NOTES

ISSUE PURPOSE

FINAL

PROJECT NUMBER

60676363

FIGURE TITLE

Peatland & Heathland Habitat Network Model

FIGURE NUMBER

Figure 8-1

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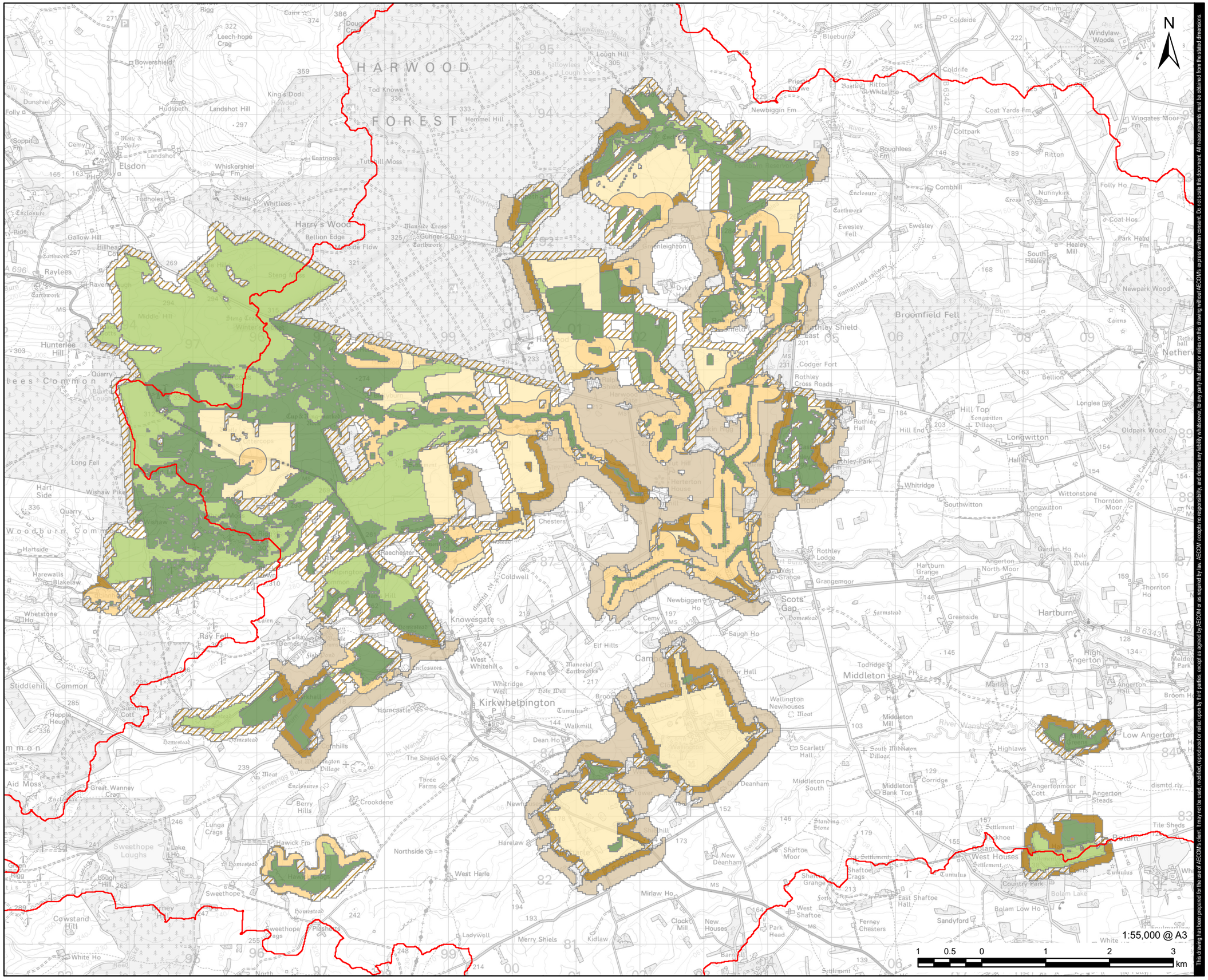

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LEGEND

- Wansbeck Catchment Boundary

Semi-Natural Grassland Habitat Network

- Primary Habitat
- Associated Habitats
- Restorable Habitat
- Fragmentation Action Zone
- Network Enhancement Zone 1
- Network Enhancement Zone 2
- Network Expansion Zone

NOTES

ISSUE PURPOSE

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PROJECT NUMBER

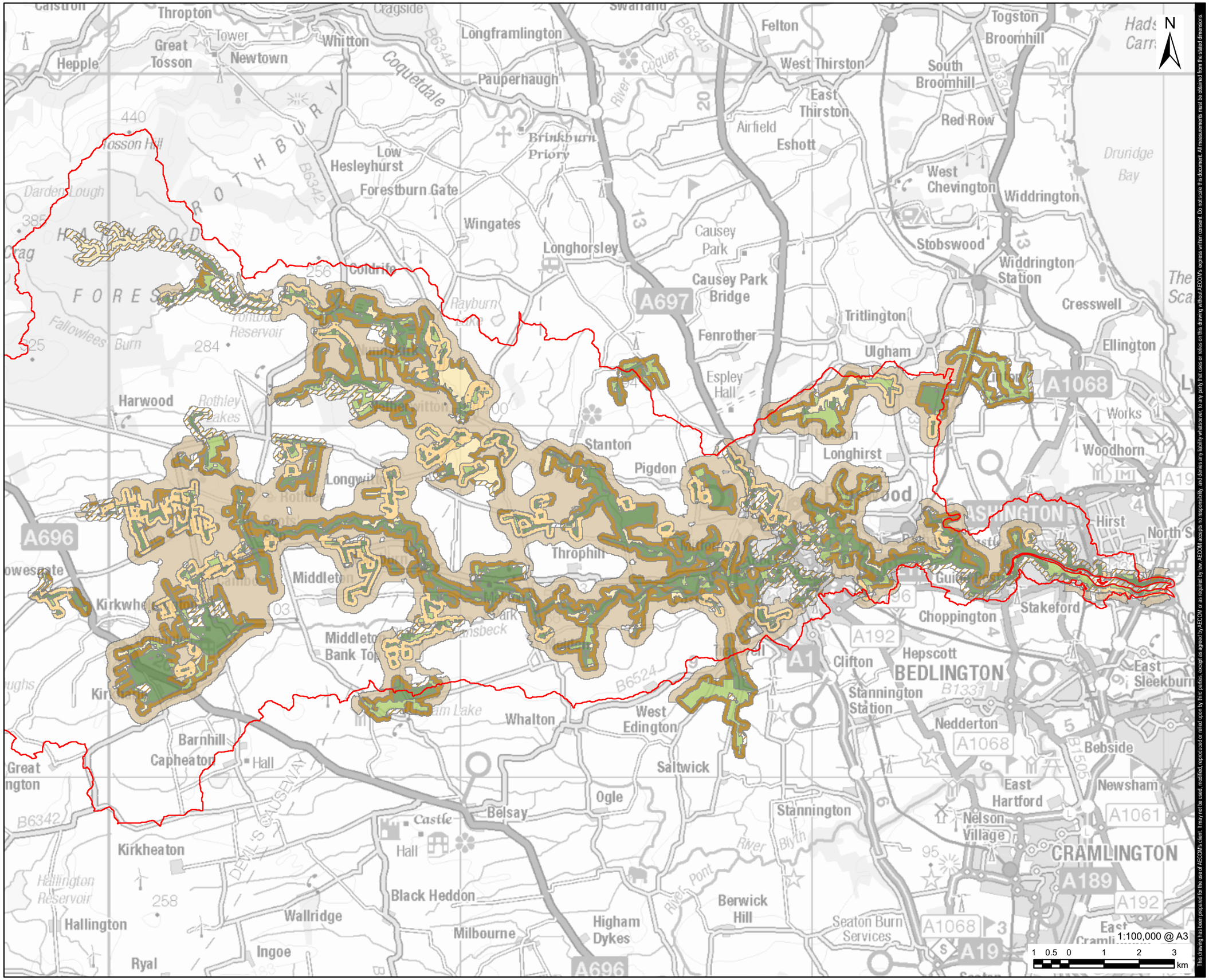
60676363

FIGURE TITLE

Semi-Natural Grassland Habitat Network Model

FIGURE NUMBER

Figure 8-2



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Manchester, M1 4HD
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LEGEND

- Wansbeck Catchment Boundary

Woodland, Trees and Scrub Habitat Network

- Primary Habitat
- Associated Habitats
- Restorable Habitat
- Fragmentation Action Zone
- Network Enhancement Zone 1
- Network Enhancement Zone 2
- Network Expansion Zone

NOTES

ISSUE PURPOSE

FINAL

PROJECT NUMBER

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FIGURE TITLE

Woodland, Trees & Scrub Habitat Network Model

FIGURE NUMBER

Figure 8-3

9. Limitations

9.1 As part of this project, AECOM were requested to apply a model developed by Natural England to map Habitat Networks to the Wansbeck study area. This model comes in the form of a Feature Manipulation Engine (FME) workflow that takes a range of constraints and habitats data then applies a range of scenario-specific parameters to identify enhancement zones around the subject habitats.

9.2 Natural England had designed the model to work at a national scale; therefore, to make the tool suitable for use within the smaller catchment area of this study, AECOM needed to make adjustments to the scenario-specific parameters to reflect the changes in scale. To determine the most suitable values for each habitat at the scale of the study, an iterative testing process was required.

9.3 In addition, in its original form, the model was designed for more open habitat types and not those such as woodland. As Natural England is still evolving a version of the model to be more suitable for woodland habitats, AECOM had to make further adjustments to the version of the workflow model received to make it as suitable as possible for woodland habitats within the Wansbeck.

9.4 It was decided not to run the nature network modelling exercise with watercourse and wetland data as the model was not designed to work with linear features such as rivers. Instead, the method used in the river restoration plan provides a more detailed and targeted analysis which has identified a range of opportunities in the sub-catchments.

9.5 A coastal habitat network model was not created due to the constrained nature of habitats at the mouth of the Wansbeck (opportunities are limited due to the presence of the amenity barrage and existing development). The original Natural England Habitat Network Mapping omitted coast and floodplain grazing marsh and mudflats as these were transitionary habitats between terrestrial and marine, and a different approach was needed (Edwards, et al, 2020). At the mouth of the River Wansbeck, the amenity barrage has a significant effect upon ecology. The consultation event with stakeholders highlighted that work has been commissioned separately to identify habitat creation opportunities at the coast.

9.6 The habitat networks maps require careful interpretation and should be used as a guide to where existing networks could be expanded and enhanced and the scope in these areas should be considered further when opportunities arise. The network models use the locations of existing good quality habitats as a starting point to create something, bigger, better and more joined up. Where there is an absence of baseline data (for example locations of semi-natural grassland within the catchment), opportunities to enhance the habitat and create new linkages could be missed.

9.7 It was not possible to identify areas where initiatives are currently underway to either create or restore the primary habitat within the timescales of this project. Consultation with stakeholders has indicated that much of the positive habitat creation or restoration work undertaken by farmers and landowners is not captured by the priority habitat inventory or within some of the local data sets. Data on habitat quality is not always publicly available – for example information captured as part of agri-environment schemes. There may be opportunities for government organisations to share data to inform Nature Network Mapping projects, however this would need to comply with General Data Protection Regulations and the Data Protection Act 2018.

9.8 Some landowners have more resources available than others, and as such, have the capacity to map habitats in detail. This does not necessarily mean that the habitat quality is better in those locations; it reflects the level of survey effort put in to capture the baseline information.

9.9 The nature network modelling exercise utilised existing data only - information was not verified through site visits to make sure it was accurate and up to date. Consideration should be given to accuracy of available data, including the source, age of data sets, skills of the surveyor and method of collection. It is noted that different organisations describe habitats in different ways, and the project highlights the wide variety of ways that a particular habitat is described. Ideally a single survey method should be used to improve consistency, such as the UK Habitat Classification System. Recommendations to improve the quality of data to inform nature network modelling is discussed in Section 7 – Gap Analysis.

10. Recommendations

Opportunities for restoration and enhancement of terrestrial habitats identified through the modelling are summarised in Table 10-1 and summarised for each WFD catchment. Figures 10-1 to 10-3 show the habitat network models and the WFD areas combined. NEZ in the table refers to the Network Expansion Zones. For opportunities relating to watercourses and wetlands within each WFD catchment please refer to the Wansbeck River Restoration Plan (AECOM, 2022).

Table 10-1. Summary of Opportunities within the Wansbeck Catchment

WFD Catchment	Woodland	Grassland	Peatland and Heathland	Comments
Bothal Burn Catchment (tributary of Wansbeck)	Opportunities for Network Expansion Zones (NEZs) on the lower reaches of Bothal Burn and How Burn. How Burn opportunity extends to Longhirst, due to network connection through Longhirst golf course. NEZs on the upper part of Brocks Burn could be extended south to Bothal Burn, as there is a narrow strip of riparian woodland along the stream. Woodland NEZ at the top of Longhirst Burn is associated with existing mixed managed woodland with largely arable surroundings.	None identified. CEH 2019 classifies very few fields as semi-natural grassland, mainly around Longhirst. Condition unknown.	None, area not suitable.	Limited opportunities for NEZs. Best scope is new woodland along watercourses and some connections between plantations.
Delf Burn Catchment (tributary of Hart Burn)	Opportunity to enhance lower stretches of Harwood Burn and Delf Burn with broadleaved woodland next to conifer plantations.	Acid grassland is present along and near Harwood Burn. Some potential to restore more improved grassland in the vicinity.	Limited opportunities as most of the upper catchment is on peatland within Harwood Forest or other blocks of forestry. There may be some scope for conversion to heathland east of Harwood forest with grip-blocking. Some opportunities for enhancement at Greenleighton.	Potential acid grassland restoration overlaps with heathland restoration NEZ. Preferred option will depend on existing grassland condition/agricultural improvement and the soil type. Overlap with river restoration opportunities gives scope for various types of marshy grassland and swamp.
Font from Source to Wansbeck	Fragments of ancient semi-natural woodland remain along the Font (R. Wansbeck to Blagdon Burn, Coal Burn to Ewesley, stretches of Ewesley Burn and tributary) and there are two sizeable replanted	The opportunities are restoration/NEZ extending from grassland flanking Fontburn Reservoir and the Fallowlees Burn upstream. There would be scope to increase connectivity to grassland along	Upper part of subcatchment west of Ewesley has scope for restoration/NEZ, but most of it is in forestry, much of it young plantation, so limited scope.	The largest subcatchment, extends from watershed east to River Wansbeck west of Morpeth. Priorities are likely to be riparian woodland in the lower and middle catchment. This would fit with river

WFD Catchment	Woodland	Grassland	Peatland and Heathland	Comments
	sites (Newpark Wood, Coldlaw Wood). The river-based network has associated fragmentation action zones, connecting areas where there are both fragments of riparian woodland and at least remnants of hedgerow network and/or tree-lines (e.g. south side of Font south and east of Netherwitton, near Nunnykirk and the Coal Burn).	Donkinrigg Burn (Delf Burn) and around Rothley. A substantial part of the rest of the catchment is indicated as improved grassland (CEH 2019), but there is no available information on condition of the permanent pastures. Some may have potential for restoration.		restoration opportunities for riparian fencing. The upper catchment priorities are heathland restoration and restoration of acid grassland, potentially with some floodplain wetland. Forestry constrains the upper catchment, although along riparian corridors of the tributaries mosaics of semi-natural woodland and upland habitat could extend into afforested areas) even if forestry remains the major landuse.
Hart Burn from Delf Burn to Wansbeck	There are NEZ1 opportunities to expand / restore the woodland along the Hart Burn, Dean Burn and Longwitton Burn, and create linkages with woodland near Scots Gap and to the south of Angerton Lake.	There are NEZ opportunities around Rothley Crags where upland calcareous grassland, *Lolium-Cynosurus* neutral grassland and acid grassland have been mapped.	None, area not suitable.	Primary woodland habitat is present along the Hart Burn and could be expanded. Opportunities to expand grassland habitats are present around Rothley Crags.
Hart Burn from Source to Delf Burn	Small shelterbelts, and strips along small watercourses, field boundaries, fragmented. Opportunities to connect and expand in NEZ along Holy Burn, Chesters Burn.	Potential for NEZ along disused railway, south of Holy Burn, potential to expand to cluster at Scot Gap. Also, NEZ from less improved acid grassland along much of Ottercops Burn. Connects to upland grassland in upper catchment, with options for grassland or heathland restoration.	More than half the sub catchment is heathland in various condition, overlapping with acid grassland. Condition of existing heathland unknown. Network opportunities overlap with those for acid grassland.	Heathland in the upper catchment, blocks of forestry, rest is grassland, mostly improved in the lower off peat soils/moorland, but at least some with potential for restoration.
Ray Burn Catchment (tributary of Wansbeck)	Potential to extend woodland along the watercourse from the downstream end of Ray Burn. Could go beyond NEZ to increase connectivity to woodland/plantations further upstream.	NEZ in inbye grassland along both sides of Ray Burn up to confluence of Middlerigg Burn. Currently it is a mix of very improved grassland and less improved.	Upper part of subcatchment on both sides of Middlerigg Burn on peat soils, with moorland, some of it in wind farm, plus blocks of forestry, with potential for restoration.	Some overlap of opportunities for grassland and heathland on peat soil, and constraints on expansion of heathland on inbye grassland.
Wansbeck from Bothal Burn to North Sea	Some options for NEZ west of Ashington, on intensively managed grassland. Existing woodland mainly on steep valley sides of River Wansbeck, expansion constrained by urban area of Ashington.	None identified. CEH 2019 Land Cover indicates a few fields of semi-natural grassland close to River Wansbeck at West Sleekburn and northwest of Stakeford. Condition unknown.	None, area not suitable.	Largely urban, with limited opportunities for NEZs. Some scope to expand riverside woodland in upper part, and/or enhance some grassland. Needs further assessment of grassland condition.

WFD Catchment	Woodland	Grassland	Peatland and Heathland	Comments
Wansbeck from Font to Bothal Burn	Limited opportunities for NEZs to extend from Cotting Burn, Fulbeck and Scotch Gill, but constrained by Morpeth.	None identified. CEH 2019 Land Cover indicates a few areas of semi-natural grassland, including St Georges Hospital, and pastures E of A1 southwest of Morpeth and northwest near Fulbeck. Condition unknown. May be conflicts or opportunities with urban expansion.	None, area not suitable.	Priority is likely to be NEZ for ancient woodland along the River Wansbeck and right bank tributaries. Could be a combination of woodland and hedge improvement.
Wansbeck from Hart Burn to Font	Opportunities to extend ancient woodland along the steep-sided valley of River Wansbeck. NEZs opportunities to extend up watercourses to Meldon, up Clayhouse Burn and Molesden Burn.	None identified. CEH 2019 shows groupings of semi-natural grassland. Condition unknown, Mainly in small fields, e.g. around Molesden, Trophill and between Park Burn and A1. Much of the area is arable and intensively managed grassland.	None, area not suitable.	Priority is likely to be NEZ for ancient woodland along the River Wansbeck and right bank tributaries. Could be a combination of woodland and hedge improvement.
Wansbeck from Ray Burn to Hart Burn	Opportunities link and extend the woodland on estates at Wallington and Harle. Existing hedge network around Cambo gives potential to link to NEZ opportunity around Scots Gap and associated NEZ to Harts Burn area. Woodland around Bolam sets a NEZ. That cluster has potential for expansion of connectivity via small woodlands north to the River Wansbeck at Pow Burn, some of it with recent woodland planting.	A few small individual fields on the Wallington Estate and at Kirkharle provide the basis for NEZs which include parkland with improved grassland. Best opportunities appear to be in the Wansbeck valley between the two estates. Other opportunities are in the Wansbeck floodplain east of Middleton, at Bolam.	NEZ around Middleton Bank Top, with possible opportunities on the areas of peaty soil (restorable habitat). Also an area of possibly restorable habitat at Great Bavington at the head of Kirkharle Burn.	NEZ opportunities for woodland and grassland overlap at both Wallington and Harle. Site-specific combinations of woodland and grassland would be preferable. Most of the sub catchment is agriculturally improved grassland.
Wansbeck from Source to Ray Burn	Except for a couple of small areas of potential NEZ from Ray Burn sub catchment there are no woodland opportunities identified. The areas on peat were excluded from opportunities for woodland. A narrow woodland at Crook Dean is plantation on ancient woodland, not the basis for a cluster, but there may be scope for expansion of broadleaved woodland along the river downstream.	Opportunities are on both sides of the River Wansbeck in the south-east of the sub catchment downstream of Sweethope Lough, where the river has been straightened around a floodplain with acid grassland. Some inbye meadows at Ferneyrigg not included -condition unknown. May be additional scope for NEZ around those.	Restorable habitat and NEZ covers all of the upper sub catchment from the limits of peaty soils downstream of Sweethope Lough to the watershed. It is mostly existing forestry and windfarm over drained acid grassland. With some bog and heath upstream of Sweethope Lough.	Peatland areas appear to have most opportunities for restoration/NEZ. Off the peat almost all of the sub catchment is grassland, probably mostly improved, but presence of extensive ridge and furrow may indicate potential for restoration. Condition unknown, may be some potential for waxcap grassland.

Revision: 0 Drawn: EB Checked: DF Approved: KA Date: 2022-03-25

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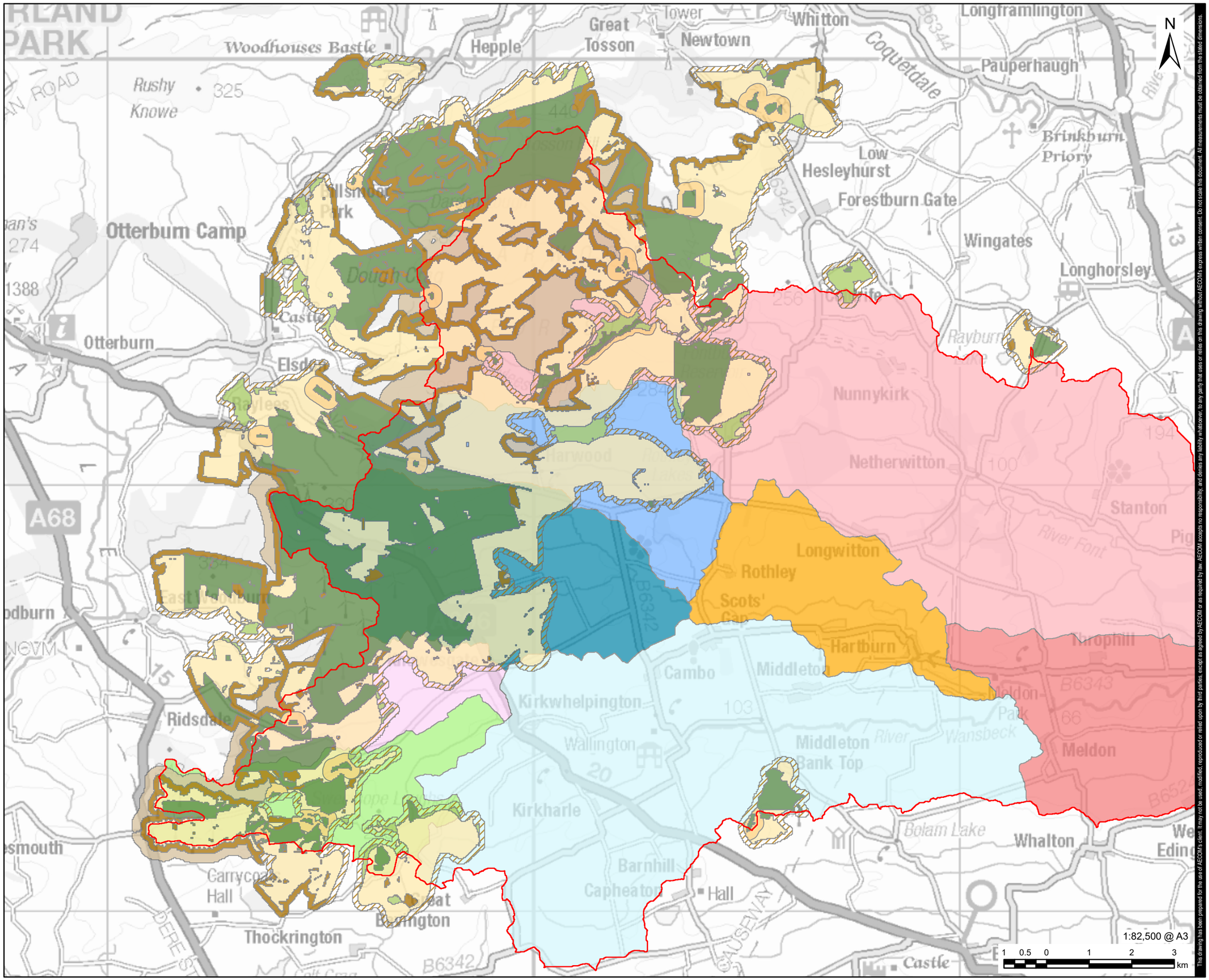

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PROJECT

Wansbeck Nature Recovery Plan

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CONSULTANT

AECOM Limited
1 New York Street
Manchester, M1 4HD
www.aecom.com

LEGEND

- Wansbeck Catchment Boundary

Peatland & Heathland Habitat Network

- Primary Habitat
- Associated Habitats
- Restorable Habitat
- Fragmentation Action Zone
- Network Enhancement Zone 1
- Network Enhancement Zone 2
- Network Expansion Zone

WFD Catchments

- Delf Burn Catchment (trib of Hart Burn)
- Font from Source to Wansbeck
- Hart Burn from Delf Burn to Wansbeck
- Hart Burn from Source to Delf Burn
- Ray Burn Catchment (trib of Wansbeck)
- Wansbeck from Hart Burn to Font
- Wansbeck from Ray Burn to Hart Burn
- Wansbeck from Source to Ray Burn

NOTES

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FIGURE TITLE

Peatland & Heathland Habitat Model and WFD Areas

FIGURE NUMBER

Figure 10-1

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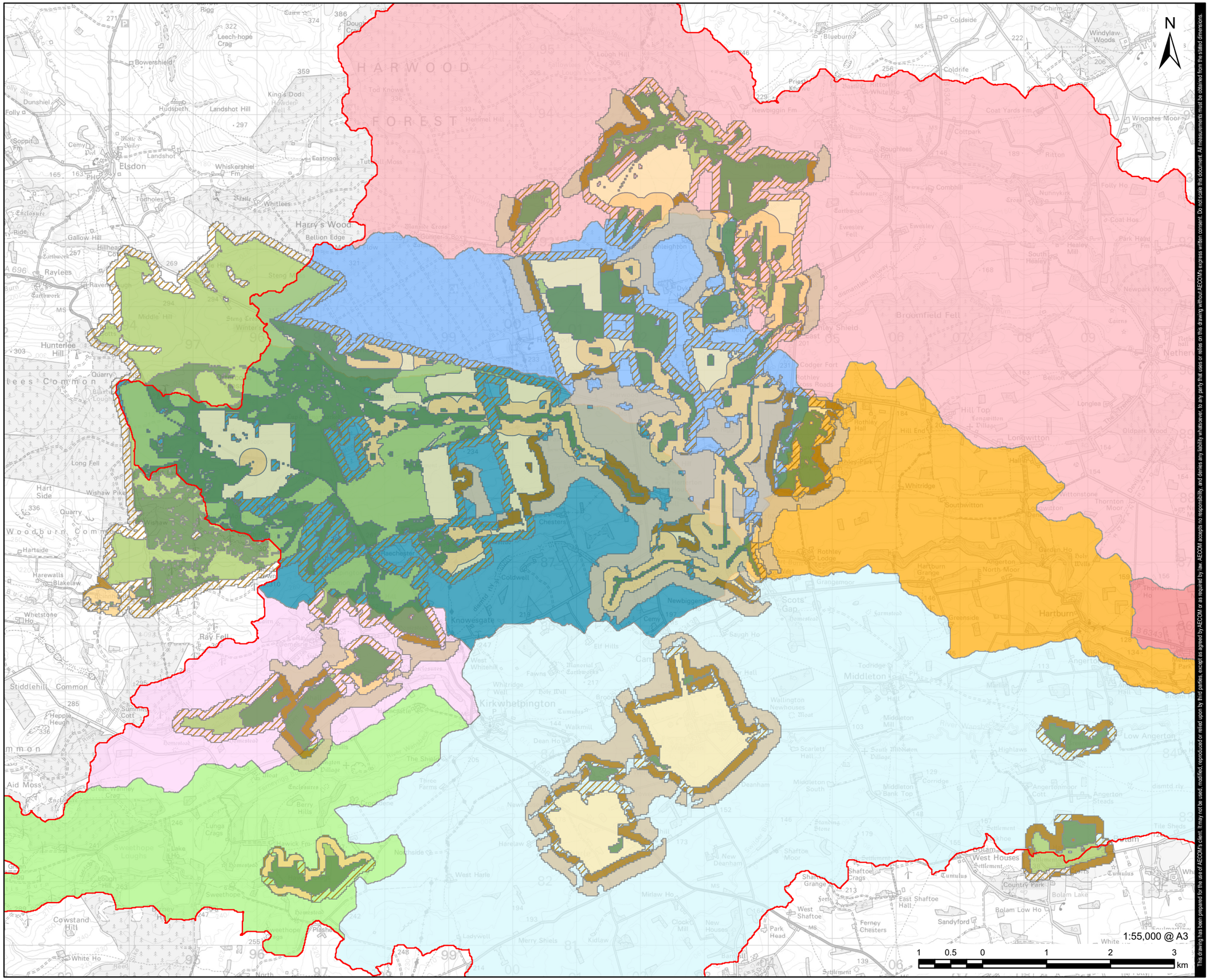

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1 New York Street
Manchester, M1 4HD
www.aecom.com

LEGEND

- Wansbeck Catchment Boundary

Semi-Natural Grassland Habitat Network

- Primary Habitat
- Associated Habitats
- Restorable Habitat
- Fragmentation Action Zone
- Network Enhancement Zone 1
- Network Enhancement Zone 2
- Network Expansion Zone

WFD Catchments

- Delf Burn Catchment (trib of Hart Burn)
- Font from Source to Wansbeck
- Hart Burn from Delf Burn to Wansbeck
- Hart Burn from Source to Delf Burn
- Ray Burn Catchment (trib of Wansbeck)
- Wansbeck from Hart Burn to Font
- Wansbeck from Ray Burn to Hart Burn
- Wansbeck from Source to Ray Burn

NOTES

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FIGURE TITLE

Semi-Natural Grassland Network Model and WFD Areas

FIGURE NUMBER

Figure 10-2

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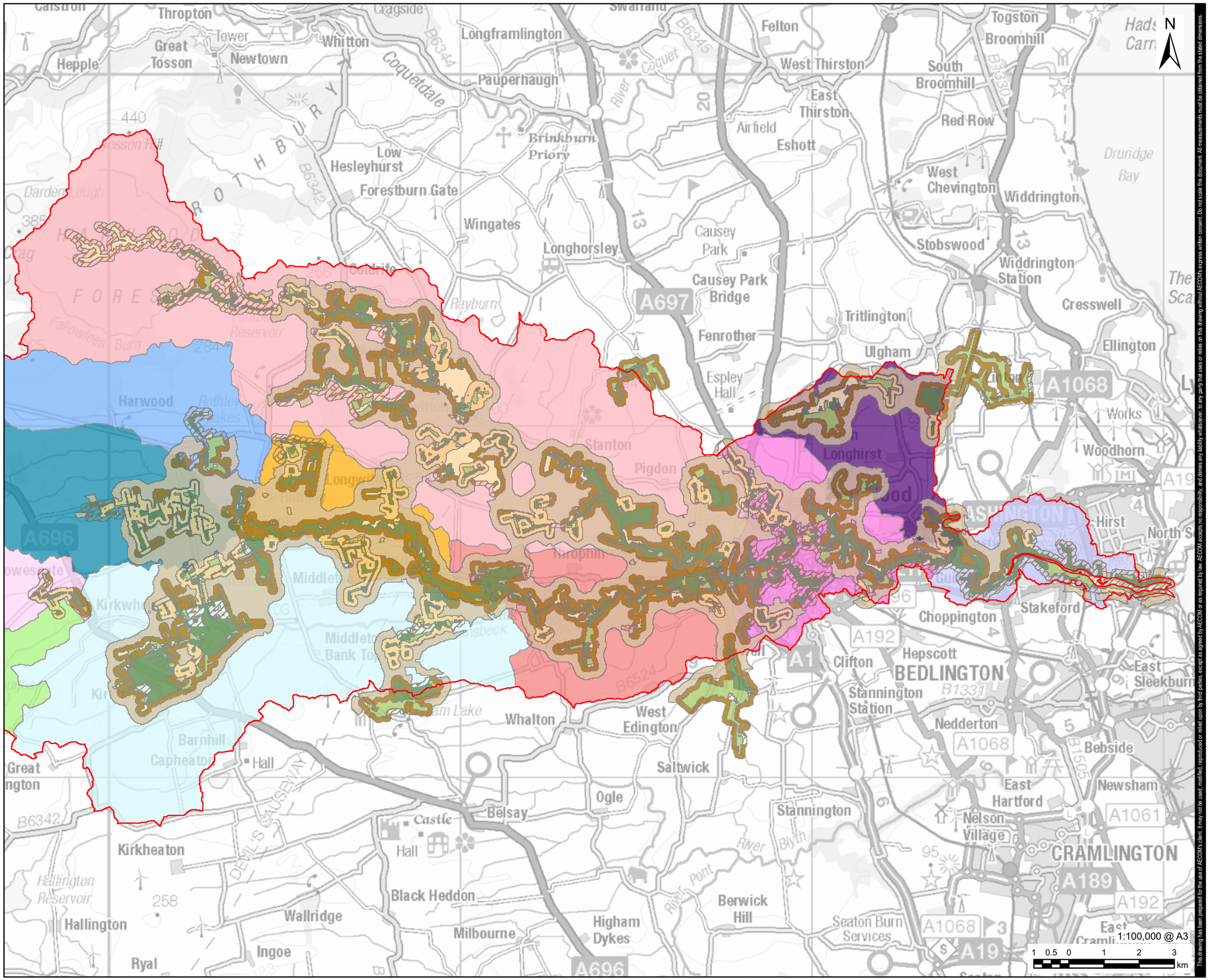

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1 New York Street
Manchester, M1 4HD
www.aecom.com

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- Wansbeck Catchment Boundary

Woodland, Trees and Scrub Habitat Network

- Primary Habitat
- Associated Habitats
- Restorable Habitat
- Fragmentation Action Zone
- Network Enhancement Zone 1
- Network Enhancement Zone 2
- Network Expansion Zone

WFD Catchments

- Bothal Burn Catchment (trib of Wansbeck)
- Delf Burn Catchment (trib of Hart Burn)
- Font from Source to Wansbeck
- Hart Burn from Delf Burn to Wansbeck
- Hart Burn from Source to Delf Burn
- Ray Burn Catchment (trib of Wansbeck)
- Wansbeck from Bothal Burn to North Sea
- Wansbeck from Font to Bothal Burn
- Wansbeck from Hart Burn to Font
- Wansbeck from Ray Burn to Hart Burn
- Wansbeck from Source to Ray Burn

NOTES

ISSUE PURPOSE

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PROJECT NUMBER

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FIGURE TITLE

Woodland, Trees & Scrub Network Model and WFD Areas

FIGURE NUMBER

Figure 10-3

Peatland and Heathland

10.1 The NLNRS Pilot identified that the highest priority actions for restoration and enhancement of peatland and heathland within the catchment are to:

- Improve the condition and quality of existing sites; and
- Restore degraded examples of peatland and heathland.

10.2 The habitat network mapping exercise identified that there are opportunities for restoration and enhancement of peatland and heathland within the following WFD catchments:

- Font from source to Wansbeck;
- Delf Burn Catchment (tributary of the Hart Burn);
- Hart Burn from Source to Delf Burn;
- Ray Burn Catchment (tributary of the River Wansbeck);
- Wansbeck from source to Ray Burn; and
- Wansbeck from Ray Burn to Hart Burn.

10.3 Restoration of degraded peatlands can be achieved through measures to stabilise areas of active erosion, to encourage revegetation with peat forming vegetation and to restore and maintain the hydrological conditions which allow peat to re-wet. Restoration may also require the removal of areas of woodland where these have been planted on deep peat, or control of self-seeded trees and scrub (NLNRS Pilot, 2021).

10.4 Heathland restoration can be achieved through changes to the management of sites. In lowland areas, heathland sites are likely to have suffered from undermanagement and their restoration may require measures such as the removal of self-seeded trees and scrub and the re-introduction of a suitable grazing regime in order to allow dwarf-shrubs to establish and expand. In contrast, heathland restoration in upland areas may need to address impacts from historic or current intensity of management, for example from livestock grazing or sporting management. Here restoration may require alterations in grazing or burning practices and active measures, such as re-seeding, to restore dwarf-shrub cover to areas from which it has been lost (NLNRS Pilot, 2021).

Grip Blocking

10.5 From the 1950s onwards grips were dug for drainage of bogs, either to help with access for farm machinery or, by drying out the land, to favour conditions for heather or grass grazing, or forestry. Grips are straight drainage channels dug into the ground, often visible on aerial maps as they form a herringbone pattern (Northumberland National Park, 2022a).

10.6 Grip blocking can help to restore natural drainage patterns, to encourage re-vegetation, to reduce erosion and to minimise hydrological changes downstream. Blocking grips will raise the water level to at, or near the soil surface, encouraging the colonisation of sphagnum mosses and other specialist plant species. The wet flushes created by blocking grips can increase invertebrate numbers, which provide a valuable food source for grouse chicks, as well as wading birds such as curlew, snipe *Gallinago gallinago*, lapwing and golden plover *Pluvialis apricaria*.

Objectives of Grip Blocking

- Restoring natural drainage patterns;
- Encouraging re-vegetation of the bog surface;
- Reducing erosion;
- Minimising hydrological changes downstream.

These objectives are achieved by:

- Blocking eroding grips;
- Blocking active grips that are maintaining themselves;
- Blocking grips across level and basin / raised mires; and
- Allowing grips to infill naturally where possible.

Methods of Grip Blocking

- Peat dams;
- Solid dams; and
- Blocking.

Further information on these methods is available in Appendix D.

Other actions

- Sitka spruce *Picea sitchensis* removal – trees that have self-seeded onto sites can be removed. The trees can either be chipped and the chippings scattered (they absorb water and the mosses like to grow on them), or brashed on two sides and laid down on the bog;
- Remove tree regeneration to prevent ecological succession to scrub / woodland;
- Remove plantation forestry from the edges of peatland heatland / heathland areas to create a buffer;
- Establish environmental stewardship agreements for sites in poor condition including burning plans;
- Heather seed can be scattered on vulnerable peat sites to restore the vegetation cover.; and
- Consider moorland burning plans (removing sensitive habitats).

10.7 Management should be timed to avoid the nesting bird season and consider the requirements of wading birds and raptors.

Opportunities for Delivery

10.8 The Border Uplands Restoration Project (Northumberland National Park, 2022b) includes some of habitats within the River Wansbeck Catchment and is carrying out blanket bog restoration. It is recommended that the Northumberland National Park Authority is consulted regarding opportunities bog restoration.

10.9 The bog habitat at Greenleighton is within the ownership boundary of the National Trust. The Wallington 50-year plan notes that wet heath and blanket bog are some of the most valuable habitats on the Wallington Estate. They are located to the north of the Estate across the three fields of Fairnley, Ralph Shield and Greenleighton. The continued improvement of these areas for conservation is a key objective within the 50-year plan, which includes connecting and expanding habitats. The report indicates that further work is needed to slow water flows. Furthermore, options to change the scale and type of grazing should be considered to achieve the best outcome for land with the potential to be wet heath and bog.

10.10 The Northumberland LNRS pilot identifies that organisations in Northumberland are working collaboratively to restore and manage peatland sites. These include the Northumberland National Park Authority, the North Pennines AONB, Northumberland Wildlife Trust and the Forestry Commission (NLNRS Pilot, 2021).

10.11 The Northumberland Peat Partnership has received funding from Defra for peat restoration which has seen the delivery of restoration works. The partnership aims to:

- Promote peatland restoration and sustainable management to support the benefits that peat delivers for biodiversity, carbon management, flood risk management, erosion control, water quality, securing an archaeological record, fire risk management, landscape quality, natural beauty and recreation;
- Evaluate the peatland resource within the Partnership Area by mapping and assessing its ecological composition and condition; and the opportunities to enhance and support ecological connectivity;

- Evaluate the peatland resource within the Partnership Area by mapping and assessing its carbon content, carbon flow dynamics; and establishing the current and potential role it has in meeting the UK's commitment to reach net-zero by 2050;
- Develop a prioritised list of costed peatland restoration plans to secure future funding to support implementation;
- Seek and secure funding for peatland monitoring projects across upland Northumberland, developing an overarching approach to build knowledge on how management and restoration actions impact on the ability of peat habitats to deliver wider benefits;
- Share relevant data, best practice and understanding of sustainable management techniques to support well-functioning peat habitats across the land management sector and contractor community; and
- Work in partnership with organisations interested in peatland conservation, including the ICUN UK Peatland Programme to share knowledge and research findings, and to promote the value to society of well-functioning peatland habitats (Northumberland Wildlife Trust, 2022).

Semi-natural Grassland

10.12 The NLNRS Pilot identified that the highest priorities for restoration and enhancement of Northumberland's semi-natural grasslands are:

- Improving the condition and quality of existing sites;
- Increasing the size of existing sites through restoration or creation; and
- Increasing the extent of grassland sites through restoration and creation.

10.13 The habitat network mapping exercise for the Wansbeck catchment identified that there are opportunities for grassland restoration and enhancement within the following WFD catchments.

- Font from Source to Wansbeck;
- Delf Burn Catchment (tributary of the Hart Burn);
- Hart Burn from Source to Delf Burn;
- Hart Burn from Delf Burn to Wansbeck;
- Ray Burn Catchment (tributary of the River Wansbeck);
- Wansbeck from source to Ray Burn; and
- Wansbeck from Ray Burn to Hart Burn.

10.14 Some of the best-known areas of semi-natural grassland within the catchment are small and fragmented. The NLNRS Pilot recommended that these existing areas are protected and any management pressures they face are addressed.

10.15 For most semi-natural grasslands, management will require a combination of low nutrient inputs combined with an appropriate grazing or cutting regime. On degraded sites, work may also be needed to manage scrub, trees, rushes, or weed species such as docks and nettles.

10.16 Water level management may be required on wet grassland sites and grazing marshes (NLNRS Pilot, 2021). Specialist advice should be sought prior to implementing water management structures. Water control structures such as sluices can be used to:

- Keep groundwater at the right level on outflows (water discharge points); and
- redirect surface water from ditches or streams.

10.17 Ditches can be created and managed to help control water levels and move water around fields. Water can be kept in features like abandoned channels that dry out naturally during the spring and summer (Defra, 2021b).

10.18 Increasing the extent of semi-natural grasslands can be achieved through the restoration of degraded sites or by the creation of new grassland areas. Action to increase extent can also help deliver improved

ecological connectivity for grasslands and ideally restoration or creation would be done as part of a chain of stepping-stone sites to link existing patches of habitats. The semi-natural grassland habitat model provides an indication of where this could be achieved.

10.19 Modification of stocking regimes will require support from farmers and landowners. The stakeholder engagement event with farmers and landowners highlighted that there was generally a positive attitude to environmentally sensitive farming methods, however they needed further information on the availability of support given (e.g., from agri-environment schemes or other sources of funding).

10.20 There are many ridge and furrow fields within the Wansbeck catchment. Although these may be mapped as permanent pasture, with limited information about habitat condition, the variation in topography can be ecologically valuable (with wet and dry areas) and as such, these grasslands may present opportunities for restoration not highlighted by the Habitat Network Modelling Tool.

Opportunities for delivery

10.21 Agri-environment scheme funding is a major source of financial support for the ongoing management of grassland sites. Additional financial resources for grassland restoration or management may be available from grant giving bodies.

10.22 Opportunities for the creation or management of wet grasslands exist through river restoration and flood management work (refer to the Wansbeck River Restoration Plan, AECOM, 2022).

Woodland, Trees and Scrub

10.23 The NLNRS Pilot identified that the highest priorities for nature recovery for Northumberland's woodlands and trees are:

- Improving the condition and quality of existing native woodland sites (particularly ancient woodland sites);
- Restoration of Plantation on Ancient Woodland Sites to native broadleaf cover;
- Increasing the size of existing native woodland sites;
- Increasing the extent of native woodlands through natural regeneration or planting, particularly adjacent to existing woodland areas; and
- Increasing the numbers of trees and shrubs outside of woodland areas.

10.24 The habitat network mapping exercise identified that there are opportunities for woodland, trees and scrub within all of the WFD waterbodies of the Wansbeck catchment.

10.25 Increasing the size of woodlands will generally improve their value for wildlife. Woodland size can be increased through targeted tree planting in suitable locations or through allowing trees and shrubs to develop naturally through regeneration.

10.26 Increasing the extent of woodlands through creation of new wooded areas can also improve ecological connectivity if targeted to create linkages of native woodland to form wildlife corridors or stepping-stones. Woodland and tree planting along riparian habitats will have benefits in preventing bankside erosion and providing shade.

10.27 In some locations, the models may indicate that either woodland habitat or semi-natural grassland could be created. A site visit would be appropriate to fully understand the site conditions and any constraints or opportunities for habitat creation, restoration or enhancement. Surveys may also be necessary where areas of peatland habitat are present.

10.28 Scrub is a valuable habitat for many species of birds and invertebrates where it does not encroach on existing high-value habitats such as semi-natural grasslands. Scrub planting may be appropriate in locations such as field margins or upland gills and may help to slow the flow of water reaching the watercourses and stabilise banks.

10.29 Hedgerows provide valuable habitat, providing shelter and a source of food to a wide range of species. Many hedgerows include mature trees or are associated with historical boundary features. Hedgerows

could be enhanced by filling in gaps and planting new hedgerow trees, creating linkages between blocks of woodland habitat. Hedgerows are important for nesting birds, foraging and commuting bats, small mammals and invertebrates. Hedgerows also provide shelter for stock and crops and reduce down wind speed, which prevents erosion.

Opportunities for delivery

10.30 Forestry England are offering to lease land from organisations and businesses for the purposes of creating and managing new woodland to support government plans for woodland creation and nature recovery (Forestry England, 2022b). The England Woodland Creation Offer (EWCO) supports the creation of new woodland as small as one hectare (Forestry Commission, 2022).

10.31 The Great Northumberland Forest is a plan to create more wooded landscapes across the county by 2030. The scheme is part of the Woodland Creation Partnership which is made up of 14 organisations including Defra, Northumberland County Council, Forestry Commission, Natural England, the Woodland Trust, Northumberland National Park Authority, the Environment Agency, the Country Land and Business Association, Forestry England, the Ministry of Defence (MOD), Confor, Northumberland CAN (Community Action Northumberland), the National Farmers' Union, and the Northumberland Wildlife Trust (Northumberland County Council, 2022).

10.32 Forest Management Plans are strategic documents produced by the Forestry Commission, to set out the management proposals for the next thirty years for the woodlands they manage (Forestry England, 2022c). As part of the production of the Plans there is scope to identify opportunities for the restoration of broadleaf tree species through woodland restructuring.

Watercourses and Wetlands

10.33 The NLNRS Pilot identified that the highest priorities for restoration and enhancement of Northumberland's rivers and wetlands are:

- Improving the condition and quality of our rivers and wetlands; and
- Increasing the size and extent of wetland areas through restoration and creation.

10.34 The River Restoration Plan (AECOM, 2022) identified that there is potential for habitat creation and / or enhancement throughout the catchment including:

- Establishing riparian buffer strips;
- Creation of floodplain wetland;
- Creation of pond and swamp habitats; and
- Development of floodplain grazing marsh;

10.35 Please refer to the River Restoration Plan (AECOM, 2022) for the locations of these opportunities and mechanisms of delivery.

Riparian Buffer Strips

10.36 Creating strips of vegetation within a field can provide a physical barrier that slows the flow of overland runoff, increases infiltration and prevents soil, sediment and nutrient loss from fields. Riparian buffer strips should be created next to watercourses (between 4 and 12m away from the bank). They can contain long grasses, trees and shrubs. Alongside a river they usually require fencing to prevent livestock from accessing both the buffer strip and the watercourse itself. Alternative drinking sources, such as drinking bays, gravity fed drinking troughs, solar pumps or pasture pumps can be used to provide livestock with access to water.

10.37 Riparian buffer strips work by increasing the roughness of the land surface, which slows runoff as well as increasing the interception and absorption of rainfall and therefore provide a natural solution to flood management. Planting trees as part of a riparian buffer strip will also help to stabilise riverbanks, helping to prevent erosion and reducing the amount of silt entering the river. The trees also shade rivers, keeping them cool for aquatic wildlife such as trout and white-clawed crayfish. Buffer strips can trap and filter runoff therefore improving the water quality of the river by helping to prevent nutrients, sediments and pesticides

from reaching the river. Keeping livestock out of the water also reduces the risk of livestock acquiring waterborne diseases (Eden Rivers Trust, 2022).

10.38 Riparian buffer strips will benefit species such as white-clawed crayfish. Erosion of riverbanks by livestock can destroy in-bank refuges used by white-clawed crayfish and the eroded sediments blanket in-channel habitat used by crayfish and salmonid fish so these species benefit from riparian buffer strips. Shading by shrubs and trees can help to keep rivers cool. Leaf litter provides a source of food for white-clawed crayfish and their detritivore prey. Large woody debris improves in-channel diversity of flow and this and the roots of riparian trees also provide refuges for white-clawed crayfish. These interventions would contribute to achieving the Strategic Aims identified within the Northumberland Crayfish Conservation Strategy (Northumberland Rivers Catchment Partnership, 2019).

Floodplain Wetland

10.39 Restoration of river channels and with their associated sinuosity provides scope to create / restore seasonally wet grassland and rush pasture with increased opportunities for feeding and breeding birds.

10.40 Land that remains damp into the summer is rich in invertebrates. Species such as lapwing breed in damp grassland and wet grasslands also provide suitable feeding and nesting habitat for species such as redshank *Tringa totanus*, snipe and curlew. Wet grassland also provides valuable feeding habitat for other farmland birds such as tree sparrow *Passer montanus*, song thrush *Turdus philomelos*, starling *Sturnus vulgaris* and reed bunting *Emberiza schoeniclus*. Soft damp soil and the edges of standing water are important to these species on all farm types when they are feeding their chicks on invertebrates. Information on re-wetting grassland and managing water levels to benefit birds is provided in Appendix E.

10.41 The creation of ponds and scrapes within floodplains will provide biodiversity benefit. Scrapes are shallow depressions with gently sloping edges which seasonally hold water. Additional information on scrape creation is provided in Appendix F.

10.42 In natural floodplains, ponds are a common and abundant habitat. As the river moves across the landscape, large linear ponds form as cut-off backwaters. Whilst in winter, small seasonal pools appear in shallow natural depressions. All these pool types are important habitats. They can be exceptionally wildlife rich and are particularly likely to support rare species.

Ponds and Swamp

10.43 Wetlands such as fen, car marsh, swamp and reedbeds can develop anywhere where water remains at or near the surface year-round. Ponds are an integral feature of wetlands and support a wide range of species including aquatic plants, aquatic invertebrates, amphibians and birds. Some of the most species rich areas for aquatic species in wetlands are the pond edge habitats rather than the uniform stands of reed or deep open water (Freshwater Habitats Trust, 2022b).

10.44 Further information on pond and swamp habitat creation is available in Appendix G.

Floodplain Grazing Marsh

10.45 Detailed information on the restoration and creation of floodplain grazing marsh is provided in *Floodplain Meadows – Beaty and Utility: A Technical Handbook* (Rothero *et al*., 2016).

10.46 Floodplains may be managed as pasture (used for livestock grazing) or as meadows (cut for hay or silage and then grazed. Floodplain-meadow communities range from relatively dry and species-rich grasslands through inundated wet grasslands to single-species swamps. Transitions to mire and ephemeral communities also occur and add to the overall diversity of the meadows. The key factors influencing plant-community distribution and composition on floodplain meadows are the availability of water during the growing season and soil fertility. Although floodplain-meadow communities separate primarily along a hydrological gradient, species composition within communities is strongly influenced by soil fertility, soil type and also management.

10.47 Typical management of a species-rich floodplain meadow to maintain or improve plant communities and achieve a good quality hay crop are:

- An annual hay cut in late June or early July;

- Livestock grazing to remove the re-growth of grass from August through to early spring, or until the site becomes too wet;
- Management of hedgerows to prevent encroachment of scrub;
- Maintenance of grazing infrastructure such as fencing;
- Stock handling and drinking points;
- Control of weeds or undesirable species such as ragwort, sedges and creeping thistle; and
- Maintenance of ditches, gutters and surface drains.

10.48 The type of animals used, the stocking density and the timing of grazing are all important factors to consider (Rothero *et al*., 2016).

Coastal and Marine

10.49 The NLNRS Pilot identified that the highest priorities for restoration and enhancement of Northumberland's coastal and marine habitats are:

- Improving the condition and quality of existing coastal and marine habitats;
- Increasing the size of existing coastal and marine habitats; and
- Increasing the extent of coastal and marine habitats in response to predicted future coastal change.

10.50 Although there could be opportunities to increase areas of saltmarsh and dunes at the mouth of the River Wansbeck, the ecology of the estuary is strongly influenced by the presence of the amenity weir. The removal of the amenity weir as a means for habitat creation would enhance the entire area of the estuary (~64ha) and create ~31ha of intertidal area (Garside and Kennedy, 2010).

10.51 A field immediately south of the estuary has been developed as a mitigation site for wetland birds and is being managed for conservation. North of the estuary the area is constrained by existing development. Dune habitats adjacent to the existing caravan park are likely to be impacted by recreation.

Opportunities for delivery

10.52 Although the removal of amenity weir would likely have a beneficial impact upon the ecology of the Wansbeck estuary, the amenity lake is popular for recreation. A detailed assessment of options for the amenity weir was outside the scope of this project. Further studies are underway looking at coastal opportunities in more detail.

Species Benefits

10.53 The Northumberland Biodiversity Action Plan includes action plans for habitats and species within Northumberland. The recommendations outlined above have the potential to have a positive effect on priority species present within the catchment. Table 10-2 below summarises the priority species / groups known to be present within the Wansbeck catchment and whether interventions have to potential to have a positive effect. The table only includes the main benefits. There is potential for indirect benefits too. For example, white-clawed crayfish benefit directly from enhancements along the watercourses. They may also benefit indirectly from measures such as woodland creation, which retains water in the catchment. This helps reduce rates of runoff and the spates which can disturb in-channel refuges used by crayfish and helps to maintain baseflow during dry periods. Grassland restoration reduces use of fertilizers and has the potential to reduce eutrophication in the watercourses and so reduce impacts on aquatic fauna including white-clawed crayfish. Other indirect benefits would also apply to other species listed in Table 10-2.

Table 10-2. Summary of Species Benefits from Habitat Creation and Enhancement within the Wansbeck Catchment

Priority Species in Northumberland	Peatland and Heathland Restoration	Woodland and hedgerow Creation,	Grassland Restoration	River and Wetland Habitat Restoration and Creation	Coastal Habitat Restoration
Barn Owl		✓	✓	✓	✓
Bats		✓	✓	✓	
Black grouse	✓		✓		
Coastal birds					✓
Common seal					✓
Dingy skipper			✓*		
Dormouse		✓			
Farmland birds	✓	✓	✓	✓	
Freshwater fish				✓	
Garden birds		✓	✓	✓	
Great crested newt				✓	
Grey seal					✓
Hedgehog		✓	✓		
Otter				✓	✓
Red squirrel		✓			
Upland waders	✓		✓	✓	
Water vole				✓	
White clawed crayfish				✓	

**associated with brownfield habitats.*

11. Green Infrastructure

11.1 Green infrastructure (GI) is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation. This network of green (land) and blue (water) spaces can improve environmental conditions and therefore citizens' health and quality of life. It also supports a green economy, creates job opportunities and enhances biodiversity (European Commission, 2022).

11.2 The National Planning Policy Framework (NPPF) describes GI as "*a network of multi-functional green and blue spaces and other natural features, urban and rural, which is capable of delivering a wide range of environmental, economic, health and wellbeing benefits for nature, climate, local and wider communities and prosperity*" (Ministry of Housing, Communities and Local Government, 2021).

11.3 GI can include parks, open spaces, playing fields, woodlands, street trees, allotments, private gardens, green roofs and walls, sustainable drainage systems (SuDS), soils, rivers, streams and other waterbodies (Town and Country Planning Association, 2022).

11.4 The Northumberland GI strategy (Northumberland County Council, 2011) provides the strategic framework to ensure the provision of good quality, well-managed, readily accessible and multifunctional green infrastructure within Northumberland. As identified in Table 3-1 above, the strategy notes that:

- *"Important green spaces within, or close to, settlements need to be protected and conserved, and potentially to include some 'green' buffering that will preclude any development that would damage or deter usage of GI directly adjacent to settlements.*
- *The role and function of Registered Parks and Gardens needs to be recognised and where possible the network of these often historic estates need to be extended to those estates not on the register, which have potential to extend the greenspace network.*
- *There is a need to protect and conserve the distinctive character of the County's river valleys.*
- [There are opportunities] *to enhance and improve the river corridors using best practice sustainable land and water management to protect the nature and character whilst also enhancing the recreational potential and biodiversity value.*
- *Enhance existing water environment habitat to benefit wildlife and protect rare and endangered species that occur especially in the more remote uplands and at the river mouth where they enter the coastal zone*
- *Support land management schemes which seek to provide opportunities to contribute to the management of flood risk and the role of sustainable urban drainage systems*
- *Encourage existing enterprises to adopt 'green' practices that are specifically designed to promote biodiversity, especially those with a direct relationship to GI (e.g., agriculture, woodland management, leisure, tourism).*

11.5 The Northumberland Local Plan (Publication Draft Plan) aspires to bring meaningful green infrastructure to the county. It is noted that Northumberland's more urban south east has significant local green assets but a lack of overall connectivity, while in the rural areas an apparent abundance of open countryside can mask an actual lack of multi-functionality and public access (Northumberland County Council, 2019).

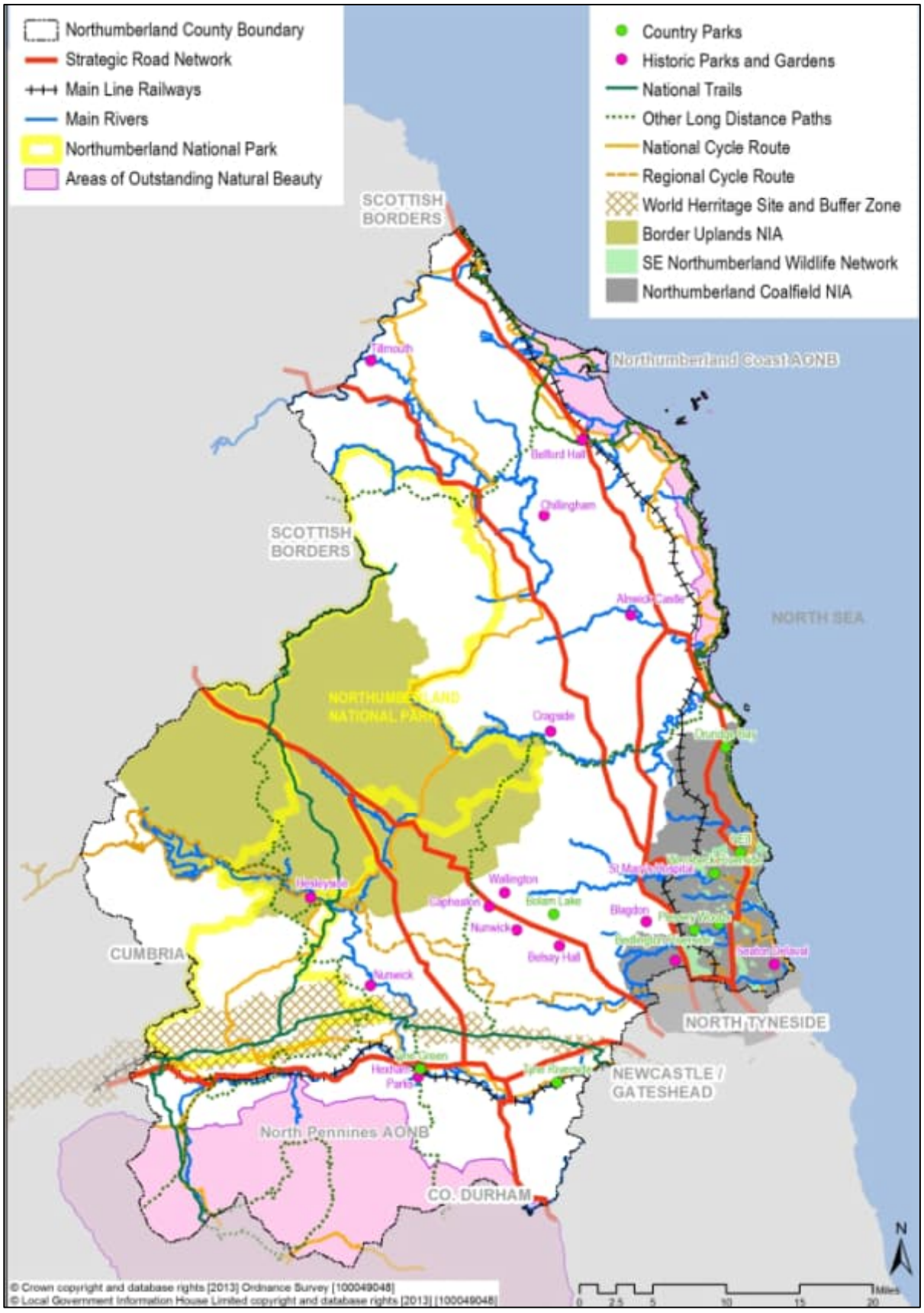


Figure 11-1 Strategic green infrastructure and corridors (Northumberland Local Plan – Publication Draft, 2019)

With reference to Figure 11-1, strategic GI assets identified within the Wansbeck Catchment include:

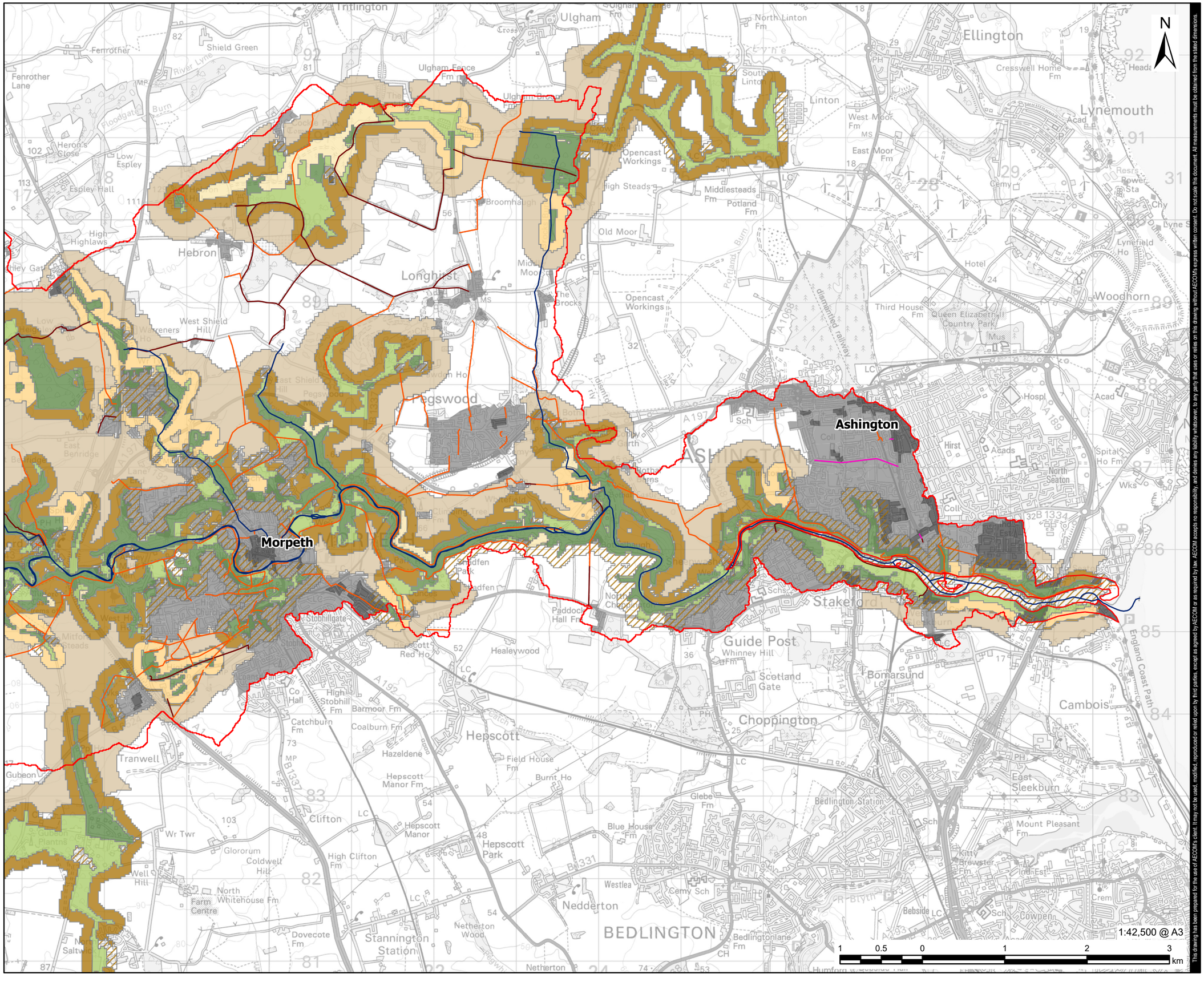
- The border uplands;
- Long distance footpaths (St Oswalds Way and the England Coastal Path);
- The Wallington estate;
- The Wansbeck Riverside Country Park;
- National cycle routes 1 and 55; and
- The river Wansbeck and tributaries.

11.6 The River Wansbeck provides a blue corridor between the settlements of Morpeth, Guidepost and Stakeford. There is a network of public footpaths along the River Wansbeck, linking Morpeth to the Wansbeck Riverside Park at Sheepwash, and the coast. The lake created by the Wansbeck amenity weir is popular for water sports.

11.7 In the west of the catchment, habitats are more rural, however the Wannies and Shaftoe crags are popular with walkers and climbers. The Wallington Estate is a popular tourist destination and promotes walking routes including the river walk, Wannie Line walk and Greenleigton Moor walk. The Dragon cycle trail at Wallington provides access to families to cycle on the Wallington Estate, and minor roads in the west of the catchment which are popular with more experienced cyclists.

11.8 The habitat network model for woodland identifies opportunities for enhancement and expansion within the east of the catchment. Figure 11-2 shows the habitat network model combined with CRoW Access Land and Public Rights of Way. Where network enhancement zones overlap with existing public footpaths, there could be increased benefits for the local community. Creating a buffer of new habitat around existing primary habitats could reduce pressure from recreation (i.e. trampling, dog fowling, litter).

11.9 Within urban areas, the planting of individual trees would enhance the green infrastructure network. Street trees can capture and store carbon, provide shade, provide a source of food and shelter for wildlife, and slow down surface water runoff. Community orchard schemes have benefit for people and wildlife and can be created in urban areas. People can be encouraged to interact with nature either through becoming custodians of the trees or by simply being around them and enjoying their fruit.



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AECOM

PROJECT

Wansbeck Nature Recovery Plan

CLIENT

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LEGEND

- Wansbeck Catchment Boundary
- Rivers

Public Rights of Way

- Public Footpath
- Public Bridleway
- Byway Open to All Traffic
- Urban Areas
- Suburban Areas

Woodland, Trees and Scrub Habitat Network

- Primary Habitat
- Associated Habitats
- Restorable Habitat
- Fragmentation Action Zone
- Network Enhancement Zone 1
- Network Enhancement Zone 2
- Network Expansion Zone

NOTES

ISSUE PURPOSE

FINAL

PROJECT NUMBER

60676363

FIGURE TITLE

Green Infrastructure Opportunities

FIGURE NUMBER

Figure 11-2

12. Discussion and Conclusions

12.1 Local Nature Recovery strategies aim to deliver a Nature Recovery Network, to increase, improve and join up our most ecologically valuable habitats. This study used local data sets within the River Wansbeck catchment as an evidence base, and Natural England's Habitat Network Modelling tool to create Habitat Network Maps, with the aim of identifying opportunities to expand and enhance habitats and / or reduce fragmentation.

12.2 The Habitat Network Model takes a range of constraints and habitats data, and then applies a range of scenario-specific parameters to identify enhancement zones around the subject habitats. Natural England designed the model to work on at a national scale; where this tool is used at different scales, adjustments are likely to be required and it will not necessarily be a simple matter to identify the best adjustments needed to optimise the model for use at catchment or subcatchment scale. Both an understanding of the baseline data and the parameters built into the model are required to run the model successfully. It is recommended that further testing of the model is completed before it is used in different scenarios and at differing scales. In addition, it is only likely to be worthwhile refining the model if the baseline habitat data has the coverage and quality to warrant it.

12.3 Data has been collected using a variety of survey methods. Ideally, habitat condition data should be collected using a single survey method to allow comparability. Biodiversity Net Gain assessments use the UK Habitats classification system (UK Hab), and it is considered that this survey method would be most appropriate to use in the future. The UK Hab allows habitat mapping to be carried out, but it would be preferable to extend this with habitat condition surveys. Further consideration should be given as to the method, for example whether this should be aligned with the Defra Biodiversity Net Gain Metric. For some habitats more detailed botanical survey may be needed. Where data sets are used to inform Habitat Network Maps, it should be clear and transparent how the data has been obtained to make sure the process is fair and robust. Data sets should be kept up to date and capture any changes.

12.4 The habitat network models identify opportunities to expand and enhance peatland and heathland, grassland and woodland habitats within the Wansbeck catchment, and in doing so, improve opportunities for wildlife and people. Peatland and heathland retain water and provide natural flood defence functions for areas downstream. Healthy well-functioning peatlands capture and store carbon. Peatland and heathland habitats are enjoyed for sport and recreation and are an important habitat for wildlife. Stakeholder engagement identified that peat depth information within the catchment may be inaccurate in some areas, and botanical surveys may be needed to assess the condition of peatland and heathland habitats. Site visits are recommended to verify baseline conditions prior to undertaking any habitat creation or restoration projects within peatland and heathland habitats.

12.5 Semi-natural grassland habitats within the catchment are fragmented, but there are opportunities to expand and enhance those that remain or create new habitats. Semi-natural grassland can protect soil from erosion, provide a range of forage for livestock, support invertebrates and birds and can become part of the character of a landscape. This project used priority habitat inventory data supplemented by local data sets as an evidence base to define 'primary habitats' within the catchment. Gap analysis and consultation with stakeholders confirmed that this evidence base may be missing some of our important habitats, particularly grassland. It is recommended that further survey of grassland habitats is undertaken to assess grassland condition and identify whether there are more areas of good quality habitat within the catchment.

12.6 There are opportunities to expand and enhance woodland habitats throughout the catchment. Woodlands can be used for business, recreation, provide flood management, be important for health and wellbeing, have aesthetic value and provide climate change mitigation. Increasing the size of woodlands will generally improve their value for wildlife. Woodland size can be increased through targeted tree planting in suitable locations or through allowing trees and shrubs to develop naturally through regeneration. Increasing the extent of woodlands through creation of new wooded areas can also improve ecological connectivity if targeted to create linkages of native woodland to form wildlife corridors or stepping-stones. Woodland and tree planting along riparian habitats will have benefits in preventing bankside erosion and providing shade. Where network enhancement zones overlap with existing public footpaths, there could be increased benefits for the local community. Within urban areas, the planting of individual trees would enhance the green infrastructure network.

12.7 The River Wansbeck has a nationally important population of white clawed crayfish, and habitat creation and enhancement projects have the potential to contribute to the strategic objectives set out in the Northumberland Crayfish Conservation Strategy. It will be equally important to prevent the spread of INNS into and within the catchment. The spread of INNS can reduce the conservation and amenity value of rivers, lakes and other waterbodies, as well as threaten the survival of rare and iconic species in the region. Preventing signal crayfish getting into the Wansbeck catchment is a high priority. Incidents of crayfish plague are very severe, but a fragmented white-clawed crayfish population may be able to recolonise, at least partially over time. By contrast, if invasion by signal crayfish starts in a watercourse there is no scope to eradicate them. This means there is no prospect of future recovery of white-clawed crayfish in the watercourse, although some physical barriers may slow or prevent upstream invasion. There is little information available at present about the potential for invasion of signal crayfish across watersheds, but this may need to be considered in some habitat restoration in the upper catchment.

12.8 The habitat network maps will require careful interpretation and opportunities for habitat creation may overlap (i.e. the same area could be identified as an opportunity for peatland and heathland or semi-natural grassland). More detailed consultation with stakeholders is recommended before opportunities are pursued, and sites visit to verify conditions should be completed. The habitat network maps could help to prioritise action in the catchment, but the areas of opportunities are probably not the only ones where there could be beneficial action for biodiversity. It should not be assumed that the aim is to create the modelled habitat of the type shown on the entire area shown. Some of the opportunity maps overlap and local surveys would need to be carried out to identify the preferred options and the constraints.

12.9 River restoration presents a range of opportunities for habitat creation and enhancement and looking at opportunities for river restoration and habitat creation and restoration holistically, will create the best outcome for nature recovery.

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Appendix A

GIS Data Register

ID	Dataset	Source	Date Received	Incoming Location	Final Name	Final Location	Notes
1	Wansbeck Catchment	Environment Agency	17/01/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220117_EA_Wansbeck_Catchment	Wansbeck_Catchment	Wansbeck_Catchment.gdb	
2	Saltmarsh Change	Environment Agency	03/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_EA_Open_Source_Data	Saltmarsh_Change	Environment_Agency.gdb	
3	Saltmarsh Extents and Zonation	Environment Agency	03/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_EA_Open_Source_Data	Saltmarsh_Extents_and_Zonation	Environment_Agency.gdb	
4	Risk of Flooding from Surface Water - 1 in 30 years (Extent)	Environment Agency	08/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_EA_Risk_of_Flooding_from_Surface_Water	ROFSW_1_in_30_Extent_clp	Environment_Agency.gdb	
5	Risk of Flooding from Surface Water - 1 in 100 years (Extent)	Environment Agency	09/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_EA_Risk_of_Flooding_from_Surface_Water	ROFSW_1_in_100_Extent_clp	Environment_Agency.gdb	
6	Risk of Flooding from Surface Water - 1 in 1000 years (Extent)	Environment Agency	10/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_EA_Risk_of_Flooding_from_Surface_Water	ROFSW_1_in_1000_Extent_clp	Environment_Agency.gdb	
7	Ancient Woodland	Natural England	03/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Natural_England_Open_Source_Data	Ancient_Woodland	Natural_England.gdb	
8	CRoW Act 2000 - Access Land	Natural England	03/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Natural_England_Open_Source_Data	CRoW_Access_Land	Natural_England.gdb	
9	Priority Habitat Inventory - North	Natural England	03/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Natural_England_Open_Source_Data	PHI_North	Natural_England.gdb	
10	Peaty Soils Location	Natural England	03/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Natural_England_Open_Source_Data	Peaty_Soils_Location	Natural_England.gdb	
11	Special Protection Areas	Natural England	03/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Natural_England_Open_Source_Data	SPA	Natural_England.gdb	
12	Traditional Orchards	Natural England	03/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Natural_England_Open_Source_Data	Traditional_Orchards	Natural_England.gdb	
13	Wood Pasture and Parkland	Natural England	03/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Natural_England_Open_Source_Data	Wood_Pasture_and_Parkland	Natural_England.gdb	
14	Special Areas of Conservation	Natural England	03/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Natural_England_Open_Source_Data	SAC	Natural_England.gdb	
15	Site of Special Scientific Interest	Natural England	03/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Natural_England_Open_Source_Data	SSSI	Natural_England.gdb	
16	Habitat Networks - Combined Habitats	Natural England	19/01/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220119_NE_CombinedHabitats	Habitat_Networks_Combined_Habitats	Natural_England.gdb	
17	OS Water Network - Hydro Node	Ordnance Survey	27/01/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220127_OS_Water_Network	OS_Water_Network_Hydro_Node	OrdnanceSurvey_Water_Network.gdb	Sourced from Defra Data Services Platform
18	OS Water Network - Watercourse Link	Ordnance Survey	27/01/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220127_OS_Water_Network	OS_Water_Network_Watercourse_Link	OrdnanceSurvey_Water_Network.gdb	Sourced from Defra Data Services Platform
19	Land Cover Map 2000	UK Centre for Ecology and Hydrology	02/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	GB_2000_LCM_Wansbeck	CEH_Land_Cover.gdb	Sent by National Trust
20	Land Cover Map 1990	UK Centre for Ecology and Hydrology	02/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	GB_1990_LCM_Wansbeck	CEH_Land_Cover.gdb	Sent by National Trust
21	Land Cover Map 2015	UK Centre for Ecology and Hydrology	02/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	GB_2015_LCM_Wansbeck	CEH_Land_Cover.gdb	Sent by National Trust
22	Land Cover Map 2017	UK Centre for Ecology and Hydrology	02/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	GB_2017_LCM_Wansbeck	CEH_Land_Cover.gdb	Sent by National Trust
23	Land Cover Map 2018	UK Centre for Ecology and Hydrology	02/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	GB_2018_LCM_Wansbeck	CEH_Land_Cover.gdb	Sent by National Trust
24	Land Cover Map 2019	UK Centre for Ecology and Hydrology	02/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA	GB_2019_LCM_Wansbeck	CEH_Land_Cover.gdb	Sent by National Trust

ID	Dataset	Source	Date Received	Incoming Location	Final Name	Final Location	Notes
				EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data			
25	Land Cover Map - Study Area	UK Centre for Ecology and Hydrology	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	LCM_StudyArea	CEH_Land_Cover.gdb	Sent by National Trust
26	Countryside Stewardship Woodland Boundary	Forestry Commission	03/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Forestry_Commission_Open_Source_Data	Countryside_Stewardship_Woodland__Boundary	Forestry_Commission.gdb	
27	Managed Woodland	Forestry Commission	03/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Forestry_Commission_Open_Source_Data	Managed_Woodland_Wansbeck	Forestry_Commission.gdb	
28	National Forest Inventory - Woodland (England, 2019)	National Forest Inventory	03/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_National_Forest_Inventory_2019	National_Forest_Inventory_Woodland__England_2019	National_Forest_Inventory.gdb	
29	National Trust - Wansbeck Species Data (Aggregated)	National Trust	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_National_Trust_Data_from_emapsite	NT_Wansbeck_Species_Data_Aggregated	National_Trust.gdb	Received from National Trust through emapsite Contractor Link
30	National Trust - Habitats	National Trust	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_National_Trust_Data_from_emapsite	NT_Habitats	National_Trust.gdb	Received from National Trust through emapsite Contractor Link
31	National Trust - Ownership Boundaries	National Trust	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_National_Trust_Data_from_emapsite	NT_Ownership	National_Trust.gdb	Received from National Trust through emapsite Contractor Link
32	National Trust Debois Survey - Boundaries4 (points)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Boundaries4_pt	National_Trust_Debois_Survey.gdb	
33	National Trust Debois Survey - Historic Routes (points)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Historic_Routes_pt	National_Trust_Debois_Survey.gdb	
34	National Trust Debois Survey - Miscelleanous Earthworks (points)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Miscellaneous_Earthworks_pt	National_Trust_Debois_Survey.gdb	
35	National Trust Debois Survey - Proposals3 (points)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Proposals3_pt	National_Trust_Debois_Survey.gdb	
36	National Trust Debois Survey - TREES2 (points)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	TREES2_pt	National_Trust_Debois_Survey.gdb	
37	National Trust Debois Survey - Access (points)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Access_pl	National_Trust_Debois_Survey.gdb	
38	National Trust Debois Survey - Boundaries4 (polylines)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Boundaries4_pl	National_Trust_Debois_Survey.gdb	
39	National Trust Debois Survey - Hedges (polylines)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Hedges_pl	National_Trust_Debois_Survey.gdb	
40	National Trust Debois Survey - Historic Routes (polylines)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Historic_Routes_pl	National_Trust_Debois_Survey.gdb	
41	National Trust Debois Survey - Miscelleanous Earthworks (polylines)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Miscellaneous_Earthworks_pl	National_Trust_Debois_Survey.gdb	
42	National Trust Debois Survey - Proposals3 (polylines)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Proposals3_pl	National_Trust_Debois_Survey.gdb	
43	National Trust Debois Survey - TREES2 (polylines)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	TREES2_pl	National_Trust_Debois_Survey.gdb	
44	National Trust Debois Survey - Access (ellipse)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Access_Ellipse	National_Trust_Debois_Survey.gdb	
45	National Trust Debois Survey - Access (area polygons)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Access_pg	National_Trust_Debois_Survey.gdb	
46	National Trust Debois Survey - Boundaries4 (area polygons)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Boundaries4_pg	National_Trust_Debois_Survey.gdb	
47	National Trust Debois Survey -	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA	Character_Areas_pg	National_Trust_Debois_Survey.gdb	

ID	Dataset	Source	Date Received	Incoming Location	Final Name	Final Location	Notes
	Character Areas (area polygons)			EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data			
48	National Trust Debois Survey - Hedges (area polygons)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Hedges_pg	National_Trust_Debois_Survey.gdb	
49	National Trust Debois Survey - Historic Routes (area polygons)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Historic_Routes_pg	National_Trust_Debois_Survey.gdb	
50	National Trust Debois Survey - Miscellaneous Earthworks (ellipse)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Miscellaneous_Earthworks_Ellipse	National_Trust_Debois_Survey.gdb	
51	National Trust Debois Survey - Miscellaneous Earthworks (area polygons)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Miscellaneous_Earthworks_pg	National_Trust_Debois_Survey.gdb	
52	National Trust Debois Survey - Proposals3 (area polygons)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Proposals3_pg	National_Trust_Debois_Survey.gdb	
53	National Trust Debois Survey - TREES2 (area polygons)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	TREES2_pg	National_Trust_Debois_Survey.gdb	
54	National Trust Debois Survey - Woods (area polygons)	National Trust	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NationalTrust_Data	Woods_pg	National_Trust_Debois_Survey.gdb	
55	OS MasterMap - Topographic Point	Ordnance Survey	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_National_Trust_Data_from_emapsite	TopographicPoint	OrdnanceSurvey_MasterMap.gdb	Received from National Trust through emapsite Contractor Link
56	OS MasterMap - Cartographic Text	Ordnance Survey	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_National_Trust_Data_from_emapsite	CartographicText	OrdnanceSurvey_MasterMap.gdb	Received from National Trust through emapsite Contractor Link
57	OS MasterMap - Cartographic Symbol	Ordnance Survey	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_National_Trust_Data_from_emapsite	CartographicSymbol	OrdnanceSurvey_MasterMap.gdb	Received from National Trust through emapsite Contractor Link
58	OS MasterMap - Topographic Line	Ordnance Survey	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_National_Trust_Data_from_emapsite	TopographicLine	OrdnanceSurvey_MasterMap.gdb	Received from National Trust through emapsite Contractor Link
59	OS MasterMap - Boundary Line	Ordnance Survey	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_National_Trust_Data_from_emapsite	BoundaryLine	OrdnanceSurvey_MasterMap.gdb	Received from National Trust through emapsite Contractor Link
60	OS MasterMap - Topographic Area	Ordnance Survey	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_National_Trust_Data_from_emapsite	TopographicArea	OrdnanceSurvey_MasterMap.gdb	Received from National Trust through emapsite Contractor Link
61	Countryside Stewardship Scheme 2016 Management Options	Rural Payments Agency	03/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_Countryside_Stewardship_Scheme_2016_Management_Options_England	Countryside_Stewardship_Scheme_2016_Management_Options__England	Rural_Payments_Agency.gdb	
62	Crop Map of England (2020)	Rural Payments Agency	08/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_Crop_Map_of_England	Crop_Map_of_England_2020	Rural_Payments_Agency.gdb	
63	In-field trees on Middleton N Farm	Northumberland County Council	01/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220201_NCC_Datasets	In_Field_Trees_on_Middleton_N_Farm	Northumberland_County_Council.gdb	
64	Potential Local Wildlife Sites - Wansbeck	Northumberland County Council	28/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220128_NCC_Datasets	Potential_Local_Wildlife_Sites	Northumberland_County_Council.gdb	
65	New Hedges on National Trust Land	Northumberland County Council	03/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_NCC_Datasets	New_Hedges_on_Nat_Trust	Northumberland_County_Council.gdb	
66	New Hedges on Middleton N Farm	Northumberland County Council	01/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220201_NCC_Datasets	New_Hedges_on_Middleton_N_Farm	Northumberland_County_Council.gdb	
67	New Woods on Middleton N Farm	Northumberland County Council	01/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220201_NCC_Datasets	New_Woods_on_Middleton_N_Farm	Northumberland_County_Council.gdb	

ID	Dataset	Source	Date Received	Incoming Location	Final Name	Final Location	Notes
68	Northumberland County Council - Coastal Habitat Mapping	Northumberland County Council	02/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220202_NCC_Datasets	NCC_Coastal_Habitats	Northumberland_County_Council.gdb	
69	Disused Railway - Wansbeck	Northumberland County Council	28/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220128_NCC_Datasets	Disused_Railway	Northumberland_County_Council.gdb	
70	All Water Datasets - Wansbeck	Northumberland County Council	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_NCC_Datasets	All_Water_Datasets	Northumberland_County_Council.gdb	
71	HK6 - Maintenance of Species-Rich Grassland	Northumberland County Council	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_NCC_Datasets\Potential_Good_Grassland	HK6_Maintenance_SR_Grassland	Northumberland_County_Council.gdb	
72	GS7 - Restoration towards Species-Rich Grassland	Northumberland County Council	31/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220131_NCC_Datasets\Potential_Good_Grassland	GS7_Restoration_towards_SR_Grassland	Northumberland_County_Council.gdb	
73	New Woods on National Trust Land	Northumberland County Council	03/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_NCC_Datasets	New_Woods_on_Nat_Trust	Northumberland_County_Council.gdb	
74	Priority Rivers - Wansbeck	Northumberland County Council	03/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220203_NCC_Datasets	Priority_Rivers	Northumberland_County_Council.gdb	
75	SE Northumberland Ponds	Northumberland County Council	28/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220128_NCC_Datasets	SE_Northumberland_Ponds	Northumberland_County_Council.gdb	
76	Streams Buffered 0-10m - Wansbeck	Northumberland County Council	28/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220128_NCC_Datasets	Streams_Buffered_0_10m	Northumberland_County_Council.gdb	
77	Streams Buffered 10-50m - Wansbeck	Northumberland County Council	28/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220128_NCC_Datasets	Streams_Buffered_10_50m	Northumberland_County_Council.gdb	
78	Wet Grassland - Wansbeck	Northumberland County Council	01/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220201_NCC_Datasets	Wet_Grassland	Northumberland_County_Council.gdb	
79	Wetlandscape - Wansbeck	Northumberland County Council	28/01/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220128_NCC_Datasets	Wetlandscape	Northumberland_County_Council.gdb	
80	Fewest Tree Establishment Constraints - Wansbeck	Northumberland County Council	09/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220209_NCC_Datasets	Fewest_Tree_Establishment_Constraints_Wansbeck	Northumberland_County_Council.gdb	
81	All Meadows - Wansbeck	Northumberland County Council	08/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_NCC_Datasets	All_Meadows_Wansbeck	Northumberland_County_Council.gdb	
82	LNRS - Union - Sand Dune Potential Rollback & Conifer Management Areas - Wansbeck	Northumberland County Council	08/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_NCC_Datasets	Union_SandDuneRollback_ConiferMgt_Wansbeck	Northumberland_County_Council.gdb	
83	LNRS - Union - Purple Moor Grassland and Rush Pasture & Conifer Management Areas - Wansbeck	Northumberland County Council	08/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_NCC_Datasets	Union_PMGRP_ConiferMgt_Wansbeck	Northumberland_County_Council.gdb	
84	LNRS - Union - Peatland Restoration Potential & Conifer Management Areas - Wansbeck	Northumberland County Council	08/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_NCC_Datasets	Union_PeatPotential_ConiferMgt_Wansbeck	Northumberland_County_Council.gdb	
85	LNRS - Union - Upland and Lowland Hay Meadows & Conifer Management Areas - Wansbeck	Northumberland County Council	08/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_NCC_Datasets	Union_MeadowPotential_ConiferMgt_Wansbeck	Northumberland_County_Council.gdb	
86	LNRS - Union - Fragmented Heath & Land Conifer Management Areas - Wansbeck	Northumberland County Council	08/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_NCC_Datasets	Union_FragHeath_LandConiferMgt_Wansbeck	Northumberland_County_Council.gdb	
87	LNRS - Union - Flood Zone 3 & Conifer Management Areas - Wansbeck	Northumberland County Council	08/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_NCC_Datasets	Union_Floodplain_LandConiferMgt_Wansbeck	Northumberland_County_Council.gdb	
88	LNRS - Union - Ancient Woodland Expansion Zones & Conifer Management Areas - Wansbeck	Northumberland County Council	08/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220208_NCC_Datasets	Union_AncientWoodExpZones_ConiferMgt_Wansbeck	Northumberland_County_Council.gdb	
89	Public Rights of Way	Northumberland County Council	11/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220211_PROWs	Public_Rights_of_Way	Northumberland_County_Council.gdb	
90	Conservation Areas	Historic England	09/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220209_Historic_England_Data	Conservation_Areas	Historic_ England.gdb	

ID	Dataset	Source	Date Received	Incoming Location	Final Name	Final Location	Notes
91	Heritage At Risk 2021	Historic England	09/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220209_Historic_England_Data	HAR_2021	Historic__England.gdb	
92	Listed Buildings	Historic England	09/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220209_Historic_England_Data	Listed_Buildings	Historic__England.gdb	
93	Registered Parks & Gardens	Historic England	09/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220209_Historic_England_Data	Registered_Parks_Gardens	Historic__England.gdb	
94	Scheduled Monuments	Historic England	09/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220209_Historic_England_Data	Scheduled_Monuments	Historic__England.gdb	
95	Phase 1 Habitat Survey - Wansbeck Catchment	Northumberland Wildlife Trust Ltd	14/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220214_NWT_Wansbeck_Phase1	Phase1_Habitat_Survey_pg	Northumberland_Wildlife_Trust.gdb	
96	1km Grid Wader Zonal Map - CU GP	Northumberland County Council	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_NCC_Datasets	_1km_Grid_Wader_Zonal_Map_CU_GP	Northumberland_County_Council.gdb	
97	Interesting Verges	Northumberland County Council	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_NCC_Datasets	Interesting_Verges	Northumberland_County_Council.gdb	
98	Channel Sinuosity	Ordnance Survey	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_River_Restoration_Plan_Layers	Channel_Sinuosity	River_Restoration_Plan.gdb	Supplied by Neil Burrows
99	Named Rivers (dissolved)	Ordnance Survey	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_River_Restoration_Plan_Layers	Named_Rivers_dslv	River_Restoration_Plan.gdb	Supplied by Neil Burrows
100	River Gradient	Ordnance Survey	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_River_Restoration_Plan_Layers	Named_Rivers_Gradient	River_Restoration_Plan.gdb	Supplied by Neil Burrows
101	River Barriers	Rivers Trust	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_River_Restoration_Plan_Layers	River_Barriers	River_Restoration_Plan.gdb	Supplied by Neil Burrows
102	Valley Bottom	Environment Agency	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_River_Restoration_Plan_Layers	Valley_Bottom	River_Restoration_Plan.gdb	Supplied by Neil Burrows
103	WFD Catchments	Environment Agency	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_River_Restoration_Plan_Layers	WFD_Catchments	River_Restoration_Plan.gdb	Supplied by Neil Burrows
104	WFD Rivers	Environment Agency	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_River_Restoration_Plan_Layers	WFD_Rivers	River_Restoration_Plan.gdb	Supplied by Neil Burrows
105	Elevation (raster)	Environment Agency	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_Topo_Rasters	Elevation	Topography.gdb	Supplied by Neil Burrows - converted to polygon for WebGIS use
106	Slope (raster)	Environment Agency	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_Topo_Rasters	Slope	Topography.gdb	Supplied by Neil Burrows - converted to polygon for WebGIS use
107	Valley depth (raster)	Environment Agency	15/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220215_Topo_Rasters	Valley_Depth	Topography.gdb	Supplied by Neil Burrows - converted to polygon for WebGIS use
108	Local Nature Reserves	Natural England	16/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220216_Local_Nature_Reserves	LNR	Natural_England.gdb	
109	OS Open Names	Ordnance Survey	17/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220217_OS_Open_Names	OS_Open_Names	OrdnanceSurvey_Open_Data.gdb	
110	Land Use - Constraints	UK Centre for Ecology and Hydrology	23/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220223_RRP_Constraints_Opportunities	Land_Use_Constraints	River_Restoration_Plan.gdb	Supplied by Neil Burrows
111	OS Merged Infrastructure - Constraints	Ordnance Survey	23/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220223_RRP_Constraints_Opportunities	OS_Merged_Infrastructure	River_Restoration_Plan.gdb	Supplied by Neil Burrows
112	River Restoration Opportunities	AECOM analysis result	23/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220223_RRP_Constraints_Opportunities	River_Restoration_Opportunities	River_Restoration_Plan.gdb	Supplied by Neil Burrows
113	Bedrock geology - Wansbeck	British Geological Survey	23/02/2022	\\na.aecomnet.com\Ifs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220223_BGS_Geology\WansbeckGeology	Bedrock_Geology	BGS_Geology.gdb	Supplied by Heather Harrison at Environment Agency

ID	Dataset	Source	Date Received	Incoming Location	Final Name	Final Location	Notes
114	Linear Geology - Wansbeck	British Geological Survey	23/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220223_BGS_Geology\WansbeckGeology	Linear_Geology	BGS_Geology.gdb	Supplied by Heather Harrison at Environment Agency
115	Superficial Geology - Wansbeck	British Geological Survey	23/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220223_BGS_Geology\WansbeckGeology	Superficial_Geology	BGS_Geology.gdb	Supplied by Heather Harrison at Environment Agency
116	SCIMAP - Simulation, channel accumulated risk	SCIMAP	24/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220224_RRP_SCIMAP	SCIMAP_Simulation_v0_1_channel_accumulated_risk	River_Restoration_Plan.gdb	Supplied by Neil Burrows
117	SCIMAP - Simulation, stream (raster)	SCIMAP	24/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220224_RRP_SCIMAP	SCIMAP_Simulation_v0_1_stream	River_Restoration_Plan.gdb	Supplied by Neil Burrows
118	SCIMAP - Simulation, connectivity (raster)	SCIMAP	24/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220224_RRP_SCIMAP	SCIMAP_Simulation_v0_1_connectivity	River_Restoration_Plan.gdb	Supplied by Neil Burrows - converted to polygon for WebGIS use
119	SCIMAP - Simulation, erosion risk (raster)	SCIMAP	24/02/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220224_RRP_SCIMAP	SCIMAP_Simulation_v0_1_erosion_risk	River_Restoration_Plan.gdb	Supplied by Neil Burrows - converted to polygon for WebGIS use
120	NATMAP1000	LandIS	01/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220301_NATMAP_Soils_Data	NATMAP1000	NATMAP.gdb	Supplied by Heather Harrison at Environment Agency
121	NATMAP2000	LandIS	01/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220301_NATMAP_Soils_Data	NATMAP2000	NATMAP.gdb	Supplied by Heather Harrison at Environment Agency
122	NATMAP5000	LandIS	01/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220301_NATMAP_Soils_Data	NATMAP5000	NATMAP.gdb	Supplied by Heather Harrison at Environment Agency
123	NATMAP Leaching	LandIS	01/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220301_NATMAP_Soils_Data	NATMAP_Leaching	NATMAP.gdb	Supplied by Heather Harrison at Environment Agency
124	NATMAP Runoff	LandIS	01/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220301_NATMAP_Soils_Data	NATMAP_Runoff	NATMAP.gdb	Supplied by Heather Harrison at Environment Agency
125	NATMAP Vector	LandIS	01/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220301_NATMAP_Soils_Data	NATMAP_Vector	NATMAP.gdb	Supplied by Heather Harrison at Environment Agency
126	NATMAP Soilscapes	LandIS	02/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220302_NATMAP_SoilScapes	NATMAP_Soilscapes	NATMAP.gdb	Supplied by Carole Adolf at Natural England
127	Woodland Network - Run 1	AECOM modelling output	10/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220310_Network_Models_Version1	WDL_Network_Woodland_Run1_v1	Hab_Network_Modelling.gdb	Model output created by Geoff Chapman
128	Woodland Network - Run 2	AECOM modelling output	10/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220310_Network_Models_Version1	WDL_Network_Woodland_Run2_v1	Hab_Network_Modelling.gdb	Model output created by Geoff Chapman
129	Peatland & Heathland Network - Run 1	AECOM modelling output	10/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220310_Network_Models_Version1	PHL_Network_Heathland_Run1_v1	Hab_Network_Modelling.gdb	Model output created by Geoff Chapman
130	Grassland Network - Run 1	AECOM modelling output	10/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220310_Network_Models_Version1	GRS_Network_Grassland_Run1_v1	Hab_Network_Modelling.gdb	Model output created by Geoff Chapman
131	Grassland Network - Run 2	AECOM modelling output	10/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220310_Network_Models_Version1	GRS_Network_Grassland_Run2_v1	Hab_Network_Modelling.gdb	Model output created by Geoff Chapman

ID	Dataset	Source	Date Received	Incoming Location	Final Name	Final Location	Notes
132	Woodland Network - Run 2 (version 2)	AECOM modelling output	15/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220315_Network_Models_Version2	WDL_Network_Woodland_Run2_v2	Hab_Network_Modelling.gdb	Model output created by Geoff Chapman
133	Peatland & Heathland Network - Run 1 (version 2)	AECOM modelling output	15/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220315_Network_Models_Version2	PHL_Network_Heathland_Run1_v2	Hab_Network_Modelling.gdb	Model output created by Geoff Chapman
134	Grassland Network - Run 2 (version 2)	AECOM modelling output	15/03/2022	\\na.aecomnet.com\lfs\EMEA\Altrincham-UKMCR1\Legacy\UKMCR1FP002-V1IE\Proposal\3512\EA EcoSF3 Wansbeck\3. GIS\03_Incoming\20220315_Network_Models_Version2	GRS_Network_Grassland_Run2_v2	Hab_Network_Modelling.gdb	Model output created by Geoff Chapman

Appendix B

Designated Sites Within the Wansbeck Catchment

Table 13-1 Summary of Statutory Designated Sites within the Wansbeck Catchment

Name	Designation	Description
Simonside Hills	SAC	On the northern boundary of the catchment. Designated for its habitats including European dry heath and blanket bog.
Simonside Hills	SSSI	Designated for the following habitats: bogs, broadleaved, mixed and yew woodland and dwarf shrub heath.
The Northumberland Shore	SSSI	Located at the mouth of the River Wansbeck. Designated for habitats: Littoral Rock and Littoral Sediment.
Bavington Crags	SSSI	On the southern boundary of the catchment. Designated for acid grassland habitat.
Greenleighton Quarry	SSSI	Designated for its geological interest.
Fallowlees Flush	SSSI	Designated for fen, marsh and swamp habitats.
Castle Island	LNR	A remnant salt marsh island now marooned in brackish water, approximately 300 m inland from a weir on the River Wansbeck, south of Ashington.
Wansbeck Riverside Park	LNR	The park covers approximately 112 hectares of woodland, grassland and the river. It is located to the south of Ashington between the A1068 and A189.
Choppington Community Woods	LNR	The site of two former coal mines, High Pit and Low Pit. Includes woodland habitat and a pond.
Carlisle Park	LNR	Situated in Morpeth on the south bank of the River Wansbeck, it contains the William Turner Garden, formal gardens and ancient woodland.
Scotch Gill Wood	LNR	Located off Mitford Road, Morpeth, the LNR is designated for its ancient woodland habitat.
Davies Wood	LNR	Designated for woodland habitat.
Bracken Bank	LNR	Designated for flora and fauna and woodland trees.
Borough Woods	LNR	Designated for ancient woodland habitat along the steep slopes of the River Wansbeck Valley.

Table 13-2 Summary of Non-statutory Designated Sites within the Wansbeck Catchment

Name	Designation	Description
Bothal Burn and River Wansbeck (ponds 2)	LWS	No information available
Cotting Woods	LWS	Woodland habitat.
Font River – Colt Park to Netherwitton	LWS	No information available.
Font River Woods	LWS	Woodland Habitat
Fontburn Reservoir	LWS	The reservoir is a popular fishery and holds both rainbow and brown trout. There is a conservation area immediately north of the reservoir which is managed by Northumberland Wildlife Trust and Northumbrian Water.
Green Rig Moss	LWS	Designated for peatland and heathland habitat.
Ottercops Burn and Mosses	LWS	Designated for peatland and heathland habitat.
Rothley Lakes	LWS	Created in the late 1760s as part of Sir Walter Blackett's pleasure ground. The site is 7.6 hectares and surrounded by wetlands and woodland. Supports wildlife including otter, badger, red squirrel, white clawed crayfish, bats and a wide range of birdlife. The site is home to significant veteran trees, large beech and scots pine planted from the 1760s onwards.
Shaftoe Crags	LGS	A small remnant fragment of upland habitat, where the crags are dominated by bracken, heather, rushes (Juncus spp.) and sedges (Carex spp.). The crags also support good epiphytic lichen flora, including the uncommon Lasallia pustualata.
Sweethope Loughs	LWS	Open water
The Wanneys and Aid Moss	SNCI	Aid moss is an area of blanket bog, and the Aid and Wanney crags are designated for geological interest,
Tranwell Woods	LWS	Woodland habitat.
Wallington and Little Harle	LWS	No information available.
Wansbeck and Hartburn Woods	LWS	Includes a narrow strip of ancient semi-natural woodland, plantation ancient woodland, conifer plantations and areas of broad-leaved woodland.
Wansbeck Estuary	LWS	Estuarine habitats.
Wansbeck River – Chapel Woods	LWS	Woodland habitat.

Appendix C

Minutes from Stakeholder Engagement Meetings

Meeting name Wansbeck Nature Recovery Plan stakeholder consultation	**Subject** Consultation with technical stakeholder group	**Attendees** Kirstin Aldous, Principal Ecologist, Aecom Neil Burrows, Senior Geomorphologist, Aecom Neil Williams, Associate Geomorphologist, Aecom Stephanie Peay, Associate Ecologist, Aecom Lydia Nixon, LNRS lead, Natural England Bob Cussen, Tree Action Plan, Natural England Paul Hewiitt, Estate Manager, Wallington Estate, National Trust Michelle MacCallam, landscape architect. Groundwork NorthEast Peter Kerr, Director, Northumbria Rivers Trust, Abi Mansley, GIS analyst and LNRS, Northumberland County Council Heather Harrison, Environment Agency David Feige, Environmental Design Team Manager and County Ecologist, Northumberland County Council Mark Childs, project manager Great Northumberland Forest Susie Hardy, Natural England
Meeting date 02/03/2022	**Time** 09:30-11:30	
Project name Wansbeck Nature Recovery	**AECOM project number** 60676363	

Ref	Action	Comment from	Initial
01	**Woodland – presentation by Kirstin Aldous**		
	Buffer zone, if for general woodland planting or natural regeneration 200-300m would be fine, but if more focused on creating woodland with woodland flora (poor colonisers) a narrower buffer would be better.		**D Feige**
	Don't want to show woodland everywhere – need to keep space for farming.		**L Nixon**
	Good to plant woodland along streamsides. Also join up high quality woodland. Also need to be aware of farming needs and keep best areas for growing crops.		**P Kerr**
	Consider soil maps for suitability for habitats, but also soil grades. Farmers will only want to consider habitat creation on less productive land in most cases.		**B Cussen**
	Land which is less productive is also the most likely to retain semi-natural habitat of some kind, e.g. grassland, so need to be careful that areas selected for woodland creation wouldn't be better being retain or restored as other habitat.		**S Peay (and agreement from others)**
	Previously Abi Mansley suggested a buffer of 60-100m would be useful for woodland, reflecting a typical range for natural regeneration extending from existing woodland.		**M Childs**
	In current incentive scheme woodland within 60m of existing woodland gets a one-off premium payment in addition to the grant for natural regeneration or planting, and the buffer can be extended wider in some cases.		**P Kerr**
	Consider climate in planting woodland, some species are more climate resilient than others, consider pest susceptibility/resistance. Good mxes of species are desirable.		
02	**Grassland - presentation by Kirstin Aldous**		
			L P Hewitt
			D Feige

Ref	Action	Comment from	Initial
	It can be difficult to see the potential of grassland for restoration if it is heavily grazed. May need to take grazing off or reduce it in order to assess the potential.		**L Nixon** **B Cussen**
	There isn't enough information on grassland condition. Need more information on nutrient status.		**S Peay**
	More soil sampling for nutrients might help.		
	Valley bottoms: possible conflicts of interest – more woodland or grassland? Likely want to have mosaics of different types.		
	Valley bottoms can be good for habitat creation and restoration in the riparian zone, but broad valley bottoms often have the most fertile soils and can be the most productive, at least if drained (as most are), so farmers may be reluctant to reduce production on those areas and they may be too fertile for species-rich grassland. Steeper valley sides might have more potential.		
03	**Rivers and restoration opportunities – presentation by Neil Burrows**		
	There has already been some work one to reconnect the old river channel at lower Donkinrgg Farm, only partly at high flow, also buffer zones and riparian fencing. No woody dams, tenant is reluctant. MMacC can provide details of works undertaken.		**M MacCallum**
	Lots of interesting ideas shown, but frustrated that the work presented has been done without contact with landowners and other stakeholders.		**P Kerr**
	LNRS will be a formal process. This current work will feed into that process. Any priorities identified here may be different to those from the legal process.		**L Nixon**
	L Nixon and S Peay explained that this was the earliest opportunity in the short timeframe of the project, most of the work had been in compiling GIS to carry out high level work. Landowner group meeting scheduled for 03/03/2022.		
	Riparian fencing is a key issue throughout the catchment. Maps show lots of watercourses as straight lines, scope to change in some cases. Regarding woody debris dams/leaky dams in some rivers positioning of those can exacerbate problems, where there is scouring deeper and this has been known to sometimes further disconnect the river from its floodplain. Also need to consider fish passage. Storm Arwen a potential source of material for well-placed dams.		**B Cussen**
04	**Peatland and Heathland – presentation by Kirstin Aldous**		
	New guidance came out last summer re afforestation and peat. Definition of deep peat (no planting) has been agreed. But there is still an issue regarding re-stocking of forest on peat. Is there more guidance?		**M Childs**
	There is a firm position on new planting. Not on peat 30cm or more deep or on shallower peat which is hydrologically connected to deep peat of 30cm or more. Peat maps do miss some areas of peat (in other areas of Northumberland, don't know about Wansbeck), but they have been identified when NVC surveys have been submitted with forestry proposals. There is potential for habitat restoration of some deep peat areas which won't be re-forested. There is still disagreement on restocking on peat, but it will depend on the expected yield class for forestry on the site. There are two new proposals for forestry in the Wansbeck catchment and there may be more.		**B Cussen**

Ref	Action	Comment from	Initial
	Proposals may be in line with woodland creation options identified here, or conflict. They may remove some areas from opportunities.		**A Mansley**
	All peat areas are excluded from woodland planting for Great Northumberland Forest. Others noted that there might be a case for beneficial exceptions, e.g. riparian planting or natural regeneration.		
	The GIS should be updated regularly because habitats change on the ground, and information about them.		**B Cussen**
	There has been some deciduous woodland creation done, have included in GIS where known, e.g. areas from Wallington and a few others		**L Nixon** **D Feige**
	The default position should be no planting on peat or peaty pockets. Can review individual cases where applicable.		
	Could Water Companies be a possible source of funding for restoration work in upland areas – there are water supply reservoirs in the upper catchment.		**H Harrison**
	Yorkshire Water has undertaken work with universities on the issue of colour in water. It is cheaper to improve management in uplands to reduce colour in reservoir waters than to build infrastructure to treat for colour. H Harrison asked to be put in contact with Yorkshire Water (SP to do).		**S Peay**
05	**Coastal – presentation by Kirstin Aldous**		
	United view was that the barrage should be removed, because it is damaging to the ecology. But the view was that, politically, it wouldn't be possible due to amenity interests, because it has become popular for water-based recreation. There may be the possibility of reintroducing a partial tidal range.		
	Another study is underway to assess the feasibility of changing the barrage, but it will not be ready for c 2 months.		**M MacCallum**
	A field south of the estuary (visible with pale dots on the air photography) has been developed as a mitigation site for wetland birds, so that will stay in management for conservation. North of the estuary the area is already built up and the field remaining between the coastal caravan park and the rest of the urban area is under development pressure. Furthermore that area would be subject to heavy disturbance and risk of predation (cats) so not suitable for birds.		**D Feige**
	There is very little scope to do anything at the coast here.		**B Cussen**

Meeting name Wansbeck Nature Recovery Plan stakeholder consultation	**Subject** Consultation with farmer group	**Attendees** Kirstin Aldous, Principal Ecologist, AECOM Neil Burrows, Senior Geomorphologist, AECOM Lydia Nixon, LNRS lead, Natural England Abi Mansley, GIS analyst and LNRS, Northumberland County Council Heather Harrison – Environment Agency Various farmers and landowners within the catchment.
Meeting date 03/03/2022	**Time** 10.00 -13:30	
Project name Wansbeck Nature Recovery	**AECOM project number** 60676363	

#	Comments
01	Farmers generally reacted positively to the scheme and welcomed opportunities to deliver nature-based solutions within the catchment.
02	There were concerns that there was still too much 'white space' on the baseline maps, and that they did not capture the good work that farmers were already doing.
03	Some landowners (such as the National Trust) have more resources available to them to map their land (volunteers) – it does not necessarily mean there are more habitats present or the land is in a better condition. This can skew the mapping results.
04	Farmers would like a greater understanding of how improvements might be funded. Farmers who were already making improvements on their farms should not miss out.
05	Whilst the strategic approach to the project was understood, landowners wanted to have a say in how the land might be managed in the future and preferred a 'bottom up' rather than 'top-down' approach.
06	Farmers felt that mapping the quality of the habitats present was a useful exercise – knowledge is power.
07	Many farmers have already made management plans within their estates, identifying the best areas to make improvements.
08	The maps we created used publicly accessible data and data that had been shared by partner organisations. Information on land condition is collected as part of agri-environment scheme applications but is not publicly available. This might be a missed opportunity.
09	Ridge and furrow fields within the catchment have historic value and the topographical variation provides a microclimate of wet and dry areas that can be botanically more diverse.
10	There are more areas of wet, marshy grassland within the catchment that are not showing on the maps.
11	Habitats such as woodland require a commitment over a long period of time and farmers / landowners can be nervous creating these in case they miss future opportunities.
12	There is a focus on the environment currently, but this could switch to food production depending upon politics / world events.
13	There was frustration with current schemes – many comments that these were admin heavy, and farmers often don't get paid on time.
14	Where farmers have accessed funding and made improvements to their land, they could hold workshops or training sessions to demonstrate what is possible.

Appendix D

Farming for Wildlife – Grip Blocking

for birds
for people
for ever

FARMING FOR WILDLIFE

Grip blocking

Andy Hay (rspb-images.com)

The use of solid dams can help restore natural drainage patterns and encourage the colonisation of characteristic vegetation.

Moorland gripping is the practice of digging ditches to drain wet areas of heath and blanket bog. Gripping was a practice particularly widespread in the northern uplands in the 1960s to the mid 1980s, often encouraged by grant aid. The use of drainage ditches on Exmoor and Dartmoor was also common. Changes to the hydrological management of upland habitats can be detrimental to the characteristic vegetation and species of the uplands, as well as increasing the risk of soil erosion and flash flooding. Grip blocking can help to restore natural drainage patterns, encourage re-vegetation, reduce erosion, and minimise the knock-on effect of hydrological change downstream.

BENEFITS FOR WILDLIFE

Grip blocking helps restore a characteristic community of plants

Blocking grips will raise the water level to at, or near, the soil surface, encouraging the colonisation of sphagnum and other specialist plant species, for example bog asphodel, cloudberry, bog orchid and sundew. Blanket bogs and other mire vegetation communities are of significant conservation value.

Grip blocking can provide important feeding habitat for birds

The wet flushes created by blocking grips can increase invertebrate numbers, which provide a valuable food source for grouse chicks as well as wading birds, such as curlews, snipe, lapwings and golden plovers. Cranefly (leatherjackets) and chironomid larvae are particularly important for foraging chicks.

GUIDELINES OVERLEAF

HOW CAN I BENEFIT WILDLIFE WITH GRIP BLOCKING?

DETRIMENTAL EFFECTS OF DRAINAGE USING GRIPS INCLUDE

- Loss of young birds, including grouse and waders, which fall into and cannot get out of steep-sided grips.
- Loss of lambs and sheep, which fall into deep, eroded grips and can't escape.
- Damage to the delicate mosaic of characteristic plant species associated with a diversity of wet soil conditions.
- A reduced number of invertebrates, which are used as a food source for a variety of birds.
- An increased incidence of flooding and flash flooding caused by greatly increased speed of run-off.
- An increase in erosion and silting up of streams.

OBJECTIVES OF GRIP BLOCKING

- Restoring natural drainage patterns.
- Encouraging re-vegetation of the bog surface.
- Reducing erosion.
- Minimising the knock-on effect of hydrological change downstream.

These objectives are achieved by

- Blocking eroding grips.
- Blocking active grips that are maintaining themselves.
- Blocking grips across level and basin/raised mire areas.
- Allowing grips to infill naturally where possible.
- Designing works to avoid danger to stock and wildlife.

METHODS OF GRIP BLOCKING

Peat dams

- Using a 'plug' of peat to hold back the water in the grip encourages the silting up process, which can become rapidly recolonised by sphagnum and other plant species.
- For small drains, dams can be quickly constructed by removing spadefuls of peat and placing the peat on the site of the dam. On larger drains it may be easier to use a machine.
- The peat dams should be formed using peat extracted from the grip itself up slope from the proposed dam, and then compacted into the grip. Peat should never be taken from undisturbed areas of moorland.
- The height of the dam should just exceed the height of the grip to prevent water over spilling the dam – water should be encouraged to seep out at the sides.
- On shallow gradients, grips may need to be blocked at regular intervals.
- It is important that the depth of water behind the dam does not exceed 60 cm as this can cause a hazard to livestock.

Solid dams

- Dams can also be constructed using solid materials such as corrugated plastic sheeting, plastic piling, and wooden structures.
- Solid dams should last for many years and are not prone to drying and cracking in dry periods like peat dams. Solid dams can be particularly useful when blocking wide or deep dams.
- Dams constructed from corrugated plastic sheeting are relatively easy to install and they cause minimal disturbance to the site where the dam is being constructed. Create narrow 'starter notches' with a spade, and then position the sheeting vertically into the notches. Push the sheet into the ground as far as possible, place a sturdy piece of wood across the top of the sheet and lightly hammer the plastic to the required depth. The top of the dam should just exceed the height of the grip.
- Interlocking plastic piling is available, and can be used to construct dams that are strong and watertight. Plastic piling is particularly useful for blocking wide grips.
- Piles should be driven into the peat at least 40 cm beneath the bottom of the drain.
- Plastic piling can be expensive, and the heavy nature of the material can make it difficult to transport.

Blocking

- Bales of plant material such as heather and rush can be used to block grips and slow down the rate of water flow, thus encouraging silting and recolonisation of natural vegetation.

OTHER MANAGEMENT CONSIDERATIONS

- Blocking grips adjacent to in-bye pasture can provide damp pasture beneficial for breeding wading birds. Water run-off from gripped moors can lead to flash flooding on the in-bye, which can be detrimental to ground-nesting birds and also lead to a temporary loss of grazing.
- The use of machinery can seriously damage some vegetation in the uplands, and where appropriate other methods should be considered.
- Care must always be taken to minimise hazards and disturbance to livestock and wildlife.

Agri-environment schemes can fund this type of management. You can get further information on this and other ways of managing your farm for wildlife from:

RSPB

Agricultural Adviser, The RSPB, UK Headquarters, The Lodge, Sandy, Bedfordshire SG19 2DL. Tel: 01767 680551

FWAG

Farming and Wildlife Advisory Group, NAC, Stoneleigh, Kenilworth, Warwickshire CV8 2RX. Tel: 024 7669 6699

THE GAME CONSERVANCY TRUST

The Game Conservancy Trust, Fordingbridge, Hampshire SP6 1EF. Tel: 01425 652381

RSPB regd charity no 207076

24-1336-02-03

PRIORITY ACTION

- Ensure work undertaken as part of a programme of grip blocking does not damage existing vegetation.
- Seek expert advice prior to undertaking a programme of grip blocking.
- Grant aid may be available from statutory conservation agencies and through agri-environment schemes.

Sponsor:

defra

Department for Environment Food and Rural Affairs

Contact the Defra helpline for information and application packs for agri-environment schemes: 08459 335577.

Appendix E

Farming for Wildlife - Managing Water Levels to Benefit Birds

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FARMING FOR WILDLIFE

Managing water levels to benefit birds

Eric Woods (rspb-images.com)

Waders such as the snipe need land with a high water table in the spring and early summer.

Land that remains damp into the early summer is a particularly good source of earthworms, insects and other invertebrates, providing rich feeding habitat for a number of farmland birds. Several birds of conservation concern, notably wading birds such as lapwings, breed in damp grassland. Where re-wetting is considered, the aim is to combine water control and appropriate land management, particularly grazing, to produce the desired wetland habitat.

BENEFITS FOR WILDLIFE

Maintaining higher water levels on grassland from late winter into the spring and early summer provides important breeding and feeding habitat for a variety of birds

By re-creating grasslands that remain damp into the summer, ideal feeding and nesting conditions may be created for wading birds such as lapwings, redshanks, snipe and curlews.

Suitable breeding habitat may also be created for other birds, such as yellow wagtails. Different species have preferences for certain sward structure and levels of soil dampness, so appropriate management is essential to benefit any particular species.

Wet grassland also provides valuable feeding habitat for other farmland birds such as the tree sparrows, song thrushes, starlings and reed buntings. Soft damp soil and the edges of standing water are important to these species on all farm types when they are feeding their chicks on invertebrates.

GUIDELINES OVERLEAF

HOW CAN I MANAGE WATER LEVELS TO BENEFIT BIRDS?

Selecting suitable sites for re-wetting

- Many farms will have areas that, in the past, remained wet into the summer, but have since been drained. Areas targeted for wet grassland management should generally have been wetter in the past.
- Knowledge of the past management history, notably drainage, will be valuable and, in some cases, simply reversing or controlling the outflow of water from a drainage ditch will bring the desired result.
- Knowledge of habitats and species present in the locality, both past and present, should be used to inform decisions on the desired end-result.

Understanding soils

- Water moves faster through soils composed of large particles (sand or peat) and well-structured soils. Water flows more slowly through soils composed of small particles (clay or silt), particularly where the soil structure is poor. Some clays may be virtually impermeable.
- Soil type will determine whether manipulating water tables alone will create soft ground, ideal for feeding birds. If not, water will need to be directed into features such as 'scrapes' or foot drains, providing shallow water and muddy margins in which birds can probe and search for food.

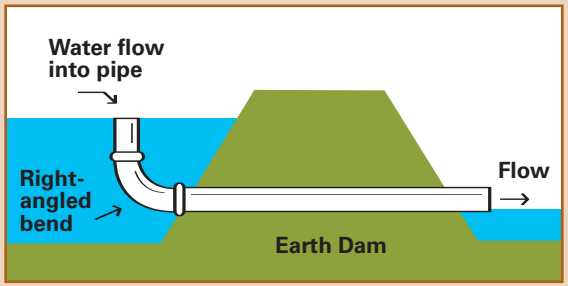
HLS Managing water levels

- Re-wetting may be undertaken in a range of soil and hydrological conditions and the simplest schemes are often no more complicated than reversing or reducing the drainage function in a particular area.
- In areas with a wetter climate, such as upland areas, the rainfall is sufficient to keep sites wet into June, and reducing the rate of run-off is sufficient.
- In drier locations, it will be necessary to direct water to a chosen location and/or install water control structures to reduce losses. The availability of water is a crucial factor. Water input will depend on rainfall, surface water (river/stream flows) and groundwater levels. Water loss will depend on evapo-transpiration (from vegetation and open water) and seepage from groundwater, drainage or run-off.
- Water control structures, such as sluices, enable the ability to control the inflow or outflow of water and thus the water level in the field. Without control, the grassland may dry out too soon in early dry weather, while a wet spring may result in levels remaining too high.
- A cost effective sluice can be constructed with a length of plastic piping, either rigid pipe with a swivel end or flexipipe, laid through an earth dam in the outflow ditch (figure 1). Adjusting the upstream end will set the desired water levels.
- Consider any likely impacts on surrounding land from blocking or diverting drainage and consult with the necessary statutory agency (eg The Environment Agency in England and Wales) for further advice.

The water regime

- Retain a high water table from March to May over 30% of the area and/or shallow water on 5–10% of the area. The majority of the land should be able to support grazing livestock without causing serious poaching.
- From May to July, allow natural draw down of water levels, creating shrinking shallow pools with muddy edges.
- From July, the water table should be reduced sufficiently to enable any machinery operations to be undertaken without damaging soil structure. If possible, maintain some water in ditches to benefit other wildlife.

Figure 1
Diagram of pipe sluice



KEY POINTS

- Assess hydrology and soils prior to attempting re-wetting.
- Aim to maintain a high water table from March to June.
- Ensure grassland management provides desired sward structure through the breeding season.
- The Higher Level Scheme can fund re-wetting projects.

KEY

HLS = Higher Level Stewardship

For full details, refer to Defra scheme handbooks.

For answers to all of your farm wildlife enquiries, visit www.farmwildlife.info

You can get further information on this and other ways of managing your farm for wildlife from:

Agricultural Adviser, The RSPB, UK Headquarters, The Lodge, Sandy, Bedfordshire SG19 2DL
Tel: 01767 680551
www.rspb.org.uk/farming

Farming and Wildlife Advisory Group, NAC, Stoneleigh, Kenilworth, Warwickshire CV8 2RX Tel: 024 7669 6699
www.fwag.org.uk

The Game Conservancy Trust, Fordingbridge, Hampshire SP6 1EF Tel: 01425 652381
www.gct.org.uk

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Appendix F

Farming for Wildlife - Scrape Creation for Wildlife

RSPB

a million voices for nature

FARMING FOR WILDLIFE

Scrape creation for wildlife

Above: Wetland invertebrates and birds will benefit from the creation of scrapes on your land

Scrapes are shallow depressions with gently sloping edges, which seasonally hold water. They create obvious in-field wet features that are very attractive to wildlife.

They support a wide variety of invertebrates and can provide important feeding areas for breeding wading birds and their chicks.

BENEFITS OF SCRAPE CREATION

Creating new scrapes, and other wet features, is a great way of enhancing damp grassland for wildlife.

They support a wide variety of aquatic, terrestrial and aerial invertebrates, such as beetles, bugs and molluscs, some of which can be rare and of conservation importance.

Research has shown that wet features can provide very important feeding areas for breeding wading birds such as lapwings and redshanks, and their chicks, which find lots of invertebrate food in and around the wet muddy edges. Other farmland birds such as tree sparrows and yellow wagtails may also benefit from these insect-rich areas.

GUIDELINES OVERLEAF

CREATING SCRAPES ON YOUR LAND

Location

The suitability of site for scrape creation may depend on factors such as:

- soil type
- size of site
- land levels and topography
- water sources and quality
- existing land drainage systems and drain locations
- existing flora and fauna, SSSI designations and archaeological/landscape features.

Scrapes for wading birds will usually be located in the lower lying and more open areas of a site, away from tall hedges, woodland and overhead lines. Fields over three hectares are best, while for some aquatic invertebrates a wider variety of situations will be of benefit.

Avoid areas with existing wildlife interest and seek advice about features of landscape, historical or archaeological importance, as scrapes may not be appropriate in some situations. Create a 'cluster' of scrapes of varying sizes and designs, rather than one big one, to provide the greatest benefits for a range of wildlife.

Mike Shurmer (RSPB)

Scrape creation

Gary Woodburn (RSPB)

A simple scrape feature

Scrape design

The most important parts of scrapes for wildlife are the margins. Shallow water and muddy edges provide ideal conditions for wetland invertebrates and plants, and allow access for waders and their chicks to find food. A scrape can be any shape, but edges should always be very gently sloping and with irregular and varied outlines if possible.

Scrapes should be shallow, though not with a uniform depth across the whole area. Deeper areas towards the middle of the scrape should be around 50 cm deep, with humps and hollows throughout to provide as many niches for plants and animals as possible. The suggested minimum size of a scrape is approximately 20 m2. Three of these per hectare would represent a good level of habitat provision. Management of the scrape and sward may also be a factor when deciding on design. If mowing is used, keep the scrape layout simple to make tractor operations simple and quick. Shallow scrapes can be mown through.

Soils

Scrapes can be created on a variety of soil types. On low permeability soils, for example clays and silts with poor structure, the objective is to retain 'perched water' in the features. On permeable soils, for example peats, or those with sand or gravel elements, the objective may be to raise the general water table in the soil so that scrapes will 'break through' to the water table, creating obvious in-field wet features.

Water supply and quality

Scrapes should hold water from March through to the end of June to provide feeding areas for waders and their chicks. These features will usually remain wetter for longer than the surrounding grassland, and so become increasingly important as the rest of the site dries out as summer progresses. Wader chicks may be particularly reliant on these areas to ensure they can find enough food before fledging.

Nigel Blake (rspb-images.com)

Redshank

Gary Woodburn (RSPB)

A scrape created on an old ditch line, with water control pipe

Some scrapes will simply be fed by rainfall and winter floodwater, where this is sufficient. Scrapes can also be created along in-field ditch lines where they are fed by water from the ditch, or connected to them by a footdrain or similar water carrier. Providing an outflow with a control sluice will allow levels in the scrape to be controlled.

Connecting the scrape to a water source may be preferable for wading birds, as the feature is likely to retain water and its associated muddy feeding margins for longer. However, this may be less beneficial for other associated wildlife, if such water contains excessive nutrients, chemicals or silt. Allowing some scrapes to completely dry up at the end of summer will also benefit some invertebrates by limiting larger predators and maintaining early successional habitat stages. A variety of connected and non-connected features are probably best.

Scrape management

Once the scrape is created, it is important to maintain open, muddy margins where wading birds can find and access food. If the margins become too overgrown with plants such as rush, wader use will decline rapidly. Allow livestock to graze and poach the margins at low levels, and do not fence the scrape off. Mowing all, or some of, the margins each year may also be required.

Maintain a small proportion of longer marginal vegetation to provide additional habitat variety, which will benefit invertebrates and plants and provide cover for chicks.

Consents and licensing

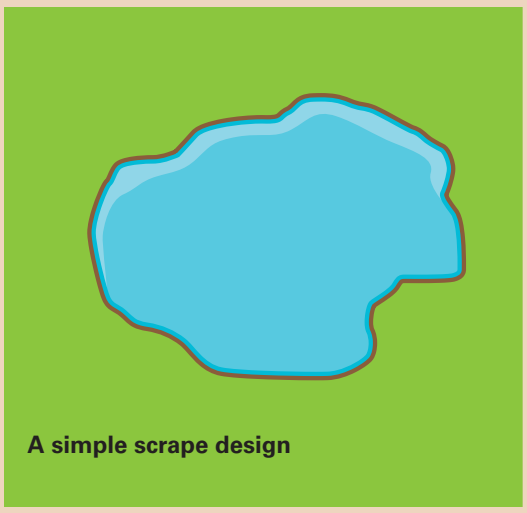
Creating water-retaining features such as scrapes may require consents, licenses or permissions. Consult with the relevant statutory body at an early stage, which may be able to provide advice and help with your project.

Funding

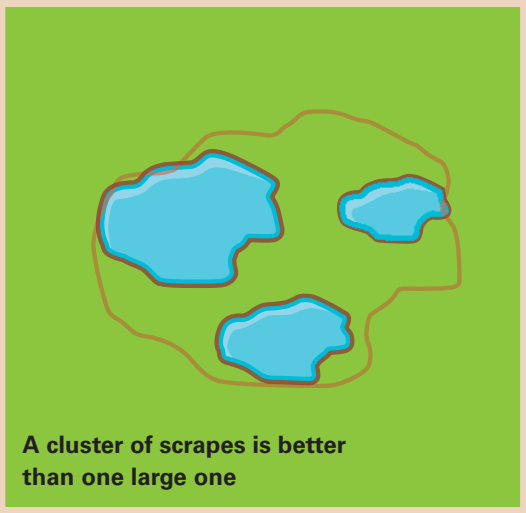
The scrapes, foot drains and grazing management outlined in this leaflet may be eligible for grant funding under current agri-environment schemes.

Chris Knights (rspb-images.com)

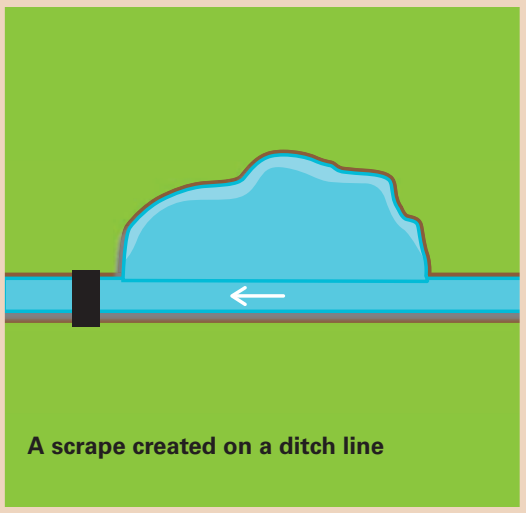
A lapwing chick feeding at the muddy margins of a scrape



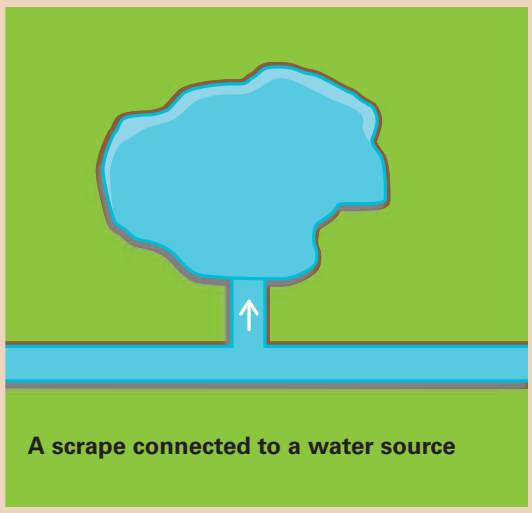
A simple scrape design



A cluster of scrapes is better than one large one



A scrape created on a ditch line



A scrape connected to a water source

FOOT DRAINS AND THE ROTARY DITCHER

Foot drains are long, linear scrapes, typically up to three metres wide and 50 cm deep, which are designed to hold surface water and act as important wet features in their own right. They can also be used to channel water to the centre of fields from perimeter ditches and to feed other wet features.

As they are long and narrow, foot drains provide more wet edge relative to the area of the feature, therefore providing more feeding areas for wading birds. Recent studies have also shown that creating such features is highly beneficial for wetland invertebrates, such as aquatic beetles and flies. 'Foot drain floods' are areas where water overtops foot drains in spring, to create areas of shallow splashing which are an important additional habitat feature for waders.

RSPB research (Eglington 2007 & 2010) has shown that:

- fields with high foot drain flood densities attracted significantly higher densities of nesting lapwing, which nested near such features
- later in the season, chick field use increased significantly with foot drain density and chicks were more likely to forage nearer foot drain floods in areas of wet mud created by receding water levels
- in late season, lapwing chick body condition was significantly higher in fields with foot drain densities of more than 150 m/ha
- wet pools and foot drains supported a greater biomass of terrestrial invertebrates, and a greater abundance of aerial invertebrates, than the surrounding grazing marsh.

Foot drains can be designed to minimise impacts on field management. If topography allows, foot drains can be spaced to allow tractors to cut and turn between them. Simple crossing points can be installed to enable machinery to move across the field. Soil type, topography and water level management are all important when designing the layout of foot drains. Combining scrapes and areas of shallow splashing within foot drain layout and function may provide most benefit.

The rotary ditcher

A foot drain with associated areas of shallow splashing

Gary Woodburn (RSPB)

The rotary ditcher

Mike Shurmer (RSPB)

Foot drains can be created with a rotary ditcher or 360° excavator. The RSPB imported a rotary ditcher from the USA in 2002 with the support of the Heritage Lottery Fund. A rotary ditcher has several advantages:

- foot drains can be created at a rate of up to 200 m per hour – 10 times faster and half the cost of an excavator
- laser-levelling gives an accurate depth of excavation, with adjustable cutting blades able to create variable foot drain profiles
- spoil is spread up to 30 m away as the foot drain is dug
- the machine can also create ditches and simple scrapes up to 12 m wide
- the rotary ditcher and operator can be contracted to work on your site.

For more information visit www.rspb.org.uk/rotaryditcher

KEY POINTS

- Creating wet scrapes, foot drains and pools is a great way of enhancing damp grassland for wildlife.
- They support a wide variety of wetland invertebrates, including rare and important species.
- They encourage wading birds to nest on a site and provide invertebrate rich areas for feeding.

For further information on this and other ways of managing your land for wildlife, please contact:

The RSPB, Conservation Management Advice,
UK Headquarters, The Lodge, Sandy, Bedfordshire SG19 2DL
Tel: 01767 680551
E-mail: conservation-advice@rspb.org.uk
www.rspb.org.uk

Front cover images: Alsoton wetland by Gavin Thomas (RSPB), lapwing by Nigel Blake and great diving beetle by Richard Revels (both rspb-images.com)

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Appendix G

Freshwater Habitats Trust Factsheets

Pond design

MILLION PONDS PROJECT

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

1. Introduction and principles

Any pond design works if you have clean water. Even vertically-sided tanks will develop rich wildlife communities. But with good design it's easy to create better opportunities for wildlife, making ponds richer and longer-lived.

To maximise the wildlife value of a pond site:

- Create pond complexes or multiple pools rather than a single waterbody.
- Within complexes, include both permanent and seasonal ponds. Ponds don't need to hold water all year round: temporary ponds are important wildlife habitats.
- Make sure that almost all pond slopes are shallow, less than 1:5 (12°) and preferably less than 1:20 (3°).
- Make broad, almost flat, undulating wetland areas around and between ponds.
- Create underwater bars and shoals to benefit aquatic plants.
- Design according to your landscape. If ponds are grazed, even tiny micro-pools can persist in the long term. If the pond surrounds are not grazed, dig at least some larger ponds (at least 20 m diameter) to avoid complete over-shading by trees.
- Use design to minimise future problems for your ponds: think about how the pond will be used by people and animals.

2. Create pond complexes

Creating a single clean water pond is good. Creating a pond complex with many different ponds is even better (Figure 1).

The simplest way to increase site richness is to dig a series of ponds with different maximum depths. Ideally some pools should dry up every year, others dry occasionally in drought years, and some should be permanent.

It is possible to make pond complexes at all but the smallest sites. Individual pools can be tiny, just a few meters across. But it's best to keep shallow and deep water pools separate (except, perhaps in winter high water conditions) to maintain different communities in different ponds.

What's in this factsheet?

What is a pond?

Ponds are permanent or seasonal waterbodies between 1 m^2 and 2 hectares in surface area (about 2.5 football pitches).

This definition includes temporary ponds that dry up during the year, as well as tiny pools and very shallow ponds like 'wader scrapes'.

Creating varied sites has long term benefits for wildlife:

- The mosaic of permanent, semi-permanent and seasonal ponds will encourage a far greater variety of plants, invertebrates, amphibians and mammals to use the site.
- It creates a protective network whatever the climate that year or however the ponds mature. If one pool becomes unsuitable, plants and animals can move to another.
- It provides a safety net so that if unwanted species (like invasive plants or ornamental fish) or pollutants get into one pond, others remain problem free.

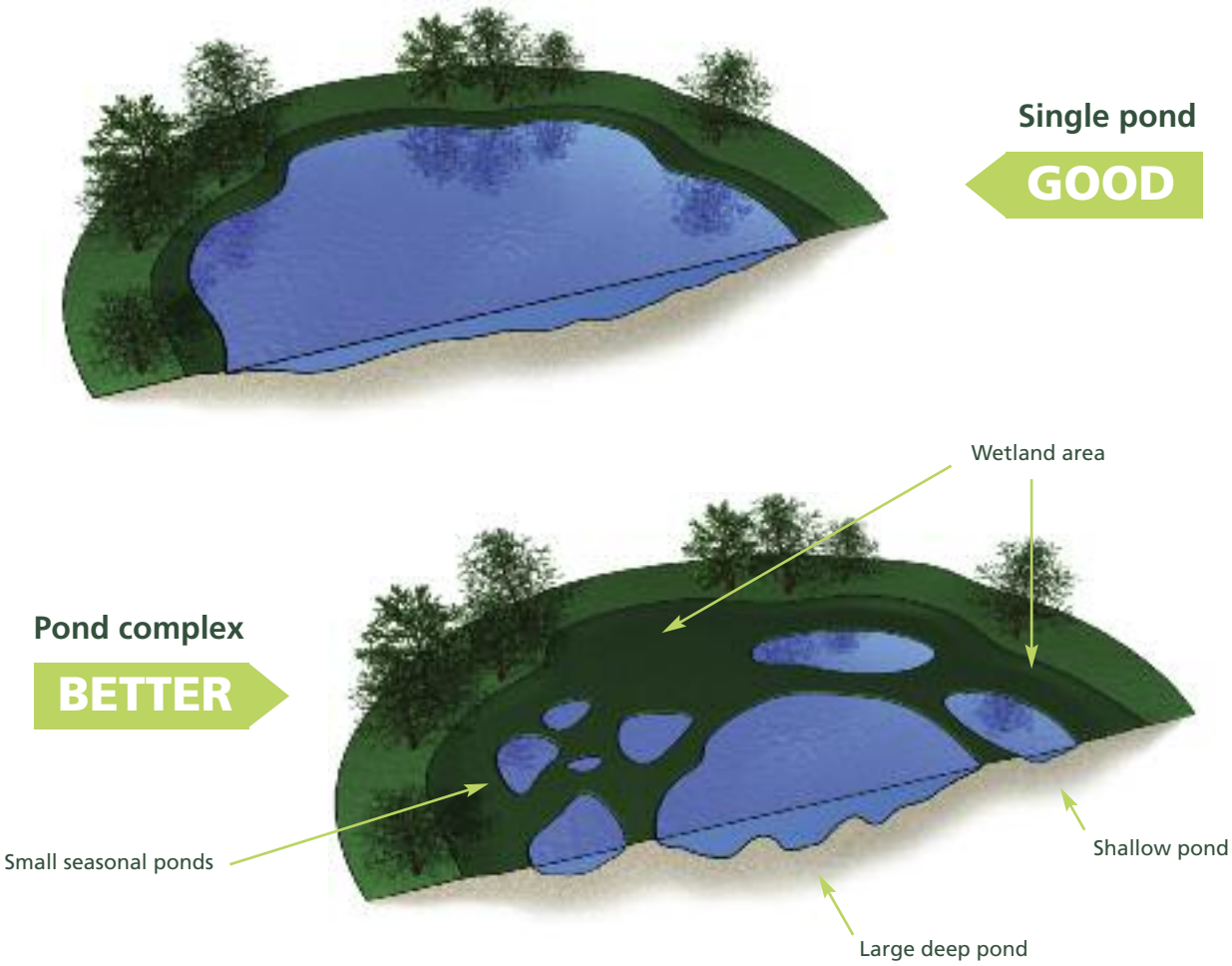


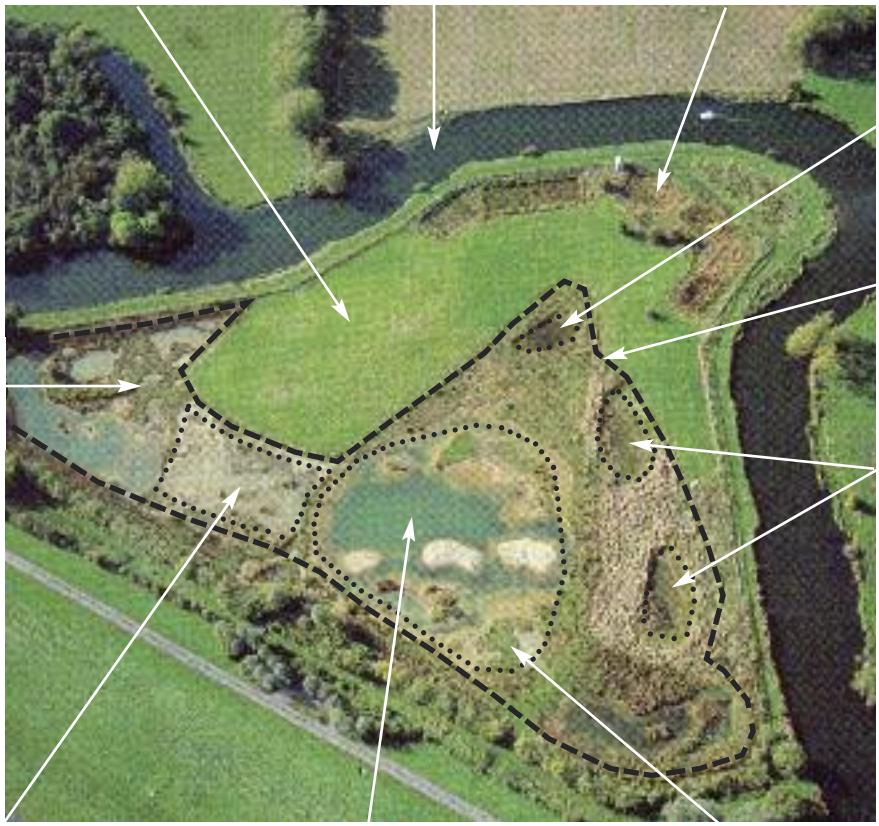
Figure 1. Create complexes of ponds with different depths and surface area. This will increase the range of wildlife attracted to the site, and provide habitats in all climate conditions.

Pinkhill Meadow pond complex

The Pinkhill Meadow pond complex was created in 1990 and has some 40 ponds of varying sizes and depths on a five hectare site. It quickly became one of the richest pond sites in the UK.

Detailed monitoring of the site shows that individual ponds have changed in wildlife value, but 20 years on the site as a whole is still as rich as ever. The ponds monitored reached 'Priority Pond' status (see the *Pond HAP*) very quickly – after just three years, and this is still the case today, some 15 years later.

This creation scheme was a partnership between the Environment Agency, Thames Water and Pond Conservation.



3. Pond design and landscape type

The landscape type in which you put a pond will fundamentally affect how the pond develops. You can use design to make sure that ponds in any landscape are long-lived and maintain a varied range of habitats through their lifetime.

The most important landscape distinction is between ponds that are grazed by stock (cattle, sheep or horses), and those that are not (Figure 2).

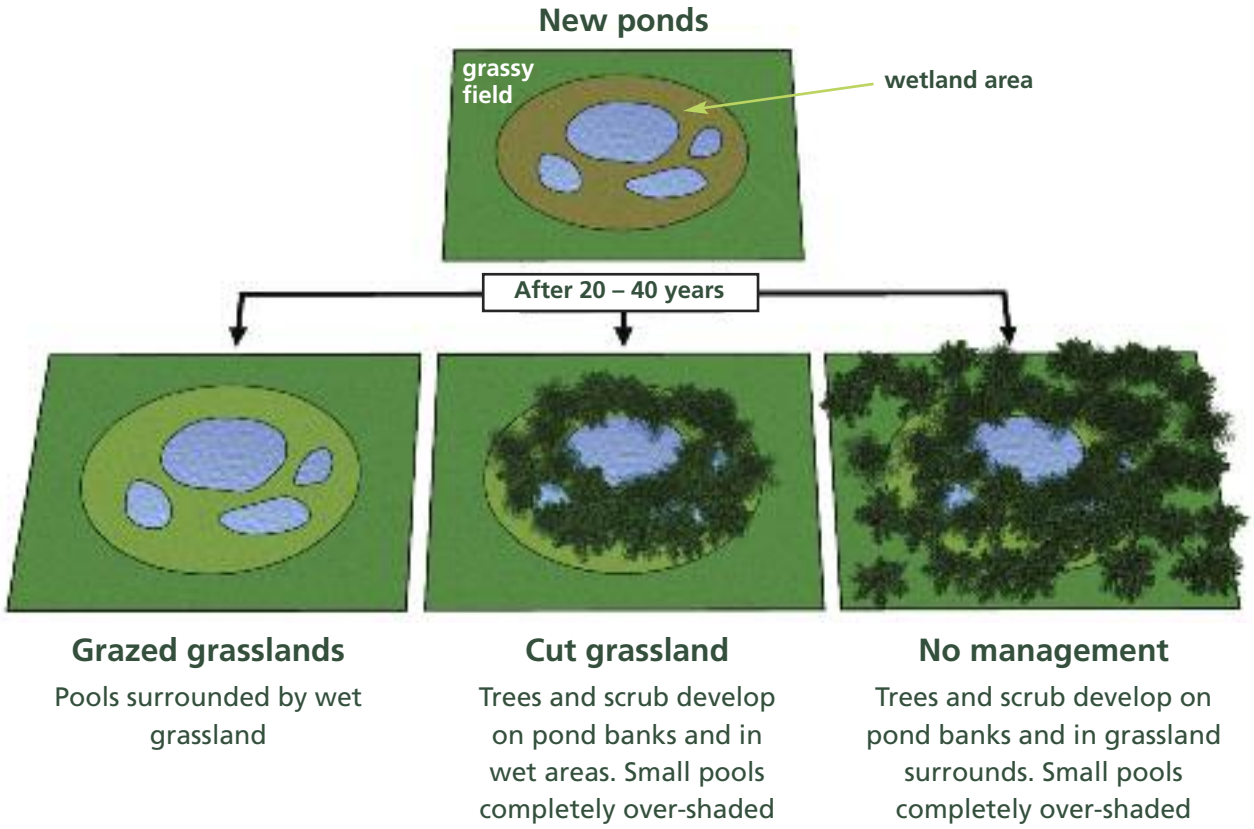


Figure 2. Ponds on grazed and un-grazed sites develop very differently over time.

If ponds are grazed, even small-scale features such as tiny 20 cm deep grassy pools are worth creating and these features will usually be maintained in the long term. This gives enormous flexibility in pond design: all sizes, shapes and depths of pond and pool will work (Figure 3).

If ponds are not grazed, tiny pools are quickly filled by the roots and leaves of taller sedges and reeds. As ungrazed sites mature they will usually become wooded and small pools can quickly become heavily shaded and full of leaves. Even if sites are cut or mowed, a tree-lined fringe will usually grow up on the un-cut pond edges, overshading the pond.

There is nothing wrong with tree-shaded leaf-filled pools: they can support distinctive pond animal communities, and wet woodland is a priority habitat type. However, small leaf-filled ponds tend to be rather uniform. Where sites are not grazed, it is worthwhile including large (sometimes shallow) waterbodies and carefully planning pond edge and slopes to ensure wetland plants can grow at the margins (see website for lots of design examples).

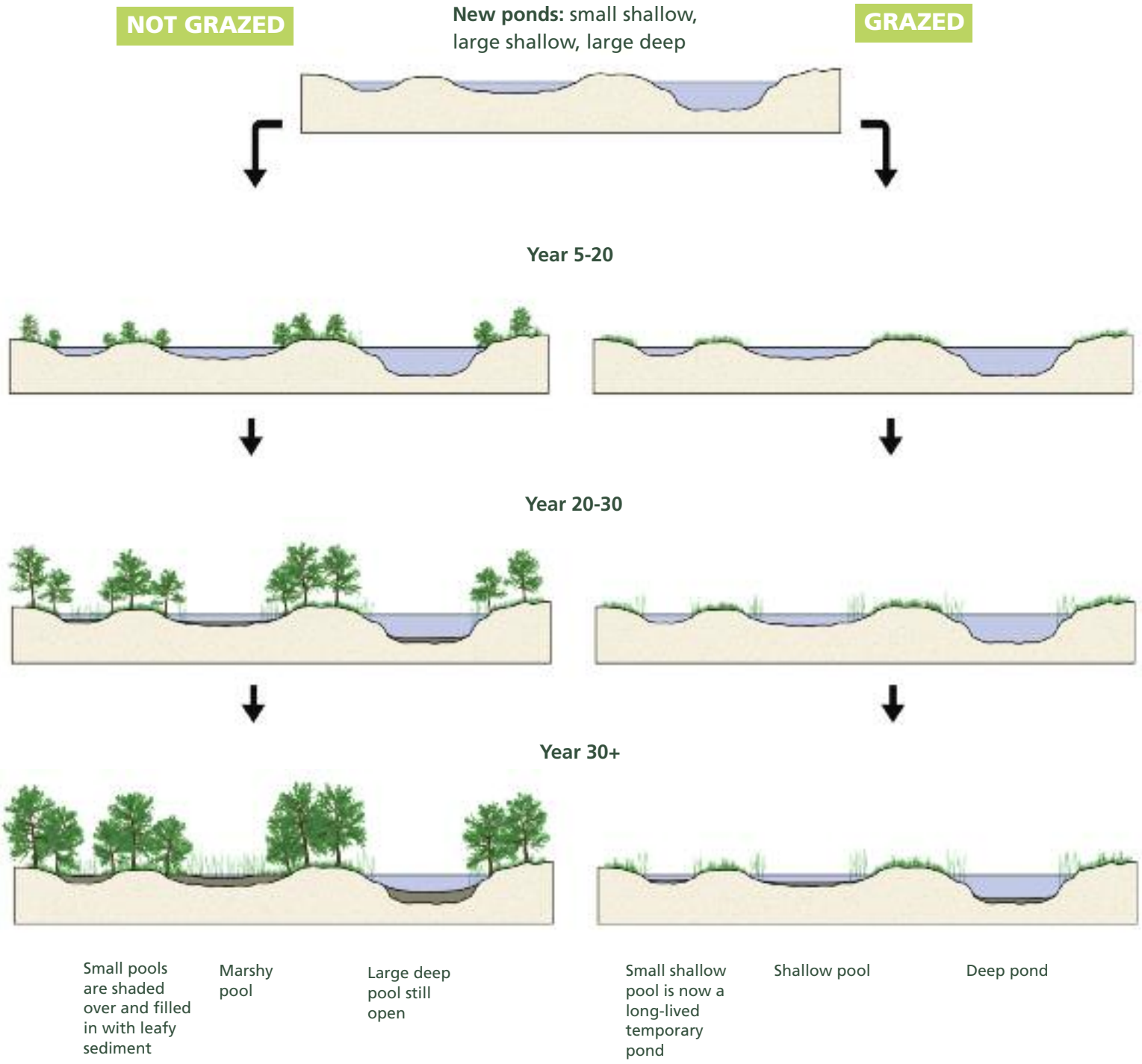


Figure 3. The fate of small, deep and shallow ponds under grazed and ungrazed management.

4. Designing different areas of the pond for wildlife

To design good wildlife ponds it helps to understand the different areas of a waterbody and how they are used by plants and animals (Figure 4).

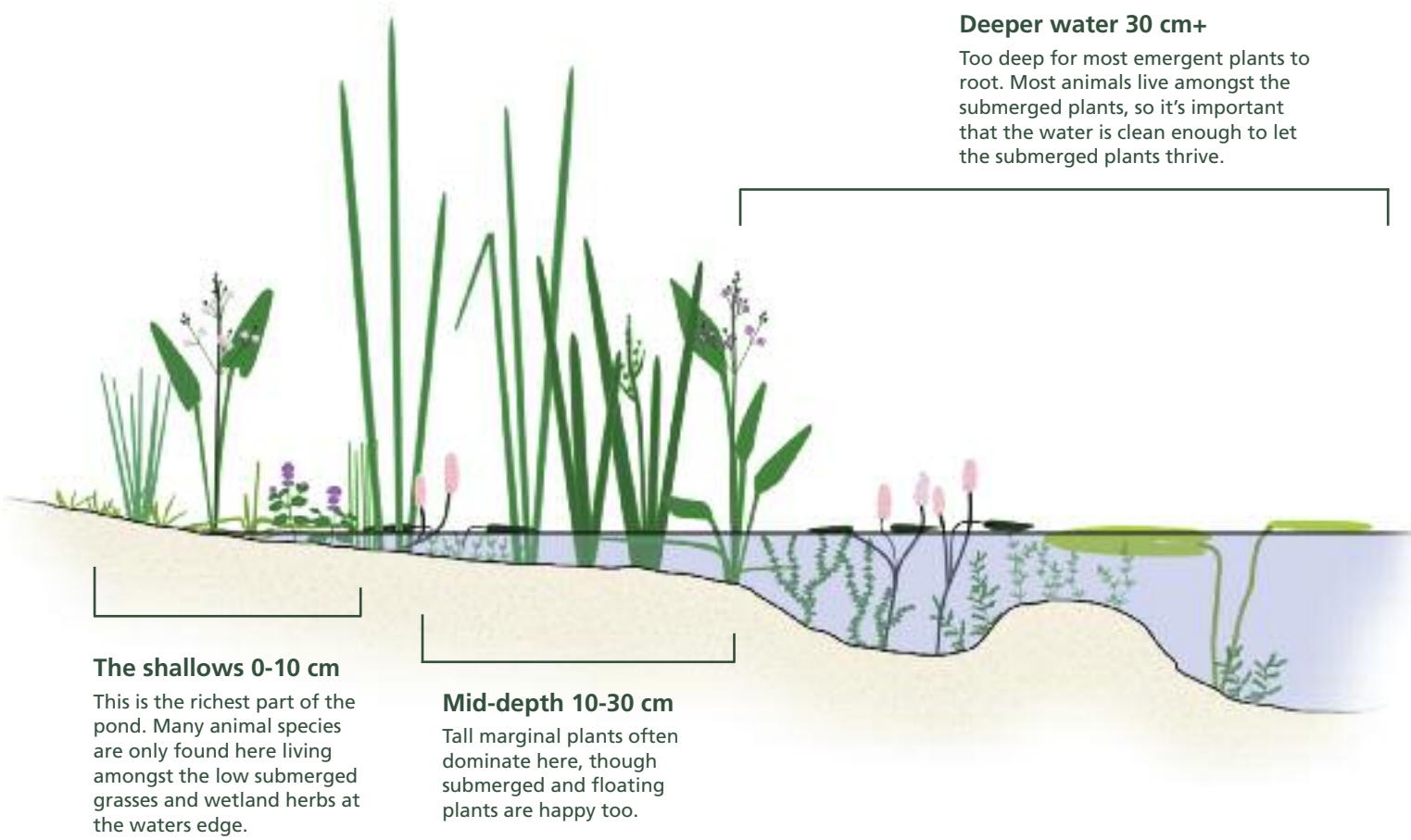


Figure 4. Where's the wildlife?

4.1 The drawdown zone

One of the many myths about ponds is that pond water levels need to be stable throughout the year. In most ponds, nothing could be further from the truth.

Typically, pond water levels drop by around half a meter or more during the summer months. This exposes a seasonal 'drawdown zone' – an area of mud and vegetation which is flooded in winter and spring, and progressively dries as water levels fall in summer. The ever-changing drawdown zone is one of the most important areas of a pond. It is an exceptionally rich habitat for plants and invertebrates, and often used by birds and small mammals as a feeding area.

Designing the drawdown zone

In traditional pond designs the drawdown area is rarely considered and, by default, is usually restricted to a narrow strip at the water's edge. Broadening the drawdown to create extensive summer marsh and mud habitats can considerably improve a pond's wildlife value (Figure 5).

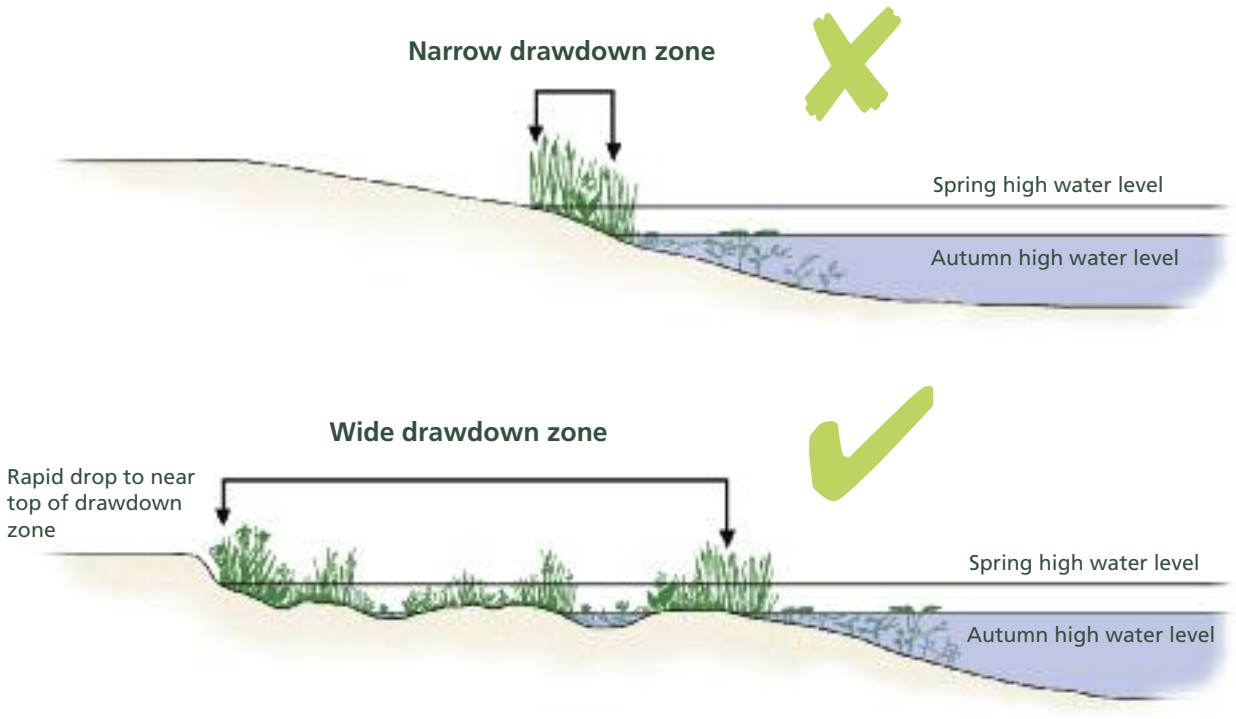


Figure 5. **Create broad undulating drawdown zones – they are one of the most valuable areas for wildlife.**

To design a good drawdown zone you need to roughly know the height of the winter and summer water levels (something that is not always easy before you dig a pond: see *Factsheet 10*). At sites where space is limited it can be useful to cut down steeply through the overburden (which will eventually form the pond's upper banks), then the slope below the top of the winter water level can be flattened off to create the drawdown zone (Figure 5).

Where a number of pools are being created close together, a good option is to remove overburden across the whole area to near the upper drawdown level (Figure 6). This increases the amount of spoil that needs to be excavated (with cost implications), but creates rich and natural wetland areas between the ponds and makes it easy to create new pools or change the site later without generating much additional spoil.

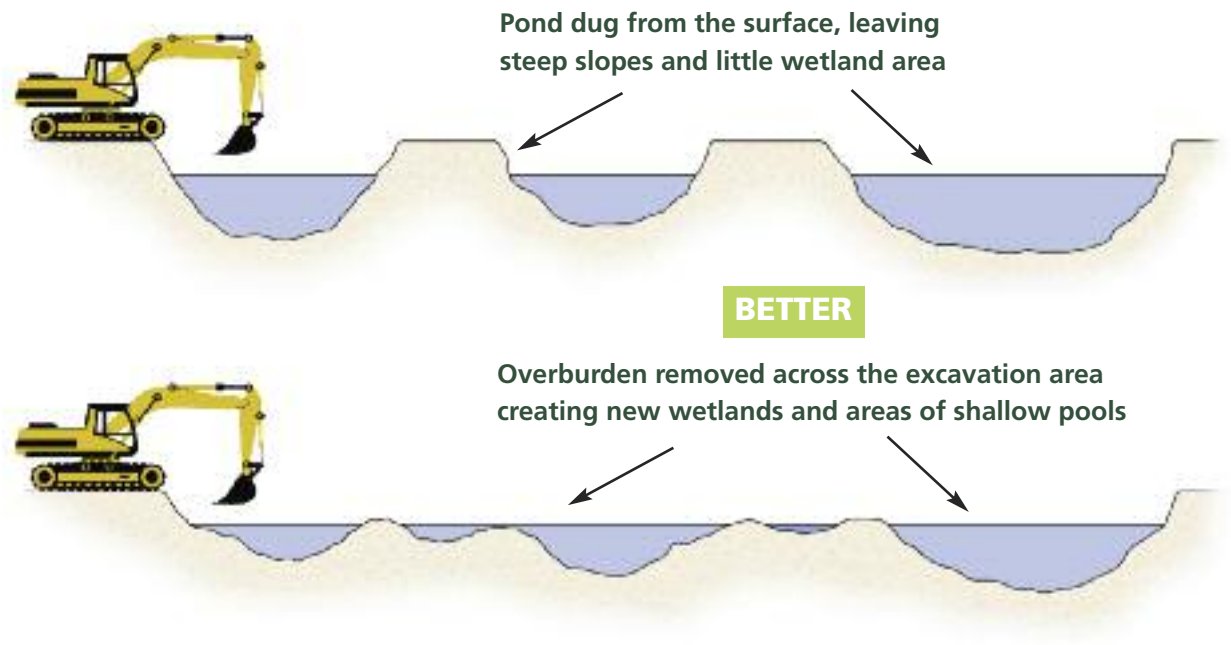


Figure 6. **Rather than excavating all the ponds from the surface, strip off overburden across the whole area and create new pools and wetland areas between.**

Undulating drawdown zones

Drawdown zones don't need to slope evenly down to deeper water: they can undulate, creating pools, spits and marshy areas around the pond edge. Designed well, these wet areas create a patchwork mosaic of small-scale habitats which can be exceptionally rich in plants and invertebrates (see Pinkhill Meadow box).

4.2 Shallow water

Many people know that the shallow areas of a pond are the best for wildlife, but think that 'shallow' means water 20 – 30 cm deep. Most pond animal species live in very shallow areas, right against the bank, often in water that's often only 1 – 10 cm deep. To improve ponds for wildlife, focus on these marginal areas.

Designing shallow water

To create such shallow areas, ponds need to slope very gently at the edge, at less than 1:5 (12°) and preferably less than 1:20 (3°) (Figure 7). Typical pond margins of 20-30° are usually too steep. With a 20° slope the critical wildlife-rich area (water less than 10 cm deep) is only a band around 35 cm wide – slightly more than the length of your shoe (Figure 8).

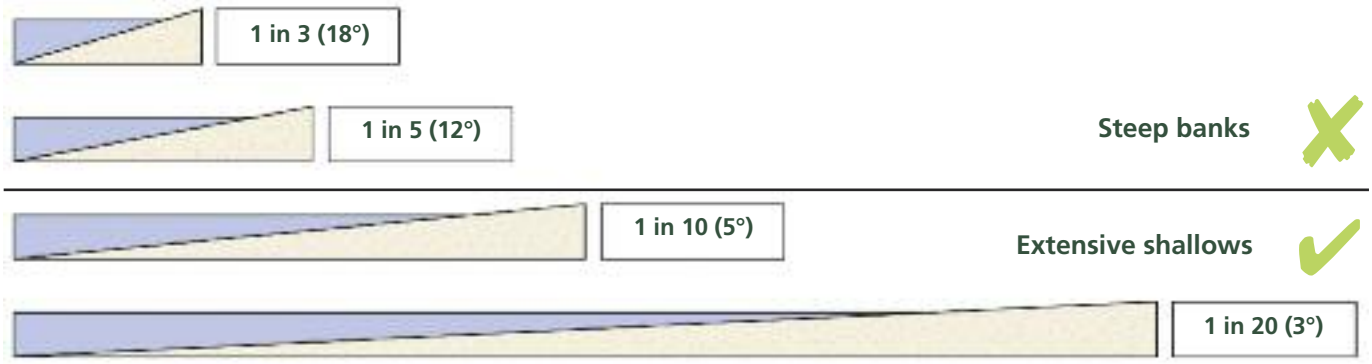


Figure 7. Bank angles. Slopes less than 1:10 are preferable for water's edge areas (though the terrestrial bank above can be much steeper). The aim is to create broad areas of very shallow water. Even with a 1:10 slope the shallow water zone (<10 cm deep) is only 1 m wide. Three strides from the bank, and the water is over the top of Wellington boots – too deep for many pond animals to be comfortable.

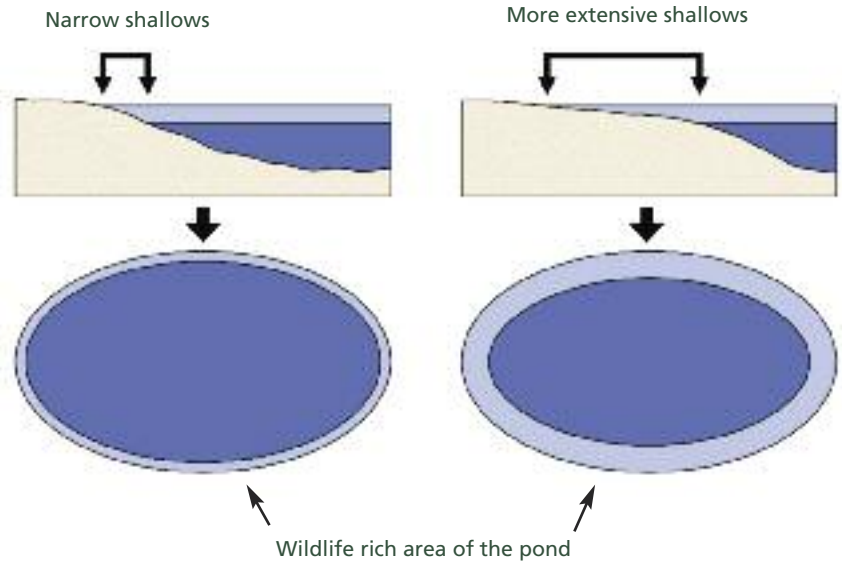


Figure 8. Design extensive shallows to improve the pond for wildlife.

To create deeper ponds (with depth over 0.5 m) and broad areas of shallow water – you need larger ponds. For a small pond (less than 10 m x 10 m) with an average summer drawdown of 0.5 m in height, even with quite a steep 10° (roughly 1:6) slope, the maximum summer water depth in the middle would be 50 cm, and the average depth 25 cm.

If necessary go for an asymmetric shape with some very shallow water, and a steeper far bank to gain water depth (Figure 9).

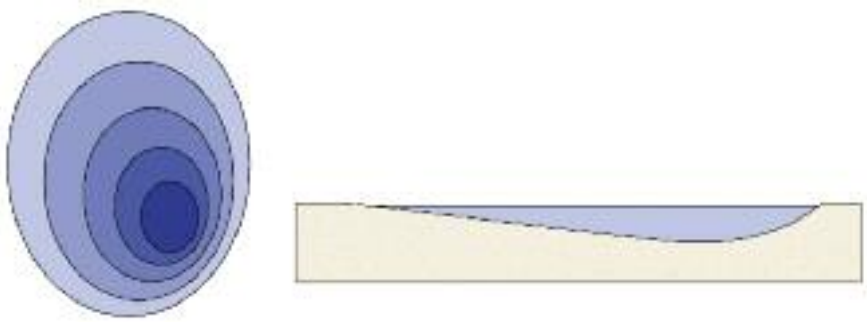


Figure 9. Asymmetric profile – useful to combine shallow water areas with greater depth.

Scalloped edges

Another classic way to increase the area of shallows and the length of pond margins is by creating embayments around the pond edge. This works well on ponds of all but the smallest size.

4.3 Deeper water

Traditionally it has been thought that deeper open water areas are an essential component of a successful wildlife pond, and older guides used to suggest that new ponds should be dug to at least 1.5-2 m deep. In fact, deep water is quite a specialised habitat, vital for few species.

This said, although deeper water (more than 30 cm deep) is not necessary in a pond, it can be useful within a pond complex. From a wildlife perspective deep water can also be valuable habitats – but the water needs to be clean. From a practical point of view:

- Where vegetation is not grazed down by stock, deep water can be used to stop marginal emergent plants dominating all ponds.
- Deeper ponds will take longer to fill in with sediment, so the permanent-water phase of the pond is more prolonged.

Designing deep water areas

A general rule in pond design is: the poorer the water quality, the shallower you make the pond. This is because submerged deep water plants, which provide homes for many animals, don't grow well in polluted water. So if the water is polluted, its best to go for shallow ponds where unfussy marginal plants (like yellow flag, water mint, and wetland grasses) can grow – at least then you don't end up with a rather scummy, cloudy pond with an impoverished deep water zone.

BUT – one of the many benefits of ponds created as part of the Million Ponds Project is that, because they have clean water, deep-water ponds can be created without worry. Most clean water ponds will support rich submerged plant communities and since many native submerged plant species are now uncommon and declining, this is a major opportunity to benefit wildlife.

Amongst the particular target plants for deep clean water ponds are the many submerged stonewort and pondweed species which are now becoming rare in the UK. We can design the deep water areas of our ponds to help these species thrive (Figure 10).

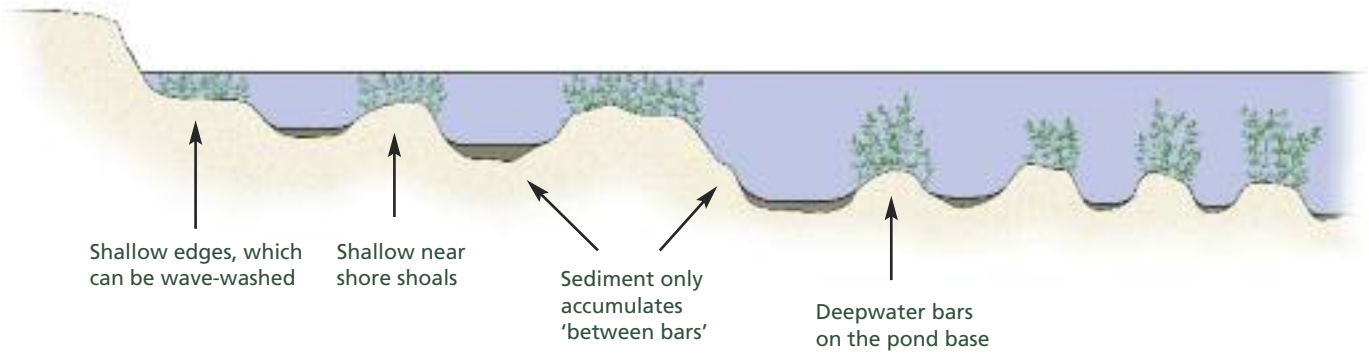


Figure 10. Organic sediments don't accumulate on top of submerged shoals and bars – so uncommon submerged stonewort and pondweed species can thrive.

Many of our rarest submerged plants need mineral soils to root into – they are happy in the bare clay or sand at the bottom of new ponds, but not in the dark organic-rich silts that build up as ponds age. You can keep mineral substrates exposed on the pond bottom for longer by creating underwater hummocks and bars. Organic sediments slip off the top of the bars, filling up the low troughs between the bars, and leaving the bar-top sediment-free for plants to root into (Figure 10).

The main draw back with this design is safety – rapid changes in underwater slopes can be treacherous for people wading in the pond – so this is not an ideal design for sites with public access.

5. Varying pond area

There is no right size for a pond but the landuse in which a new pond is created can influence the size of ponds that work best.

Tiny pools

Even tiny micro pools just a meter or so in diameter can be rich in wildlife – and will support different species to those in nearby deeper pools (Figure 11). Small pools are quick to make, and can be useful for adding variety to larger sites, since you can create many ponds in little space. The smallest pool that can easily be dug with a digger bucket is about 0.5 m diameter.

The main consideration which will determine whether it is worth creating very small pools on a site is the site's subsequent management. If ponds are not grazed by stock, tiny shallow pools usually fill in quickly. If they are grazed, even the smallest shallow pools can be very long-lived (Figures 3 and 11).

Figure 11. Even tiny pools can be good for wildlife – particularly where they are kept open by grazing.

Large ponds

The number of wetland bird species you can attract to a pond increases with pond area. For most other plant and animals however, the relationship is less clear cut – very roughly to double the number of species you need to increase the area by tenfold. So doubling the size of a pond can double the cost of excavation, but makes little difference to the number of species that will occur there.

Evidence shows that you will get more species if you create many smaller ponds rather than one single large waterbody in a given area. This said, there are situations where larger ponds are at a distinct advantage:

- In wooded landscapes larger ponds don't get completely over-shaded.
- Large ponds give you scope to create complex waterbodies: it's possible to combine extensive undulating shallows, deep water and islands in a single pond.
- Large ponds often have wind-blown waves, which can be used to advantage (see next section).

6. Wind, fetch and bank erosion

On larger ponds strong winds will often whip up waves. The longer the fetch (length of water across which the wind blows), the bigger the waves (Figure 12). As waves hit the far bank, they can erode small sharp-edged cliffs. The prevailing wind direction in Britain is broadly from the south-west. So, in a large pond, the opposite (north-east) banks will be the most eroded. Even moderate-sized 20-30 m diameter ponds can be affected by wave-wash, especially if the pond is located in an exposed landscape with few trees or hedges.

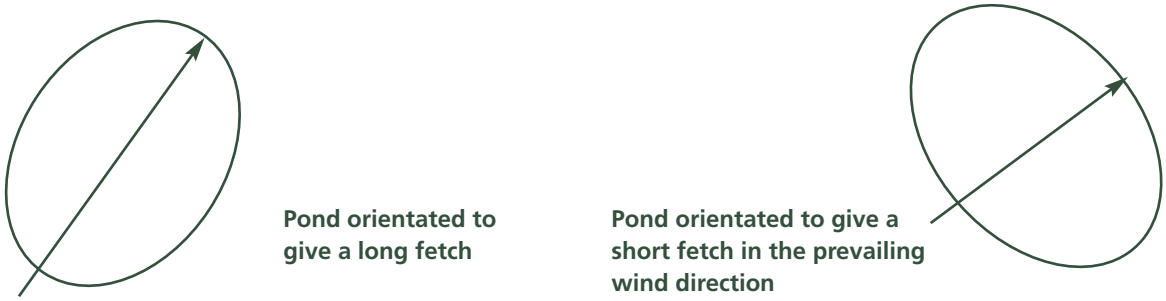


Figure 12. Wave wash.

Wave wash is often seen as a bad thing, and certainly steep eroded banks can be can inhospitable to wildlife. But, like many natural processes, waves can be a creative force. They are particularly useful for pond making in two ways (Figure 13):

- **Keeping bare sediments for submerged plants:** as noted above, clean-water ponds are good habitats for submerged plants like stoneworts which grow on bare sands or clays. Wave wash can help keep areas free of organic sediment and suitable for these plants by: (i) continually eroding sand and clay bank materials, and depositing them in the water (ii) keeping the pond base free of organic silt by washing organic silts into deeper water areas (Figure 10).
- **Creating wildlife rich backwaters:** a useful effect of the wind is that it blows seeds, spores, animal eggs and plant fragments across a pond and concentrates them along the wind-blown margin. If the right conditions are created, and these seeds germinate, the wave-washed margin can develop into a particularly rich habitat. The key is to slacken the wind and wave energy before it reaches the bank and erodes it. This can be done by creating islands or deep embayments along eastern margins. Very narrow-necked pools work particularly well, especially if their entrance is off-set so that they don't face the prevailing wind. Islands can be similarly protected from waves by creating submerged bars along their front edge.

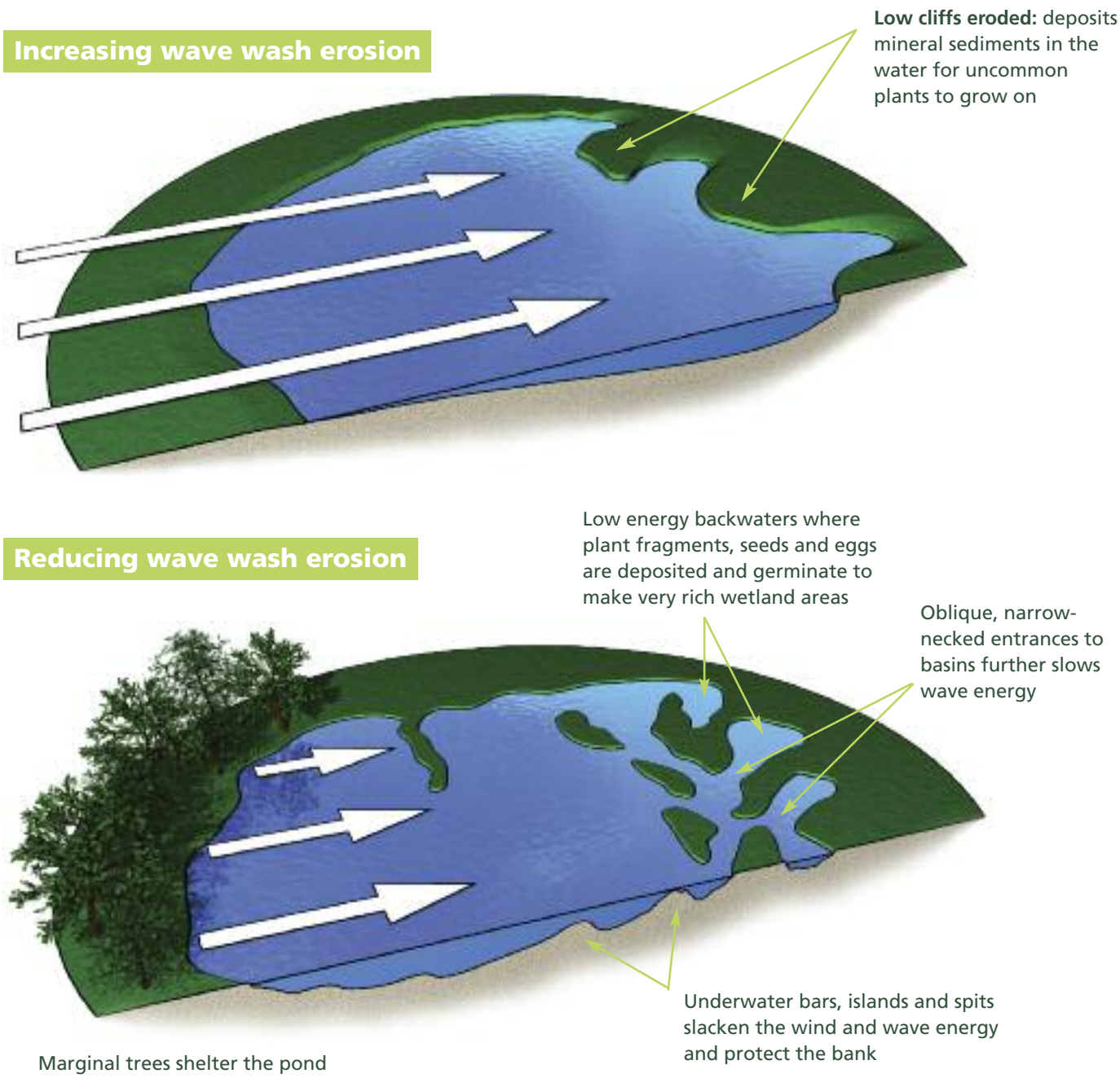


Figure 13. Using design to increase or reduce wave wash effects.

7. Islands

There are pros and cons to including islands in a new pond (Figure 14). For waterfowl and wading birds, islands can provide safe areas for feeding, roosting and nesting. However, if large numbers of feral geese or gulls regularly congregate, this may damage pond vegetation and degrade water quality.

Islands can add new habitats to ponds, especially if the pond margins are closely grazed, and the ungrazed island edges have tall wetland vegetation. However, in small ponds, their edges can be colonised by emergent plants like bulrush that quickly spread across the rest of the pond.

The main problem with islands is that it can be difficult to get their height just right. Often they are created too high, and quickly become wooded, blocking views and, in some cases, providing perching places for crows on the look out for wading bird chicks.

If islands are too low this is much less of a problem: they just become submerged bars – useful for aquatic plants to root in.

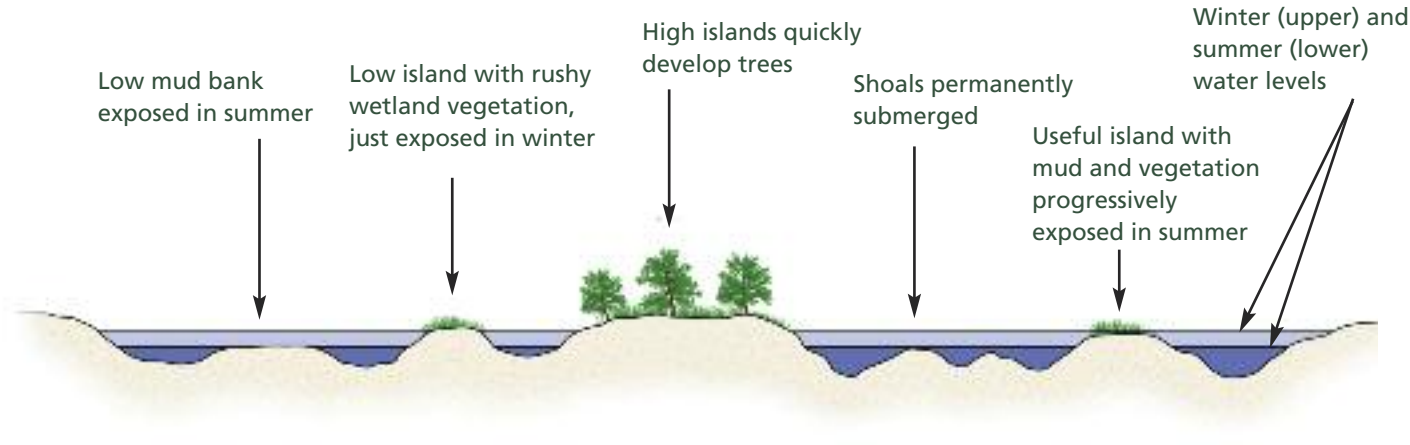


Figure 14. Design islands to minimise the need for management – ideally keep them low.

To minimise the need for management, create islands so that they are submerged in winter and early spring, which will kill off tree and shrub species, but become progressively exposed in summer to provide feeding and roosting areas. Higher islands, 20 – 50 cm above average spring water level, can be useful for water fowl and waders but plan in time to allow for periodic management. If management (or monitoring) is likely, consider creating a submerged causeway which will allow you access by wading rather than requiring a boat.

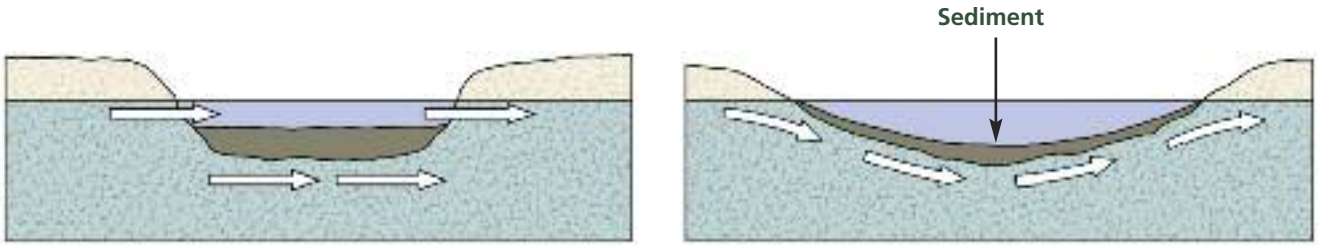
Islands, just like pond margins, can be varied habitats: depending on their height and exposure they can create either a marshy wetlands or, if lower, off-shore mud-banks for feeding waders. They can also be used in many ways to create shelter and seclusion to adjacent bank areas.

Where possible, locate islands at least 4-5 m away from the bank and maintain at least 0.5 m depth of water in summer, to provide birds with some protection from predators.

8. Adding even more variety to sites

Anything that adds to the natural variability of a site will usually add to its richness. Here are some examples:

- **Different water sources and substrates:** Groundwater fed ponds have a different chemistry and water regime (e.g. drawdown height) to surface water ponds, and in many places it is possible to create both pond types. Similarly, if geology varies, it is sometimes possible to create gravel, clay and peat-based ponds on a single site.
- **Different locations:** Even within one field, ponds created on a hedge line with its shade, shelter and leaf-litter will support a different fauna and flora to a mid-field pond.
- **Different bank angles:** Shallow edged ponds are especially useful for wildlife, but steep edged ponds can work too. This is especially true in gravel and sand based groundwater ponds where steep banks can keep the pond connected to groundwater after it has begun to silt-up (Figure 15).



This waterbody has steep banks. This stops sediment accumulating at the edges, so the pond continues to be groundwater fed – an advantage if the groundwater is clean.

This waterbody has shallow slopes and has now become sealed-off from groundwater by its own accumulating sediments.

Figure 15. Steep banks can sometimes be useful in groundwater fed ponds.

9. Design for change

Pond creation is not an exact science: often you won't know exactly where the water will sit before the pond is made, and may want to modify the pond a little when you do. Some features will also work better than others and you may want to dig new pools or alter banks.

When designing a pond, its worth planning for change from the outset. In particular: try to maintain access to all edges of the pond, leave borders along fence lines, ensure spits are wide enough to take a digger, and think about shallow-water pathways to islands.

10. Pond designs for Biodiversity Action Plan species

There are over 80 Priority Species that use ponds in the UK. They include animals like Lesser Horseshoe bats and Tree sparrow which feed over and around ponds, together with 70 or more specialised plants and animals that live in the water and around the pond edge.

Clean water is critical for many of these species. A recent review showed that 85% of the rarest Priority Species need good water quality to survive.

A major aim of the Million Ponds Project is to create clean water ponds that will support the populations of many of these species. To do this 1,000 ponds will be specifically created for them over the next four years.

During 2009-2010, *Species Dossiers* will be available for key Priority Species, to provide guidance about the places, habitats and designs which will best support these species.

11. Design practicalities

This factsheet focuses on pond designs that will create good wildlife habitats. But on any site, wildlife will be only one of the factors that influence design.

As the planning phase continues and you understand more about the site (e.g. its hydrology archaeology, location of service pipes), the original design may need to be modified a number of times. The implication is that it can be useful to keep designs rough, and flexible in the early stages, so that changes can be more easily accommodated.

Other issues, such as location, project planning, access, safety and particularly budget will constrain what is possible (see *Factsheets 5* and *6*).

12. The Design Bank

More detailed design ideas for new ponds can be found on the *website*.
They currently include:

- Woodland ponds
- Grazed ponds

Future factsheets will include:

- Heathland ponds
- Ponds in wetlands
- Moorland ponds and bog pools
- River floodplain ponds – how ponds fit in with river restoration
- Dune slack pools
- Ponds near paths – designs to minimise problems from dogs, fish and alien species
- Ponds and safety
- Designs to minimise risk of bird strike
- Ponds on farmland
- Agri-environment grants – designs to maximise funding benefits
- SUDS ponds

For further information about the Million Ponds Project please visit *www.freshwaterhabitats.org.uk/projects/million-ponds* or email enquiries to *info@freshwaterhabitats.org.uk*

SUPPLEMENTARY HABITAT FACTSHEET

Designing wildlife ponds in the river floodplain

MILLION PONDS PROJECT
Pond Conservation

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

1. Why add ponds to the floodplain?

In natural floodplains, ponds are a common and abundant habitat. Indeed, the area of ponds often exceeds the area of the main river on the floodplain. As the river moves across the landscape, large linear ponds form as cut-off backwaters. Whilst in winter, small seasonal pools appear in shallow natural depressions. All of these pool types are important habitats. They can be exceptionally wildlife rich, and are particularly likely to support rare species.

Today, most of our rivers, streams and ditches are no longer clean water habitats because of nutrient enrichment and other pollution. Ponds connected to the river have declined in quality and many floodplain species are now under threat. This factsheet explains how, by following a few simple design rules, we can create wildlife rich floodplain ponds (Figure 1).

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Figure 1. Ponds in Boardwalks LNR, Peterborough (left) - created for amphibians. Temporary ponds in the River Gowy floodplain, Cheshire (right), habitat for the rare Lesser Silver Water Beetle *Hydrochara caraboides*.

What's in this factsheet?

2. Design principles for floodplain ponds

The key to creating wildlife rich ponds in the floodplain is to ensure that they have clean water. It also helps if they form part of a wetland complex that includes both permanent and seasonal water.

- **Don't connect ponds directly to the river.** Because most streams and rivers are polluted, create ponds which will not be regularly flooded. Ponds fed by groundwater or surface water will have cleaner water.
- **Individual pond designs can be very simple.** Wetland complexes with ponds of different surface area, depth and seasonality will support many more species than a single isolated pond.
- **Create ponds adjacent to other wetland habitats.** Animals and plants will move to new habitats as part of the natural process of pond succession.
- **Ponds in the floodplain which are regularly flooded need to be shallow.** Most submerged plants cannot grow in deeper water so deep polluted ponds tend to be rather barren habitats. If water quality is poor, create shallow pools less than 0.5m deep which will fill with emergent plants. If ponds are connected to the river, be prepared to create new ponds every 5-10 years, because they will quickly fill with sediment.

3. Choosing pond location and finding a clean water source

Deciding where to put a pond will be the most important decision you take when creating a floodplain pond. It will determine how good the pond will be for wildlife, which species the pond will support and the future management needs of the pond.

Water sources for ponds on the floodplain

The floodplain is not always a good source of unpolluted water for your pond. There are four main ways that the pond could receive water and each has its pros and cons (Figure 2). Water quality will depend on the surrounding land use and how the floodplain is managed.

Figure 2: Water sources for ponds on the floodplain

	PROS	CONS
Surface water and direct rainfall Water collects in ponds which are perched above the natural aquifer.	These ponds will have ***very clean water*** provided the surface water drains from an unpolluted catchment, e.g. woodlands, heathlands or low intensity grasslands.	Surface water fed ponds need an impermeable barrier such as a clay substrate to hold water. Test holes may be required in areas of variable geology to determine whether ponds will hold water.
Groundwater Water seeps into the pond from sub-surface water. The pond can be permanent or temporary.	Groundwater levels are often close to the surface in the floodplain; therefore it is easy to create ponds which will hold water for part of the year. These ponds will often have ***very clean water*** provided the groundwater is fed from a largely unpolluted catchment.	If the surrounding catchment is very intensively managed (e.g. under arable), groundwater fed ponds can suffer from high levels of fertilizer nutrients.
Floodwater During the winter, ponds in the floodplain may become inundated with flood water.	Many species in the floodplain disperse to new habitats during times of flood. Ponds may flood and become connected as groundwater levels rise. They don't have to be connected to the river during flooding - if not connected to the river they will still have ***clean water***, even after flooding.	Rivers may breach their banks annually or only sporadically. The more frequent the inundation and the greater the disturbance (agriculture/development) in the catchment, the lower the water quality in the pond.
Connected to the river Ponds can also be connected directly to the river or ditch network.	Ponds connected to the river and ditch network as part of a pond complex can provide nurseries for fish and support bird populations which feed on them. Connected ponds can also be useful refuges for mammals like water vole, and otter which are not too worried by water pollution.	Most streams and rivers in the UK are now significantly polluted. Ponds connected to these water courses will quickly become polluted, often more so than the stream because the pond fills rapidly with polluted sediment. Often these ponds are poor in species and are dominated by a few tolerant species, e.g. Reed Sweet-grass *Glyceria maxima*.

Where to locate ponds in the floodplain

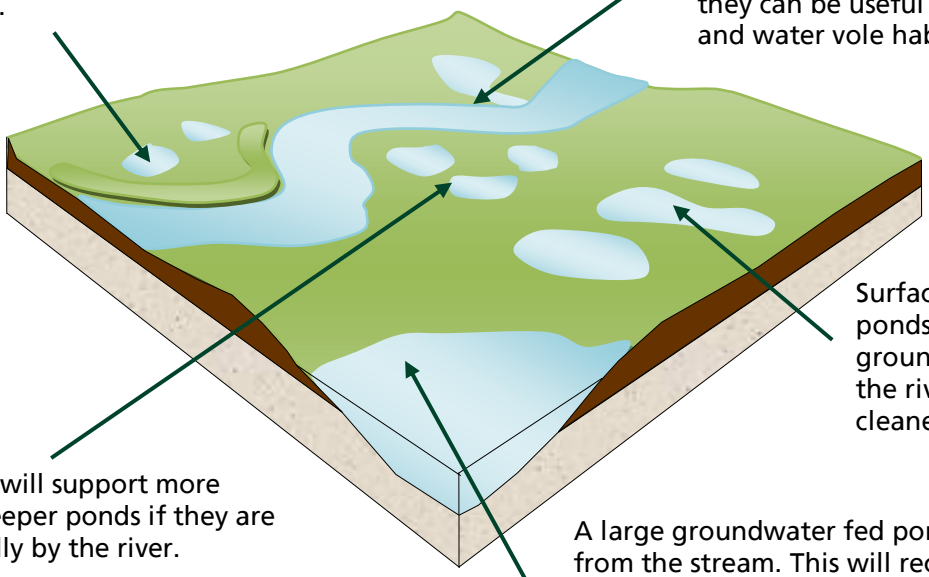
The source of water can make a big difference to water quality (see *Pond Creation Toolkit Factsheet 2* for more information on creating clean water ponds for wildlife). With this in mind there are some basic principles for creating ponds in the floodplain to increase their wildlife value (Figure 3 and 5):

- **Avoid areas which are regularly flooded by the river**. Flooding will not usually occur over the whole floodplain every year. Flooding may only happen once every 100 years or even once every 1000 years. To identify where your site is on the floodplain check the 'extreme flooding' zone on Environment Agency flood maps (www.environment-agency.gov.uk).
- **Locate ponds on slightly higher ground within the floodplain.** These ponds will flood less frequently and will receive the majority of their water from surface water, not the river. If the surrounding landuse is low intensity, e.g. heathland, woodland or species rich grassland, the water quality is likely to be high.
- **Put ponds behind natural levees.** Some rivers have developed natural levees (flood deposition mounds which create a barrier between the river and the floodplain). These can reduce the frequency of flood events and increase the chance of ponds being fed predominantly by clean surface water or groundwater.
- **Think about wildfowl.** They often use river floodplains as migration corridors. Large numbers of gulls and wildfowl can degrade floodplain ponds and considerably reduce their wildlife value. Smaller ponds, particularly those created adjacent to woodland or hedgerows will be more sheltered and avoided by large numbers of wildfowl, whilst still providing valuable habitats for many plant, insect and mammal species.

Figure 3. Choosing the right location in the river floodplain can make a big difference to water quality

High quality, low lying ponds in the floodplain are fed by groundwater and protected from regular flooding by a natural or artificial levee.

Ponds linked to rivers or ditches and ponds flooded by the river annually will usually be polluted and have a shorter life than surface-fed or groundwater-fed ponds. However they can be useful as fish nurseries and water vole habitats



Surface-water fed ponds on higher ground, further from the river often have the cleanest water quality.

Shallow ponds will support more species than deeper ponds if they are flooded annually by the river.

Some shallow water emergent plants are not fussy about water quality so can grow irrespective of water quality, providing a habitat for invertebrates, amphibians and birds.

A large groundwater fed pond set away from the stream. This will receive cleaner water than a pond linked directly to the river.

Groundwater is a good water source for deeper ponds, especially in less intensive catchments.

Figure 4: Opportunities for pond creation in the floodplain

Create ponds:

- as part of floodplain restoration to increase the variety of clean freshwater habitats in the floodplain.
- to increase the diversity of uniform areas, such as stands of Common Reed *Phragmites australis* or Purple Moor-grass *Molinia caerulea*.
- in semi-improved habitats, e.g. grasslands which are no longer fertilised or in arable field corners from which nutrient-enriched soil has been stripped.
- In areas where they won't cause an obstruction to future land-use changes, e.g. along the margins of fields or by sectioning off a river meander.

The RSPB reserve at Otmoor, Oxfordshire is a restored wetland complex of ponds, ditches, wet grassland and grazing marsh created on former arable land. These floodplain habitats are not directly connected to the river - retaining high water quality and supporting many rare species such as Tassel Stonewort *Tolypella intricata*.

Avoiding sensitive areas

Creating new ponds in the river floodplain has many benefits, and there are many opportunities to do this (Figure 4 and 5), but it shouldn't be at the expense of valuable existing wetland habitats. Make sure you carry out a risk assessment before digging new ponds (see *Pond Creation Toolkit Factsheet 6* for more information).

- **Create ponds adjacent to rather than instead of other wetland habitats.** Fens, swamps and marshes are rare habitats supporting important plants and animals. Consider creating ponds in these habitats only after careful assessment (see *Supplementary Habitat Factsheet: Wetlands and Reedbeds* for more information).
- **Avoid areas with high archaeological value.** River valleys often have a long history of human occupation and a high archaeological value. It is important to check with the county archaeologist early in the planning stage.

Legal issues dealing with spoil

- The Environment Agency will be concerned to ensure that any excavated spoil (a) does not reduce the floodplain's capacity to store floodwater and (b) is not piled up causing an obstruction to floodwater movement. This often means that spoil will need to be removed from the floodplain to another disposal site - a process that can be expensive. Check the Environment Agencies flood map to ensure the site is technically in the floodplain www.environment-agency.gov.uk. If so, contact the Environment Agency directly for further advice.

4. Floodplain pond designs

Pond size and shape

Natural ponds in the floodplain can be very variable in size, ranging from small natural depressions just a few metres in width, to oxbow lakes and cut-off meanders which can be greater than 2ha in surface area. The ponds can also vary in the length of time they hold water, from just a few months to fully permanent waterbodies. In a complex of ponds, these gradients of size and water permanence will add greatly to the wildlife value of the site.

- **Temporary ponds** overlying the groundwater aquifer can be shallow (<40cm deep) and simple in profile.
- **Medium sized ponds** are usually up to 50cm or at most 1m deep, depending on local hydrology. Deeper ponds will only be successful when they are created in clean water areas. They can be very valuable for submerged and floating-leaved plants, and can be used strategically to prevent complete colonisation of the site by plants such as Common Reed *Phragmites australis*.
- **Linear ponds**, less than 3m in width and up to 50cm deep, can replicate the cut-off meanders and ditch habitats found in floodplains .
- **Large deep ponds** (<0.5ha and up to 2.5m deep). Ponds in the floodplain which are deeper than about 50cm will need to have a clean water source to support submerged aquatic species. They should include some large shallow undulating drawdown zones (i.e. a slope less than 1:20 (3^{o}) to provide bare ground for marginal plants and feeding areas for wading birds. Consideration of birdstike risk to aircraft will be needed for large wetland areas (see *Supplementary Advice Factsheet: Pond designs to reduce the risk of birdstrike* for more information).

  If you do create deeper areas of water, you can make things more interesting for wildlife by creating a series of underwater bars and shoals. These will increase the shallow water habitat of the pond and prevent bare substrates becoming smothered by silty deposits, which is important for species such as stoneworts. Wave-wash in larger ponds can also help to maintain bare areas (see *Pond Creation Toolkit Factsheet 4* for further information).

Floodplains are also naturally dynamic places, so staggering pond creation (for example, creating new ponds every 5 years or so) will create a gradient of pond ages, mimicking the natural periodic creation of ponds on floodplains.

Pond profiles

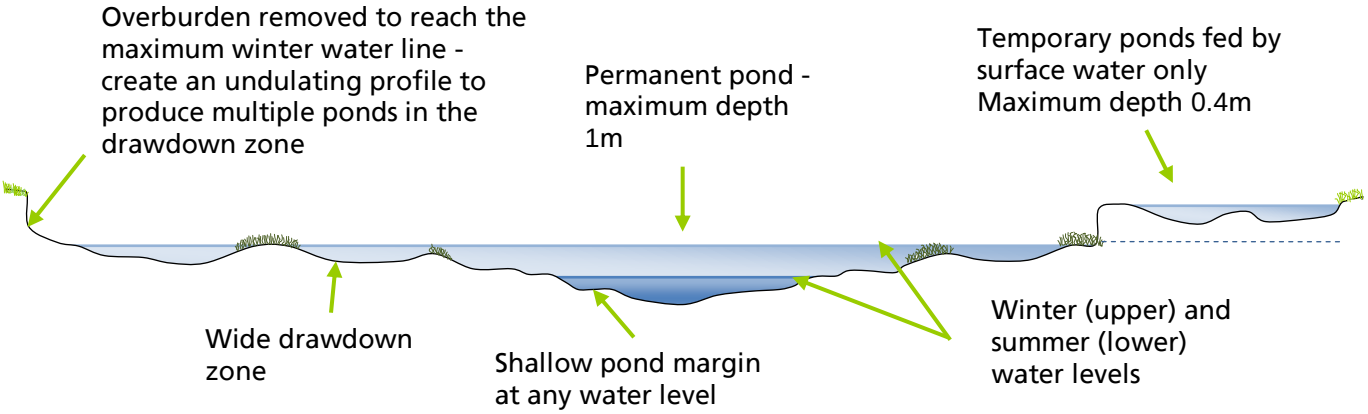
In general, very shallow pond profiles are best for wildlife. The pond edge area is particularly important, because shallow water supports the greatest number of wetland species (see *Pond Creation Toolkit Factsheet 4* for more information).

It is also worth thinking about the 'drawdown zone': the area of mud and vegetation which is flooded in winter and spring, and progressively dries as water levels fall in summer. This is a very important habitat for wetland species. Drawdown zones don't need to slope down evenly to deeper water: they can undulate, creating pools, spits and marshy areas around the pond edge. These wet areas create a patchwork mosaic of small-scale habitats which can be exceptionally rich in plants and invertebrates (see Figure 5 and *Pond Creation Toolkit Factsheet 4*).

Not all pools **have** to have extensive shallows however, and there are sometimes situations where steep banks are an advantage (Figure 6). This is particularly true of ponds where space is limited and steep sided ditch-like ponds need to be created. As noted above, on floodplains, such pools mimic the natural morphology of cut-off channels. And particularly if they are fed by good quality groundwater, these waterbodies provide excellent freshwater habitats for many deeper water plants and animals.

Figure 5. Example of a pond complex with undulating drawdown zone and lots of shallow water

A large pond (15 x10m) is created with a deeper centre (max. 1m) and undulating pond profile. This creates small shallow ponds in the pond margin as the water levels fall during the summer. Other ponds in the complex are perched above the groundwater level and are fed by surface water only.



PROFILE

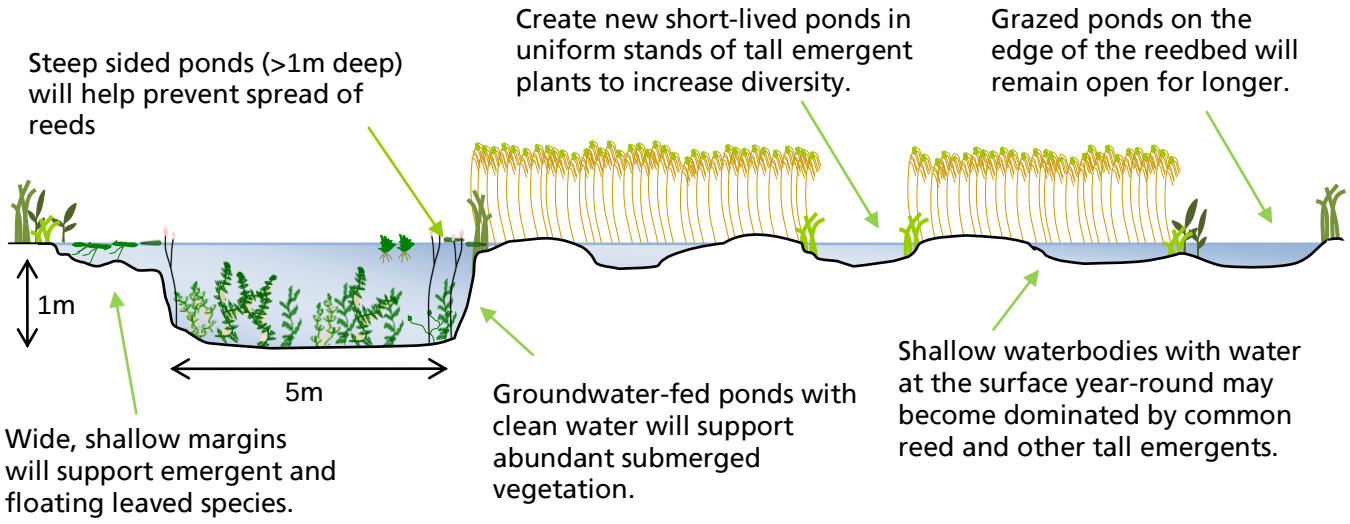
20m

AERIAL VIEW

Figure 6. Example profile of a steep-sided linear pond fed by high quality groundwater, with adjacent reedbed

Ponds which are relatively steep sided can prevent colonisation of dominant wetland plants such as Common Reed *Phragmites australis*. Steep-sided ponds will also provide excellent habitat for invertebrates, amphibians, birds and water vole. If some of the pond margin has a shallow profile it can also support important emergent, submerged and floating leaved species.

To increase diversity in the reedbed include ponds with different depths and profiles. Whilst some may become dominated by reed, others will remain open, creating a succession of habitat types.



5. Management of floodplain ponds

Adjacent habitats

Identifying which habitats surround the pond can make a big diffence to its wildlife value, so it is important to establish the aim and target species (if any) of the pond creation scheme before work begins.

- **Scrub and trees** adjacent to the pond will provide valuable habitats for amphibians and many bat species, and shelter for many insect species. Wading birds prefer open vistas, as trees next to the ponds will provide perches for raptors and corvids (crow family).
- **Reedbeds** are valuable for many bird and insect populations and can act as a screen to protect floodplain ponds from disturbance. Shallow water ponds can quickly become smothered by common reeds and without management the number of species they can support will be reduced.
- **Floodplain grazing marsh** can be a very good location for pond creation because the grassland itself often supports few species of conservation concern. However, stocking levels need to be managed to ensure that ponds are not damaged by high levels of nutrients or excessive trampling. The exact number of cattle or other stock per ha is difficult to determine because the number of ponds on the site will also affect grazing pressure in and around the ponds. In general, stock poaching which creates bare ground along the pond margin can be very beneficial, because it reduces the cover of more dominant plants. As long as trampling does not reduce the entire pond to a mud bath all year round, you have probably found a good level. Some species may require late successional habitats and if you are creating ponds for these species it may be worth restricting grazing from part of the site to allow taller emergent plants to develop. New ponds will need to be created to replace the early bare ground habitats which are being lost by natural processes.
- **Rivers.** Floodplain ponds will usually naturally support native fish species if they hold water year round. However, wildlife ponds cannot support large stocked populations of fish without this having a detrimental effect on the plants and invertebrates. If fishing is being considered as a recreational activity on the site it's best to allocate separate ponds for fishing and ponds for wildlife.

The early years

If your pond is fed by a clean water source, you should need to do very little in the way of management. However there are a few steps you can take in the first few years of a pond's life to iron out any future problems.

- **Don't plant up ponds.** Native plants will begin to colonise your pond in the year following their creation. Floodplain ponds are particularly good at colonising quickly. Rushing things will reduce the area available for specialist plant and animal species which like barer habitats and may increase the risk of bringing in invasive non-native species.
- **Keep an eye on which plants colonise the pond in the early years.** Invasive species can be removed manually if you spot them early on. Most native species will be welcome but in wetland sites you may want to remove uniform stands of single species, such as Bulrush *Typha latifolia* in the early years, to allow space for other plants to colonise. Grazing will also reduce the cover of these species.

6. Designing floodplain ponds for BAP species

Over 40% of Biodiversity Action Plan (BAP) pond species can be found in floodplain ponds (e.g. Figure 7) and many are restricted to this habitat type. Most require good water quality, and creating new clean water ponds in the floodplain can significantly improve the habitat available for these threatened species.

- **Find out about the specific requirements of the target species.** Many rare species have poor powers of dispersal and will need new habitat to be created close to existing populations. Some also require grazing animals to disturb the pond edges and to move eggs, seeds, spores and plant fragments to new habitats. However, although some species have very exacting habitat requirements (see individual *Species Dossiers* for more information) others, including wading birds can be less fussy and are easy to cater for.
- **Create a complex mosaic of ponds** to provide a gradient of water depths, size and flooding regimes. This will increase the likelihood that suitable conditions for target species will occur somewhere in any one year. Ponds in the floodplain are often highly dynamic and many species are specially adapted to this way of life, appearing only when conditions are suitable.
- **Create some ponds with direct connection between ponds** at high water level – even if this is only in very wet years. This can benefit species which rely on flooding for dispersal, e.g. True Fox Sedge *Carex vulpina*. Traditionally this process would be done by river flooding, but these days because rivers are so polluted, the connecting water should be from groundwater or surface water and ideally not river flood water.
- **Rare species are often early pond colonisers**, e.g. stoneworts, so it is important to allow new ponds to develop naturally, i.e. without planting-up. Because other species require late successional habitats e.g. Scarce Emerald Damselfly *Lestes dryas*, it is worth creating new ponds periodically, whilst leaving others to silt up. Providing a landscape with a range of different pond ages and habitat types.

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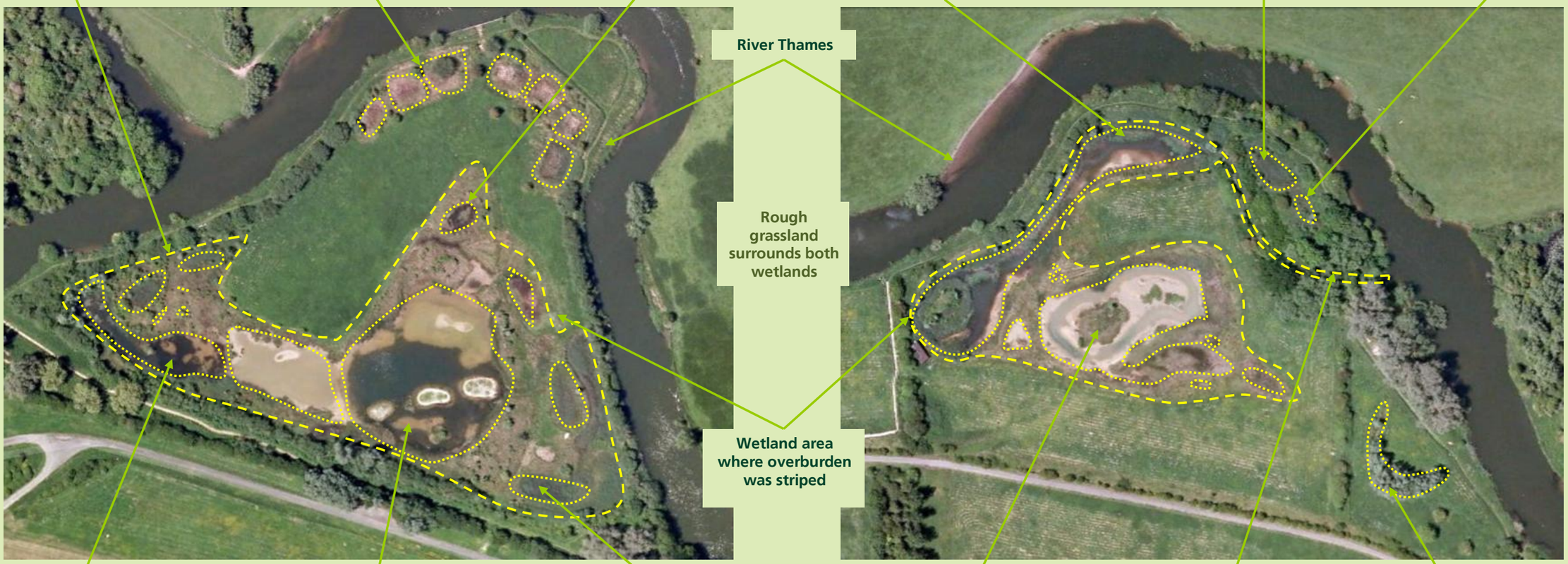
Figure 7. BAP species associated with floodplain ponds. From top: Oxbow Diving Beetle *Hydroporus rufifrons*, True Fox Sedge *Carex vulpina* and Eel *Anguilla anguilla*.

7. Case study: Shrike Meadow and Pinkhill Meadow, River Thames Floodplain, Oxford

These two wetland creation schemes were created in the 1990s in the floodplain of the River Thames at Farmoor Reservoir, Oxfordshire by Thames Water and the Environment Agency. At Pinkhill Meadow, ponds were designed to maximise plant, animal and bird diversity by creating a variety of pond types based on the principle of clean water ponds. Here the ponds were not connected to the river. At Shrike Meadows the ponds were created to provide an off-river flood refuge for fish, and a habitat for water vole and wetland birds. Some ponds were connected to the river by a ditch which flooded during the winter months.

The Pinkhill Meadow pond complex was created in 1990/1991 in degraded grassland. The site was designed as an **off-river** enhancement, and comprises a mosaic of approximately 40 permanent, semi-permanent and seasonal ponds together with associated areas of wet meadow and reed bed. The site developed to become exceptionally rich in both plants and aquatic animals.

Shrike Meadow created in 1999/2000, lies 200m south of Pinkhill and occupies a similar riverside location. The pond complex includes a reed lagoon semi-permanently **linked** to the Thames by a channel, together with a large scrape and around 11 ponds of varying sizes and depths. The site is very rich but the poorer water quality means this site only supports around half the number of species found at Pinkhill.



8. Further reading

This factsheet concentrates on the issues of pond creation in the floodplain. We have also created *Supplementary Habitat Factsheets* for *Designing ponds in grasslands* and *Designing ponds in wetlands and reedbeds*.

- RSPB (1997) The Wet Grassland Guide: Managing Floodplain and Coastal Wet Grasslands for Wildlife. Eds. Treweek, J., Drake, M., Mountford, O., Newbold, C., Hawke, C., Jose, P., Self, M. and Benstead, P.
- RSPB (1994) The new rivers and wildlife handbook. Eds. Ward, D., Holmes, N. and Jose, P.

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