



Oxford Flood Alleviation Scheme

Habitat and botanical survey report

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Executive Summary

The report presents the results of a survey carried out between April and October 2020 to collect baseline information about the habitats and vascular plants in and around the proposed Oxford Flood Alleviation Scheme, which extends over the floodplain of the River Thames through Oxford. The survey comprised the following elements:

- classification and mapping of habitats following UK Habitat Classification survey methodology;
- survey of hedgerows and lines of trees following the *Hedgerow Survey Handbook*;
- assessment of habitat condition following the Defra Biodiversity Metric 2.0; and
- recording of populations of notable vascular plants.

The results of the survey are shown in Figure A.1. Priority habitats and hedgerows and lines of trees that are species-rich or 'important' under the Hedgerows Regulations 1997 on ecological grounds are shown in Figure A.2. The results have been evaluated to identify habitats and populations of vascular plants of biodiversity value, listed in the table below and shown in Figure A.3.

Recommendations have been made for further survey, avoidance, mitigation, and enhancement of the features identified by the survey. These outcomes are summarized in Table 5.1. Quantities within the scheme are based on the boundary at the time of the survey.

Ecological feature	Value	Quantity within the scheme
Habitats		
Priority habitat – Hedgerows	Moderate	5,431m / 51 features
Priority habitat – Lowland Calcareous Grassland	Moderate	0.35ha
Priority habitat – Lowland Meadows (Annex I habitat)	High	3.39ha
Priority habitat – Lowland Meadows	Moderate	3.45ha
Priority habitat – Lowland Fens	Moderate	0.57ha
Priority habitat – Wet Woodland	Moderate	1.34ha
Priority habitat – Wet Woodland (other areas)	Low	7.20ha
Non-priority habitat grassland with restoration / enhancement potential	Moderate / Low	22.41ha
Vascular plants		
Adder's-tongue (<i>Ophioglossum vulgatum</i>)	Moderate	1,000s of plants
Alder buckthorn (<i>Frangula alnus</i>)	Moderate	1 plant
Creeping marshwort (<i>Apium repens</i>)	Very High	NA
Fritillary (<i>Fritillaria meleagris</i>)	Low	1 plant
Hybrid bedstraw (<i>Galium x pomeranicum</i>)	Moderate	1 plant
Marsh ragwort (<i>Senecio aquaticus</i>)	Low	100s of plants
Quaking-grass (<i>Briza media</i>)	Low	50-100 plants
Ragged-robin (<i>Silene flos-cuculi</i>)	Low	100-200 plants
Strawberry clover (<i>Trifolium fragiferum</i>)	Moderate	2 populations
Thames dandelion (<i>Taraxacum tamesense</i>)	High	NA

1. Introduction

1.1 Oxford Flood Alleviation Scheme

The Oxford Flood Alleviation scheme (FAS) is critical in reducing the long-term risk of flooding to residential and commercial properties on the floodplain in the Oxford area. The principal component of the FAS is a new channel to the west of the city centre, accompanied by modifications to the Seacourt, Hinksey and Bulstake streams, designed to reduce water levels in the river during flood events without increasing levels further downstream.

The “Red Line Boundary” (RLB) of the Scheme, i.e. the land on which permanent works or contractor’s temporary working areas are proposed or which would be used for access from the highway network, is shown in drawing number IMSE500177-CH2-XX-ZZ-VS-EN-1032 attached to this report as Figure 1.

1.2 Purpose of this report

This report presents the results of a survey undertaken in 2020 to collect baseline information about the habitats and vascular plants for the Environmental Statement and biodiversity net gain for the scheme. The habitat survey followed the UK Habitat Classification survey methodology (UK Habitat Classification Working Group, 2018) to classify and map habitats, and surveyed hedgerows and lines of trees following the *Hedgerow Survey Handbook* (Defra, 2007).

The results of the survey are discussed, highlighting habitats and plant populations of biodiversity value. Recommendations are made to avoid or mitigate potential impacts to these features, and for further survey, and potential enhancements for habitats and plant species that could be incorporated into the scheme are described.

2. Methodology

The survey covered all land within the RLB as it was up until October 2020, including some areas subsequently removed from the RLB, and comprised the following elements:

- habitat survey;
- hedgerow survey;
- habitat condition assessment; and
- botanical survey.

Methods for these elements are described in sections 2.2 to 2.5. The timing of the survey is described in section 2.1.

The survey was undertaken by Jacobs ecologist David Morris MCIEEM (Senior Ecologist), the Botanical Society of Britain and Ireland (BSBI) county recorder for the vice county of Oxfordshire (v.c.23).

All ecological information previously gathered for the scheme was reviewed in advance of the survey, including information about designated sites and results of previous habitat survey.

2.1 Survey timing

The habitat survey was carried out over spring and summer 2020, with information initially gathered during an ecology walkover for the scheme in April and other ecology surveys in May and June. A visit to complete the habitat survey and carry out the habitat condition assessment was undertaken on 30th June and 1st-2nd July, when all previously gathered results were reviewed.

The hedgerow survey was carried out on 29th and 30th September and 1st October. During this period, habitat within parts of the RLB that could not be visited in July (such as the land north of the caravan site on Abingdon Road) were surveyed.

The botanical survey was carried out in parallel with the habitat and hedgerow surveys.

Full details of the timings of survey of specific areas are included in the results.

2.2 Habitat survey

To map and classify habitats across the RLB, the survey followed the UK Habitat Classification (UKHab) survey methodology (UK Habitat Classification Working Group, 2018). The design of the survey, and preparation and collection of the data are described below.

2.2.1 Survey design

In order to provide sufficient detail for the calculation of the Defra Biodiversity Metric, the fine scale mapping methodology recommended in UKHab was followed, i.e.:

- features smaller than the minimum mapping unit (MMU) of 25m² were mapped as points;
- linear features less than 1m wide were mapped as lines; and
- linear features more than 1m wide or non-linear features of area greater than the MMU were mapped as polygons.

The choice of MMU meant that hedgerows and many watercourses were mapped as polygon features. Hedgerows and lines of trees (UKHab primary habitats 'h2 Hedgerows' and 'w1g6 Line of trees', respectively)

were therefore also recorded separately as lines in order that they could be surveyed following standard methods (see section 2.3).

All habitats were classified to at least level 4 in the UKHab primary habitat classification hierarchy, and to level 5 where applicable. However, surface waterbodies were classified only to level 3, i.e. 'r2 Rivers and streams' for flowing water and 'r1 Standing open water and canals' for still water. Further assessment of these habitats to identify priority habitats was carried out separately as part of the scheme.

All categories of secondary habitat code were used to record additional habitat attributes.

In addition to primary and secondary habitat types, for each habitat feature mapped the following additional information was collected:

- date of survey;
- notes;
- component National Vegetation Classification (NVC) plant communities;
- photographs;
- lists of vascular plants; and
- condition assessment.

Notes included information such as habitat structure and management, with photographs collected representative of these. Plant communities of the NVC (Rodwell, 1991-200) were assessed based on professional judgement. Lists of vascular plants recorded the component taxa from within each of the canopy, shrub and field layers of the vegetation, with the abundance of each taxon in each layer given a qualitative score of abundance using the DAFOR system, i.e. 'dominant', 'abundant', 'frequent', 'occasional', 'rare', 'locally dominant', 'locally abundant' or 'locally frequent'.

The level of additional information was determined based on professional judgement of the ecological value of habitats, e.g. detailed notes, photographs and full lists were collected for priority habitats. Condition assessment was undertaken for all habitat features mapped within the RLB. Details of the condition assessment methodology are provided in section 2.4.

2.2.2 Pre-survey mapping

Due to the large area for survey and, based on previous survey results, the complexity of habitats across this area, pre-survey mapping was carried out in order to maximise the efficiency of field survey and minimise potential field and post-processing errors. The pre-survey mapping aimed to produce preliminary habitat mapping of the area within 50m of the RLB, identifying:

- 1) buildings;
- 2) road and railway infrastructure;
- 3) waterbodies;
- 4) areas of tall vegetation likely to represent wooded habitats; and
- 5) open areas supporting herbaceous vegetation.

Features 1) to 3) were assigned the UKHab primary habitat codes 'u1b5', 'u1e' and 'r', respectively. Features 4) and 5) were assigned the preliminary habitat codes for woodland ('w') and grassland ('g'), respectively.

The pre-survey mapping was carried out in ArcGIS Pro using Ordnance Survey Master Map (OSMM) polygon data as basemap. Buildings, roads and railways were identified as polygons in the OSMM dataset that included the text strings 'Buildings', 'Road' and 'Rail' in the 'Theme' attribute, respectively. Waterbodies were identified as polygons with the 'Theme' attribute equal to 'Water'.

Step 4) above was carried out as follows, using OSMM data and the Environment Agency's 1m composite LiDAR Digital Terrain Model (DSM) and Digital Surface Model (DTM) raster datasets (circa 2016):

- 1) Vegetation height was calculated by subtracting the DSM raster from the DTM raster and extracting the pixels with positive grid values.
- 2) The output of 1) was simplified using the Filter tool to perform a low pass filter.
- 3) To represent polygon areas of tall vegetation, the output of 2) was used to extract pixels with grid values greater than 0.5m, and the 'Polygonize' tool was run on the extracted raster.
- 4) The polygon areas were simplified by:
 - a) deleting polygons of area less than 100m²; and
 - b) eliminating gaps enclosed by polygons, where the area enclosed was less than 100m² by:
 - i. running the Union tool with 'Allow gaps' to fill in gaps enclosed by polygon areas (assigned grid value -1);
 - ii. deleting polygons with grid value -1 and areas at least 100m²;
 - iii. running the Dissolve tool to merge the output of ii., removing the gaps.
 - c) running the Simplify Polygon tool on the output of b) using the weighted area method with 100m² minimum area and 5m simplification tolerance.
- 5) The output of 4) was intersected with the subset of OSMM polygons where the 'Make' attribute equalled 'Natural'. The results were also clipped against features representing rivers.

Non-wooded areas were identified by using the Erase tool to remove the output of 5) from the OSMM dataset.

The output of the above geoprocessing steps was manually checked and simplified as follows, using Google satellite imagery (circa 2020) and LiDAR data (circa 2017):

- the accurate delineation of boundaries between wooded and non-wooded areas was checked against satellite imagery, redrawing polygons as required;
- areas of vegetation of more-or-less uniform appearance were merged or split, applying the MMU described in section 2.2.1;
- areas with complex mapping in the OSMM dataset (such as along linear features) were simplified, applying the MMU rules described in section 2.2.1; and
- the locations of watercourses were checked against LiDAR data and if narrower than 1m were converted to line features.

2.2.3 Field survey

ArcGIS Online was used to store and manage data the large amount of complex data to be gathered for the survey. An online map was created that included layers for the RLB and the results of the pre-survey mapping. The results of the pre-survey mapping were validated, and new information added to the map in the field using the *ArcGIS Collector* app on an iPad.

The field data were edited for final production in ArcGIS Pro.

2.3 Hedgerow survey

The hedgerows and lines of trees recorded from the habitat survey (UKHab primary habitats 'h2 Hedgerows' and 'w1g6 Line of trees', respectively) and intersecting or along the boundary of the RLB were surveyed in greater detail following the *Hedgerow Survey Handbook* (Defra, 2007).

The line features representing hedgerows and lines of trees were given a unique identification number (HID) and loaded into a layer in a map in the *ArcGIS Collector* app for field use, together with a layer showing pre-digitized 30m sample sections for each feature, with the number and location of sample sections following the *Hedgerow Survey Handbook*. For each feature the following were recorded in the field:

- survey metadata, e.g. date of survey and any limitations;
- habitat attributes; and
- lists of the following vascular plant taxa, the vegetation layer in which they occurred and their abundance (following the system described in section 2.2.1) from the whole hedgerow and from 30m sample sections:
 - woody plants;
 - climbing plants;
 - woodland herbs, including those listed on Schedule 2 of the Hedgerows Regulations 1997 and ancient woodland indicators (Rose, 1999); and
 - invasive non-native plants, such as Himalayan balsam (*Impatiens glandulifera*).

The full list of attributes recorded is provided in Table B.1.

Woodland herbs recorded from hedgerows early in the season were carried forward into the final results once the survey was completed in October.

The recorded information was used to:

- 1) assess whether features qualified as Hedgerows priority habitat, i.e. lines of trees or shrubs comprised of at least 80% native woody species (Maddock, 2011);
- 2) assess habitat condition, following the criteria for hedgerows and lines of trees in the Defra Biodiversity Metric 2.0 (Natural England, 2019);
- 3) identify species-rich hedgerows, i.e. those with on average at least five native woody plant taxa (excluding brambles (*Rubus fruticosus* agg.) and dewberry (*Rubus caesius*)) in each 30m sample section; and
- 4) assess each feature against the wildlife and landscape criteria in the Hedgerows Regulations 1997, categorizing each feature as one of:
 - 'Important' – The feature:
 - a) was a 'countryside hedgerow';
 - b) was at least 30 years old;
 - c) was at least 20m in length, or if less than 20m then had at least one connection with another hedgerow at both its ends; and
 - d) satisfied at least one of the wildlife and landscape criteria on Schedule 1 of the Regulations.
 - 'Not important' – The feature met a) to c) above but failed d).
 - 'NA' – The feature failed to meet one of a) to c) above.

To undertake the Hedgerows Regulations assessment, the taxa recorded using the chosen nomenclature (see section 2.6) were assigned to taxa listed on the Schedules of the Regulations, as shown in Table C.2.

Assessments 2) to 3) above were automated, using calculated fields and the code blocks given in Appendix A to carry out the assessments in ArcGIS Pro. How each attribute was used in the Hedgerows Regulations and condition assessments is shown in Table B.1.

2.4 Habitat condition assessment

For each habitat feature recorded wholly or partially within the RLB, a condition assessment was undertaken following the Defra Biodiversity Metric 2.0 (Natural England, 2019). The condition of watercourses (UKHab primary habitat 'r2 Rivers and streams') was not assessed as this was undertaken as a separate survey for the scheme. For hedgerows and lines of trees (UKHab primary habitats 'h2 Hedgerows' and 'w1g6 Line of trees', respectively), the line feature representing these habitats was assessed, as described in section 2.3.

For each habitat polygon feature assessed, the date of assessment and condition were recorded. Condition was recorded as 'Good', 'Moderate', 'Poor' and 'N/A', assessed using the condition assessment form appropriate to the habitat. In some cases, professional judgement was used to assess the condition of habitats as the intermediate categories 'Fairly good' and 'Fairly poor'. For ease of managing the survey results, the assessment of polygon features was recorded as free text, referring to the main condition assessment criteria.

2.5 Botanical survey

Populations of notable vascular plant taxa, listed on of the following, were recorded if identified during the survey:

- Annex IV of European Council Directive 92/43/EEC (the 'Habitats Directive') and protected under the Species and Habitats Regulations 2017 ('European Protected Species');
- Schedule 8 of the Wildlife and Countryside Act 1981;
- listed in accordance with Section 41 of the Natural Environment and Rural Communities Act 2006;
- listed on the red lists of vascular plants for Great Britain or England (Cheffings *et al.*, 2005; Stroh *et al.*, 2014);
- listed as nationally rare or scarce in Great Britain (BSBI, 2017); or
- listed on local rare plants registers (Crawley, 2005; Erskine *et al.*, 2018).

Additional plant taxa were recorded where considered to be locally uncommon based on professional judgement, or where less common taxa typical of habitats of greater biodiversity value ('indicator species') occurred in habitats of otherwise low conservation value.

Populations of notable plants were recorded using a point layer in the Collector app. The species and notes on population size and other ecological attributes were recorded and photographs collected.

2.6 Nomenclature

The nomenclature for recording vascular plants generally followed Stace (2010). Some non-native taxa listed in Sell and Murrell (1997-2018), such as in the genera *Acer* and *Euonymus*, were also recorded.

2.7 Limitations

During the survey, the following areas had limited access or other limitations:

- It was not possible to access the land to the south of the recycling centre on Old Abingdon Road but the area within the RLB could be seen from the opposite bank of the Hinksey Stream, accessible from the Redbridge Park and Ride.
- Not all the woodland between the railway and River Thames, south of the bypass, was accessed as an aggressive occupier was encountered during initial surveys in April, and surveyors were required to leave. This area was not resurveyed but sufficient information was recorded during the initial visit to determine the habitat type and condition accurately.

- Several meadows between North and South Hinksey were mown shortly before the planned survey of these areas and so only limited information about habitat types and no information about habitat condition could be collected. These areas are described further in section 3.1.2.2.

There were the following limitations to the hedgerow survey:

- HID 3 along the boundary of the Seacourt Park and Ride was not surveyed during the hedgerow survey in October 2020 as it was within the construction area of the park and ride extension. Only a small length of the feature mapped earlier in the season from this boundary is within the RLB, and prior to the hedgerow survey this length appeared to have been removed.
- HIDs 65 and 66 along the boundary of Kendall Copse and Kennington Road had been heavily flailed shortly before the hedgerow survey in October 2020 such that information about species composition could not be recorded. However, sufficient information was collected earlier in the season to determine that these hedgerows had been planted less than 30 years previously, were dominated by non-native woody species and were in poor condition.
- One hedgerow and six lines of trees mapped during the spring and summer were not surveyed during the hedgerow survey in October 2020. Information recorded earlier in the season determined that the hedgerow had been recently planted with non-native species (hedgerow 64) and that the lines of trees comprised either crack willows (*Salix fragilis*) (HID 13) or non-native species (HIDs 9, 21, 54, 55 and 70) and were therefore not resurveyed.
- HIDs 28, 30, 33, 42, 44 and 45 were surveyed from one side only and it was not possible to see through to the other side:
 - For HID 28, land access was not available for the Oxford Rugby Club on the other side of the hedgerow. However, enough information was gathered from side 1 to determine the condition of the hedgerow and that the hedgerow would be 'important' under the Hedgerows Regulations.
 - The unsurveyed sides of HIDs 30 and 33 were accessible via the footpath between South Hinksey and North Hinksey but there was not sufficient time to walk around. However, enough information was gathered from side 1 to determine the condition of the hedgerows and that hedgerow 30 would be 'important' under the Hedgerows Regulations. Hedgerow 30 was species-poor (average native woody species per 30m section 1.67) and it was considered unlikely that there would be further woody species visible from the other side such that the hedgerow would be 'important'.
 - HIDs 42, 44 and 45 were not surveyed from the track on their southern sides. These hedgerows had been planted less than 30 years previously, and as sufficient information to assess condition was collected from the northern sides, the other side was not surveyed.

3. Results

The results of the survey are presented in Figure A.1 and described below. Full results of the survey, including lists of plants recorded and photographs, are available to view online via an interactive map at the following web address:

<https://jacobs.maps.arcgis.com/apps/instant/attachmentviewer/index.html?appid=3e0155afbbbf4e4d814c316894e7f6fd>

Features referred to below can be viewed in the online map by clicking the accompanying “[link to feature](#)” hyperlink. Clicking will open a web browser window showing the web map with the feature highlighted.¹

The full results of the survey can be downloaded as shapefiles from the page at the following web address:

<https://jacobs.maps.arcgis.com/home/item.html?id=ee1a1919fce843bca1bddb66b10b3f16>

3.1 Habitat survey

A diversity of habitat types was recorded during the survey, including the following priority habitats:

- Hedgerows;
- Lowland Calcareous Grassland;
- Lowland Fens;
- Lowland Meadows;
- Traditional Orchards; and
- Wet Woodland.

In addition, three habitats listed on Annex I of the Habitats Directive were recorded:

- H6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*);
- H6510 Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*); and
- H91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*).

The priority and other habitats recorded are described below, grouped by broad habitat. Hedgerows are described in section 3.2.

3.1.1 Calcareous grassland

Calcareous grassland habitat was recorded from Egrove Park, within the RLB east of Egrove Park Meadow Local Wildlife Site (LWS) ([link to feature](#)). This habitat comprised Lowland Calcareous Grassland priority habitat in good condition. This habitat is referable to the Annex I habitat ‘Semi-natural dry grasslands and scrubland facies: on calcareous substrates (*Festuco-Brometalia*)’ (UKHab primary habitat ‘g2a5 Dry grasslands and scrub on chalk or limestone; lowland (H6210)’).

3.1.2 Neutral grassland

Neutral grassland habitats dominated most of the area surveyed, encompassing a range of vegetation types reflecting current and past management and, to a lesser extent, hydrology. These types are described below.

¹ Compatible with the Google Chrome, Mozilla Firefox, Apple Safari and Edge Chromium.

3.1.2.1 Lowland Meadows

Lowland Meadows priority habitat (UKHab primary habitat 'g3a Lowland Meadows') was recorded from five locations within the RLB. The largest area was within Osney Mead (Botley Meadow) LWS ([link to feature](#)), which comprised largely of unimproved floodplain grassland with an abundance of species such as great burnet (*Sanguisorba officinalis*), meadowsweet (*Filipendula ulmaria*) and pepper saxifrage (*Silaum silaus*) (UKHab primary habitat 'g3a5 - Lowland hay meadows (H6510)'). This habitat is referable to the NVC plant community MG4 *Alopecurus pratensis*-*Sanguisorba officinalis* grassland and the Annex I habitat '6510 Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)'. Most of the grassland within the LWS was in good condition.

This grassland habitat type was also present in Seacourt Nature Park to the north, within a small meadow ([link to feature](#)) and an unmanaged fenced-off area ([link to feature](#)). The latter area was assessed as being in poor condition, comprising a mosaic of dense scrub and tall herb vegetation dominated by meadowsweet. The abundance of great burnet and other species of unimproved floodplain grassland in this area indicated that it was likely once similar to the LWS but had become degraded due to lack of management.

Two further types of Lowland Meadows priority habitat were recorded in more elevated areas. Two stands of floodplain grassland referable to the NVC plant community MG5b *Cynosurus cristatus*-*Centaurea nigra* grassland, *Galium verum* sub-community were recorded from sheep pasture south-east of North Hinksey, with one small stand by the bridge over the Hinksey Stream ([link to feature](#)) and a large stand covering a gravel terrace to the south ([link to feature](#)).

Lowland Meadows priority habitat was also recorded within Egrove Park Meadow LWS, comprised of species-rich grassland dominated by false oat-grass (*Arrhenatherum elatius*) ([link to feature](#)), referable to MG1d *Arrhenatherum elatius* grassland, *Pastinaca sativa* sub-community.

3.1.2.2 Other neutral grassland

There was a range of other types of neutral grassland (UKHab primary habitat 'g3c Other neutral grassland types' and subtypes). Management of such grassland ranged from regular management as meadows, under-managed meadows, grasslands managed as horse pasture and abandoned grassland. Included within this habitat were several stands that did not qualify as priority habitat but that were relatively species-rich, comprising neutral grasslands that have likely been derived through land management practices from floodplain grassland like that described in section 3.1.2.1.

The largest areas of more species-rich grassland were the meadows to the north ([link to feature](#)) and east ([link to feature](#)) of the Seacourt Park and Ride, and the meadows south-east of Osney ([link to feature](#)). Parts of the latter meadows supported species such as adder's-tongue (*Ophioglossum vulgatum*) and ragged-robin (*Silene flos-cuculi*). These meadows were assessed as being in good condition. Some of the meadows between North and South Hinksey could not be surveyed as they had been mown shortly before they were planned to be surveyed, but preliminary visits had identified them as potentially supporting similar grassland. Within these meadows were also stands of poorer quality grassland in seasonally flooded areas (UKHab secondary code 122).

Under-managed meadows were dominated by false oat-grass and other coarse grass species (UKHab primary habitat 'g3c5 *Arrhenatherum* neutral grassland'). Large areas of such grassland supported grassland in poor condition, such as the fields from South Hinksey ([link to feature](#)) to Kennington ([link to feature](#)), and the smaller fields along North Hinksey Lane ([link to feature](#)). Other stands were richer and assessed as of moderate condition, including two meadows between the Hinksey Stream and Hinksey Pools Site of Local Importance for Nature Conservation (SLINC) ([link to feature](#), [link to feature](#)), which supported an abundance of meadowsweet and other wildflowers, including some great burnet. Outside the RLB, there was similar grassland within the area known as Dean's Ham in Grandpont ([link to feature](#)). The small field west of the Seacourt Park and Ride ([link to feature](#)) also supported grassland assessed as being in moderate condition.

Pastured grassland of relatively greater species-richness was found in an ungrazed horse paddock south-east of North Hinksey ([link to feature](#)). This field supported an abundance of meadowsweet and other wildflowers, including some great burnet.

In unmanaged and abandoned areas, the above grassland types graded into tall herb vegetation. Most often, such vegetation was recorded in narrow zones around the edges of fields and on the banks of watercourses, comprising ruderal vegetation dominated by common nettle (*Urtica dioica*) and great willowherb (*Epilobium hirsutum*). However, some whole fields also appeared to have been abandoned, such as areas west of the Seacourt Park and Ride ([link to feature](#)) and two fields south of Osney Mead Industrial Estate ([link to feature](#), [link to feature](#)). The latter areas supported diverse vegetation comprised of a complex mosaic of wetland and ruderal tall herb and grassland.

Many stands of grassland within the floodplain had been disturbed as part of archaeological ground investigations for the scheme. Excavated areas had been reseeded with seed mixes dominated by a small number of 'wildflower' species such as oxeye daisy (*Leucanthemum vulgare*) and the rayed form of common knapweed (*Centaurea nigra s.l.*) and did not resemble semi-natural neutral grassland vegetation.

3.1.3 Modified grassland

Agriculturally improved grassland (UKHab primary habitat 'g4 Modified grassland') was found predominantly in areas of pasture, dominating a large area of the floodplain between North and South Hinksey ([link to feature](#)), and along the River Thames east of New Hinksey ([link to feature](#)) to the southern end of Abingdon Road ([link to feature](#)). Other areas where modified grassland was recorded included the three fields around Willow Walk Meadow LWS ([link to feature](#)) and a large meadow east of North Hinksey ([link to feature](#)). Some small stands of grassland in urban areas were also recorded as modified grassland.

3.1.4 Broadleaved, mixed and yew woodland

Most stands of woodland recorded comprised Wet Woodland priority habitat (UKHab primary habitat 'w1d Wet woodland'), of which larger stands within the floodplain were referred to the Annex I habitat '91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)' (UKHab primary habitat 'w1d5 Alder woodland on floodplains'). This habitat was found across the floodplain, comprising stands of crack willow (*Salix fragilis*) trees around the edges of fields, along rivers and that had colonised unmanaged areas. Most stands were species-poor, with a field layer dominated by common nettle, but alder (*Alnus glutinosa*) was present in some stands. Woodland to the south of the Kennington roundabout ([link to feature](#)) and around Kennington Pool LWS ([link to feature](#)) had a more diverse and less eutrophic tall herb fen field layer, with affinities to W2 *Salix cinerea*-*Betula pubescens*-*Phragmites australis* woodland. There were also linear stands of willow trees along watercourses and field boundaries, recorded as lines of trees (UKHab primary habitat 'w1g6 Line of trees'). Lines of trees are described further in section 3.2.

Other stands of woodland recorded were not priority habitat (UKHab primary habitat 'w1g7 Other broadleaved woodland'). Most stands comprised planted woodland (UKHab secondary code 36), but there were some small stands of secondary semi-natural woodland in marginal areas, such as along riverbanks.

3.1.5 Dense scrub

Dense scrub was recorded from unmanaged areas across the area surveyed. Most stands were dominated by one of bramble (*Rubus fruticosus* agg.) or hawthorn (*Crataegus monogyna*), and occasionally blackthorn (*Prunus spinosa*) (UKHab primary habitat types 'h3d Bramble scrub', 'h3f Hawthorn scrub' and 'h3f blackthorn scrub', respectively). Some stands were also dominated by dewberry (*Rubus caesius*) (recorded as 'h3 Dense scrub'). Most stands of bramble scrub recorded were dominated by the invasive non-native giant bramble (*Rubus armeniacus*).

A small number of stands of more diverse mixed scrub (UKHab primary habitat 'h3h Mixed scrub') were also recorded, for instance scrub of blackthorn, buckthorn (*Rhamnus cathartica*), dogwood (*Cornus sanguinea*) and hawthorn in the unmanaged enclosed area north of Osney Mead (Botley Meadow) LWS ([link to feature](#)).

One small stand of scrub outside of the RLB, in South Hinksey, comprised an overgrown traditional orchard, a priority habitat (UKHab secondary code 21) ([link to feature](#)).

3.1.6 Fen, marsh and swamp

Lowland Fens priority habitat was recorded from three locations. The largest stand of this habitat was in and around the Jubilee Scrape through Osney Mead (Botley Meadow) LWS, comprised of unmanaged tall herb fen ([link to feature](#)). Smaller stands were also recorded around the margin of a meadow east of Hinksey ([link to feature](#)), and in a glade in woodland south of the Kennington roundabout ([link to feature](#)).

Other types of fen, marsh and swamp habitat comprised small stands of tall herb and swamp vegetation in damp parts of fields and in ditches (UKHab primary habitat 'f2f Other swamps'). Such vegetation most often comprised clonal stands of greater pond-sedge (*Carex riparia*).

3.1.7 Standing open water and canals

Bodies of standing water (UKHab primary habitat 'r1 Standing open water and canals') were present within the Hinksey Pools SLINC ([link to feature](#)) and Kennington Pool LWS ([link to feature](#)), from a small woodland pond to the west of the Seacourt Park and Ride ([link to feature](#)) and from flood culverts within the Willow Walk between North Hinksey and Osney ([link to feature](#)). Ponds were also identified from Ordnance Survey mapping in woodland along the railway east of Osney outside the RLB ([link to feature](#)) but were not accessible.

3.1.8 Rivers and streams

There were many rivers and streams across the area surveyed, the largest being the Bulstake Stream, Eastwycke Ditch, Hinksey Stream, Seacourt Stream and the River Thames (or Isis). The Seacourt Stream flows along the north-western edge of the RLB, from Botley to North Hinksey, until it divides into the Hinksey Stream and Bulstake Stream. The former flows through the floodplain meeting the main channel of the Thames south of the Kennington roundabout, east of South Hinksey. The Bulstake Stream flows east along the edge of the RLB, meeting the Thames at Osney. The Thames flows south along the eastern edges of the RLB. The Eastwycke Ditch flows east along the northern side of Hinksey park, under Abingdon Road and into the Thames. There were also several small unnamed watercourses, such as the watercourse flowing from south-west to north-east into the RLB under the A34 from Hinksey Hill.

Unshaded stretches of larger watercourses supported stands of emergent marginal vegetation, predominantly branched bur-reed (*Sparganium erectum*) and common club-rush (*Schoenoplectus lacustris*). Other aquatic vegetation appeared to be limited, predominantly to yellow water-lily (*Nuphar lutea*). The banks of watercourses were dominated by eutrophic tall herb vegetation (UKHab primary habitat 'g3c Other neutral grassland types', secondary code 14), predominantly stands of common nettle and great willowherb.

3.1.9 Urban habitats

Parts of the RLB were dominated by urban habitats. These predominantly comprised developed land such as roads and railways (UKHab primary habitat 'u1e Built linear features') and buildings (UKHab primary habitat 'u1b5 Buildings'). Within the RLB were also urban parks (UKHab secondary code 210) in Botley ([link to feature](#)), Grandpont ([link to feature](#)), New Hinksey ([link to feature](#)) and Osney ([link to feature](#)), and allotments (UKHab secondary code 910) in Botley ([link to feature](#)), Grandpont ([link to feature](#)) and Osney ([link to feature](#)).

3.2 Hedgerow survey

The survey recorded 71 features comprising 17 shrubby hedgerows, 39 shrubby hedgerows with trees and 15 lines of trees. The results of the assessments carried out are provided in Table C.1 and described below. Trees in hedgerows are described in section 3.2.5. Hedgerows are referred to below by their unique identifier (HID).

3.2.1 Hedgerows priority habitat

Forty-five shrubby hedgerows or shrubby hedgerows with trees and 10 lines of trees qualified as Hedgerows priority habitat. Shrubby hedgerows that did not qualify as priority habitat had been planted with non-native woody species, such as the hedgerows north-west of South Hinksey and the hedgerows of cherry plum (*Prunus cerasifera*) north of Osney Mead (Botley Meadow) LWS. Lines of trees that did not qualify included lines of non-native poplars (*Populus*).

3.2.2 Species-richness

A total of 72 woody, 9 climbing and 16 woodland herbaceous plant taxa were recorded. Two invasive non-native species were also recorded, Himalayan balsam (*Impatiens glandulifera*) and Michaelmas daisy (*Aster* sp.). The taxa recorded and their frequencies are shown in Table C.2 and Figure C.2, respectively.

The ten most frequently recorded woody taxa were, in order of frequency: hawthorn (*Crataegus monogyna*); dewberry (*Rubus caesius*); ash (*Fraxinus excelsior*); crack Willow (*Salix fragilis*); the dog-rose *Rosa canina* group 'Dumales'²; blackthorn (*Prunus spinosa*); elm-leaved Bramble (*Rubus ulmifolius*); the rose hybrid *R. x dumetorum* (= *R. canina* x *obtusifolia*); buckthorn (*Rhamnus cathartica*); and elder (*Sambucus nigra*). The rose hybrid *R. obtusifolia* x *micrantha* was recorded from HID 72 where it was new to the vice county of Berkshire.

The field layer of most hedgerows was poor in woodland herbs, though [HID 20](#) had a rich ground flora, with bearded couch (*Elymus caninus*), dog's mercury (*Mercurialis perennis*), early dog-violet (*Viola reichenbachiana*), false brome (*Brachypodium sylvaticum*) and lords-and-ladies (*Arum maculatum*).

The average species-richness per 30m sample section (excluding species of *Rubus*) and total species-richness of native woody species (including species of *Rubus*) is shown in Figure C.1. Twenty-one hedgerows or lines of trees were species-rich, i.e. had on average at least five native woody taxa (excluding species of *Rubus*) per 30m sample section. [HID 20](#) had the highest total species diversity, with 22 native woody species (including three *Rubus* species).

3.2.3 Habitat condition

The results of the habitat condition assessment are summarised in Table 3.1. Hedgerows were most frequently assessed as 'Moderate' condition due to gaps in the continuity of woody vegetation and abundance of species indicative of nutrient enrichment such as common nettle. Hedgerows assessed as 'Poor' condition had an abundance of non-native species or had been damaged by land management practices. Lines of trees failed to be in good condition due to gaps in the tree canopy or the age of the trees.

3.2.4 Hedgerows Regulations

The assessment against the wildlife and landscape criteria in Schedule 1 of the Hedgerows Regulations 1997 identified 10 'Important' hedgerows. These hedgerows are identified in the web map and shown on Figure A.3.

² This taxon is now recognised as the species *Rosa squarrosa* (A. Rau) Boreau

Table 3.1: Summary of habitat condition assessment of hedgerows and lines of trees

Type	Habitat condition			Total
	Good	Moderate	Poor	
Shrubby hedgerow	7	5	5	17
Shrubby hedgerow with trees	25	13	1	39
Lines of trees	14	0	1	15
Total	46	18	7	71

3.2.5 Hedgerow trees

Many hundreds of standard trees³ were recorded during the survey, with 534 trees recorded from shrubby hedgerows with trees and 250 from lines of trees. The most frequently recorded trees were ash and crack willow, while field maple (*Acer campestre*) and pedunculate oak (*Quercus robur*) were rarer. Many hedgerows and lines of trees within the floodplain incorporated large old crack willow pollards, such as along the Hogacre Ditch ([HID 16](#)) and nearby boundary features. The floodplain between North Hinksey and South Hinksey was poorer in trees, but there was a large veteran ash tree in [HID 32](#).

3.3 Botanical survey

Twenty-three notable plant taxa were recorded, listed together with their legal and conservation statuses in Table 3.2. Further information is provided below.

Table 3.2: Notable plants recorded

Scientific name	Common name	Legal / conservation status
<i>Apium repens</i>	Creeping marshwort	European Protected Species, Schedule 8, Section 41, England Endangered, GB Critically Endangered, Nationally Rare, Oxon Rare, v.c.23 Rare
<i>Briza media</i>	Quaking-grass	England Near Threatened
<i>Fragaria vesca</i>	Wild strawberry	England Near Threatened
<i>Frangula alnus</i>	Alder buckthorn	v.c.22 RPR, Oxon Scarce, v.c.23 Scarce,
<i>Fritillaria meleagris</i>	Fritillary	Nationally Scarce, v.c.23 Scarce
<i>Galium x pomeranicum</i>	Hybrid bedstraw	-
<i>Juncus compressus</i>	Round-fruited Rush	England Vulnerable, GB Near Threatened, v.c.22 RPR
<i>Knautia arvensis</i>	Field scabious	England Near Threatened
<i>Lathyrus sylvestris</i>	Narrow-leaved everlasting-pea	v.c.22 RPR
<i>Linaria repens</i>	Pale toadflax	v.c.22 RPR
<i>Ophioglossum vulgatum</i>	Adder's-tongue	-
<i>Petroselinum segetum</i>	Corn parsley	v.c.22 RPR

³ Defined as trees with a stem diameter of at least 20cm at 1.5m above the ground if single-stemmed trees, or at least 15cm if multi-stemmed.

Scientific name	Common name	Legal / conservation status
<i>Rhinanthus minor</i> subsp. <i>stenophylla</i>	Yellow rattle	-
<i>Rosa canina</i> x <i>micrantha</i> = <i>R. x toddiae</i>	Hybrid rose	-
<i>Salix purpurea</i>	Purple willow	v.c.22 RPR
<i>Sanguisorba officinalis</i>	Great Burnet	v.c.22 RPR
<i>Senecio aquaticus</i>	Marsh ragwort	England Near Threatened, v.c.22 RPR
<i>Silaum silaus</i>	Pepper saxifrage	-
<i>Silene flos-cuculi</i>	Ragged-robin	England Near Threatened
<i>Taraxacum tamesense</i>	Thames dandelion	-
<i>Trifolium fragiferum</i>	Strawberry clover	England Vulnerable, v.c.22 RPR
<i>Urtica dioica</i> subsp. <i>galeopsifolia</i>	Fen nettle	v.c.22 RPR
<i>Valeriana officinalis</i>	Common valerian	England Near Threatened

One species recorded is designated under national legislation, Creeping marshwort, a European Protected Species, listed on Schedule 8 of the Wildlife and Countryside Act 1981 and a species of principal importance, listed in accordance with Section 41 of the Natural Environment and Rural communities Act 2006. Creeping marshwort is also Nationally Rare and Critically Endangered in Great Britain. It was recorded from the Willow Walk Meadow LWS, approximately 30m to the south of the RLB ([link to feature](#)).

Nine species recorded are not legally protected and have national conservation statuses:

- Common valerian in several places in the floodplain south of South Hinksey, in woodland and unmanaged grassland.
- Field scabious was recorded from sheep pasture south-east of North Hinksey ([link to feature](#)).
- Fritillary was recorded from a swale in Botley Park, outside the RLB ([link to feature](#)), from woodland on the bank of the Hinksey Stream south of Kennington roundabout ([link to feature](#)) and from Osney Mead (Botley Meadow) LWS, outside the RLB.
- Marsh ragwort was recorded from horse paddocks by the Thames in New Hinksey, where it was locally abundant, with many hundreds of plants ([link to feature](#)).
- Quaking grass was recorded from a small stand of unimproved grassland on the floodplain between North and South Hinksey, around 50-100 plants ([link to feature](#)).
- Ragged-robin was recorded from meadows to the south-east of Osney, where it was locally frequent, likely 100-200 plants ([link to feature](#)).
- Round-fruited rush was recorded from an unmanaged area near the Thames, east of New Hinksey, approximately 10m north of the RLB ([link to feature](#)).
- Strawberry clover was recorded growing with creeping marshwort in Willow Walk Meadow LWS ([link to feature](#)), in trampled amenity grassland in Oatlands Road Recreation Ground ([link to feature](#)) and in seasonally flooded areas of horse pasture by the Thames in New Hinksey ([link to feature](#)). The population in Oatlands Road Recreation Ground covered several square metres along a footpath.
- Wild strawberry was recorded from a driveway in South Hinksey ([link to feature](#)).

Thirteen taxa recorded are locally notable, with ten listed on the rare plants register (RPR) for the vice county of Berkshire (v.c.22) (Crawley, 2005) and three on the RPR for the vice county of Oxfordshire (v.c.23) (Erskine *et al.*, 2018). Of these, seven have no national conservation status:

- Alder buckthorn was recorded as one small bush in Osney Mead (Botley Meadow) LWS ([link to feature](#)) (in v.c.23) and was planted in several hedgerows north-west of South Hinksey (in v.c.22).
- Corn parsley was recorded from disturbed ground at a trial trench site near north Hinksey (in v.c.22) ([link to feature](#)).
- Fen nettle was recorded across the floodplain (in both v.c.c. 22 and 23), along riverbanks and in unmanaged fields, where it was locally abundant.
- Great Burnet was recorded where it was found in improved and semi-improved grasslands. It was abundant in unimproved grassland in Osney Mead (Botley Meadow) LWS (v.c.23) and was found in several other areas. It is not rare or scarce in Oxfordshire but is a characteristic species of unimproved floodplain grassland.
- Narrow-leaved everlasting-pea was recorded at the edge of woodland along the railway sidings in New Hinksey (in v.c.22), outside the RLB ([link to feature](#)).
- Pale toadflax was recorded from the railway sidings in North Hinksey (in v.c.22), outside the RLB ([link to feature](#)).
- Purple willow was recorded by the Hinksey Stream to the south of Old Abingdon Road (in v.c.22) ([link to feature](#)). One small bush was also present in Osney Mead (Botley Meadow) LWS (in v.c.23) ([link to feature](#)).

In addition, the following taxa without any legal or conservation status were also recorded as noteworthy:

- The hybrid between hedge bedstraw and lady's bedstraw (*Galium album* x *verum* = *G. x pomeranicum*) was recorded from an unmanaged field south of Osney Mead Industrial Estate, likely comprised of a single clonal plant ([link to feature](#)). This hybrid is rare in Oxfordshire.
- Adder's-tongue was recorded from meadows south-east of Osney, where there was a large population spread (likely many thousands) over several meadows and locally frequent to abundant. It is not rare or scarce in Oxfordshire but is a characteristic species of unimproved grassland.
- The subspecies of yellow rattle *Rhinanthus minor* subsp. *stenophyllus* was recorded from Dean's Ham, outside the RLB ([link to feature](#)). This wet grassland ecotype of yellow-rattle is rare in Oxfordshire and had not previously been recorded from the vice county of Berkshire (Crawley, 2005).
- The hybrid *Rosa* x *toddiae* between common dog-rose (*R. canina*) and small-flowered sweet-briar (*R. micrantha*) was recorded from a hedgerow along the north-eastern boundary of Osney Mead (Botley Meadow) LWS ([link to feature](#)). This is a rare rose in Oxfordshire.
- Pepper saxifrage was recorded where it was found in improved and semi-improved grasslands. It was abundant in unimproved grassland in Osney Mead (Botley Meadow) LWS. It is not rare or scarce in Oxfordshire but is a characteristic species of unimproved floodplain grassland.
- Thames dandelion was recorded from the floodplain east of the Seacourt Park and Ride, approximately 25m to the north of the RLB ([link to feature](#)). This is a characteristic dandelion of floodplain grassland and is rare in Oxfordshire.

4. Discussion and recommendations

In this section, the results of the survey are evaluated. Habitats and plant populations of biodiversity value are highlighted, following best practice guidance for valuing ecological features (CIEEM, 2018) and the criteria used in the Environmental Statement for the scheme (Table 4.1).

Recommendations are made to avoid or mitigate potential impacts to these features, and for further survey. Based on the survey findings, potential enhancements are described for habitats and plants that could be incorporated into the scheme and contribute toward biodiversity net gain.

The features within the RLB discussed below have been identified based on the boundary at the time the survey was undertaken, i.e. up to October 2020; where post-survey changes have been significant a note has been added to the end of the relevant section.

Table 4.1: Criteria for classifying the value of ecological features

Value	Criteria
Very High	International importance e.g. Special Areas of Conservation (SAC) and Special Protection Areas (SPA).
High	National importance e.g. Sites of Special Scientific Interest (SSSI) or species whose UK population is endangered.
Medium	Regional/County importance e.g. habitats and/or species populations considered to be important within Oxfordshire.
Low	District/Parish/Local importance e.g. habitats or species populations considered to be important within Oxford or within approximately 2km of the Scheme boundary.
Negligible	Within the zone of influence only/no listed importance.

4.1 Habitats

The survey recorded five priority habitats and a diversity of other habitats within the RLB, the value of which are assessed in section 4.1.1. Recommendations for further survey to provide information that could not be collected during the present survey are made in section 4.1.2. In the following sections, recommendations are made for avoidance and mitigation, and enhancements with respect to the habitats recorded.

4.1.1 Biodiversity value

Within the RLB, the survey identified many hedgerows and lines of trees and large areas of other priority habitats, summarised in tables 4.1 and 4.2, and a diversity of other habitats. Priority habitats and important / species-rich hedgerows are shown in Figure A.2.

The value of priority and other habitats is discussed below and shown in Figure A.3.

Table 4.2: Hedgerows and lines of trees within the RLB

Type	Number of features	Length within RLB (m)
Priority habitat	51	5,431
Species-rich	20	1,690
Important	10	669
All	67	6,929

Table 4.3: Areas of priority habitat within the RLB

Priority habitat	UKHab primary habitat	Area (ha)
Lowland Calcareous Grassland	g2a5 Dry grasslands and scrub on chalk or limestone; lowland (H6210)	0.35
Lowland Fens	f2a Lowland fens	0.57
Lowland Meadows	g3a Lowland Meadows	3.45
	g3a5 Lowland hay meadows (H6510)	3.39
	Total	6.84
Wet Woodland	w1d Wet woodland	1.24
	w1d5 Alder woodland on floodplains (H91E0)	7.30
	Total	8.54

4.1.1.1 Hedgerows

There were 67 hedgerows and lines of trees recorded partly or wholly within the RLB, 51 of which qualified as Hedgerows priority habitat (Table 4.2). Four more features surveyed were on the edge of the RLB. Twenty of the hedgerows and lines of trees within the RLB were found to be species-rich. Ten features were 'important' under the wildlife and landscape criteria of the Hedgerows Regulations 1997. Some hedgerows incorporated other features of biodiversity value, such as the veteran ash tree identified in HID 32 and the many large old crack willow pollards present in many areas.

Assessment against the archaeological and historical criteria of the Hedgerows Regulations 1997 has been undertaken separately as part of the scheme (Oxford Archaeology, 2016), which identified a number of 'important' hedgerows based on their presence on pre-1850 maps. These correspond to HID 23, 37, 40, 58, 59, 62 and 63, none of which were identified as important based on the wildlife and landscape criteria of the Hedgerows Regulations 1997. The latter two hedgerows were identified as one boundary feature from old maps but are now divided by a stand of woodland; based on field evidence these boundaries were considered to be less than 30 years old, comprising lines of relatively young hawthorn along the boundary of a modern track. Hedgerows 62 and 63 are therefore not 'important' under the Hedgerows Regulations 1997. There is therefore a total of 15 hedgerows and lines of trees intersecting or along the boundary of the RLB that are 'important' under the Hedgerows Regulations 1997

Local policy (Oxfordshire County Council, 2014) identifies 'ancient hedgerows' as irreplaceable habitat. While there are no criteria for identifying ancient hedgerows, features that are important, species-rich or support veteran trees are likely to be ancient and irreplaceable. There are 27 such hedgerows and lines of trees intersecting or along the boundary of the RLB.

In summary, hedgerows and lines of trees within the RLB encompass a diversity of features of varying biodiversity value. Given the extensive network of these habitats, taken as a whole, hedgerows and lines of trees within the RLB are considered of Moderate value. However, individual features may be of Low or Negligible value, such as species-poor hedgerows, hedgerows of recent origin and lines of non-native trees.

4.1.1.2 Lowland Calcareous Grassland

One stand of Lowland Calcareous Grassland priority habitat was recorded within the RLB, an area of 0.49ha in an undesignated field to the east of Egrove Park Meadow LWS, comprising vegetation referable to the NVC plant community CG3 *Bromus erectus* grassland. This habitat is rare around Oxford (Oxfordshire County Council, 2014), with most stands around the city highly fragmented. Most sites are very small, such as on road verges,

and larger areas are designated, such as Sidling's Copse and College Pond Site of Special Scientific Interest (SSSI) and Chilswell Valley LWS. The habitat recorded within Egrove Park is therefore a significant area within Oxfordshire and would qualify as a Local Wildlife Site (Thames Valley Environmental Records Centre, 2018). The value of this habitat is therefore considered to be Moderate.

4.1.1.3 Lowland Meadows

The area of Lowland Meadows habitat within the RLB is very significant (Table 4.3). Approximately 30% of this habitat within Osney Mead (Botley Meadow) LWS, approximately 49% of that within Egrove Park Meadow LWS and all of that within the pasture south-east of Hinksey and within the Seacourt Nature Park lie within the RLB. These sites are discussed below.

Osney Mead (Botley Meadow) LWS and Seacourt Nature Park

These designated sites support Lowland Meadows priority habitat comprising vegetation referable to the NVC plant community MG4 *Alopecurus pratensis-Sanguisorba officinalis* grassland. The fenced area within the Nature Park likely once supported MG4 grassland but has become degraded through lack of management. However, it still represents unimproved grassland and is not sufficiently degraded that it could not be restored to MG4.

A site need support as little as 0.5ha of MG4 to meet the criteria for selection as an SSSI and there is a presumption that sites over 5ha would be notified (JNCC, 2014). Grassland habitats within the LWS taken alone (10.62ha) or including adjacent areas within the Nature Park (a further 0.36ha), meet this threshold area. These habitats should therefore be considered nationally important, i.e. of High value. This valuation includes the less species-rich edges of the LWS and the fenced area within the Nature Park, following best practice guidance for valuing ecological features in a degraded state (CIEEM, 2018).

Floodplain grassland within and around Osney Mead (Botley Meadow) LWS should also be considered irreplaceable. Floodplain grassland is very difficult to create or restore once damaged, and many sites around Oxford, including Osney Mead (Botley Meadow) LWS (Oxford Preservation Trust, n.d.), have been continuously managed as traditional hay meadows for over a thousand years. Traditional meadows and ancient grassland are identified as irreplaceable habitats in local policy (Oxfordshire County Council, 2014).

Finally, in addition to being priority habitats, Lowland Meadows habitat within Osney Mead (Botley Meadow) LWS and Seacourt Nature Park is also referable to the Annex I habitat 'Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)'. Annex I habitats are those of European concern and require coordinated conservation through designation of sites as part of the Natura 2000 network, in the UK known as Special Areas of Conservation (SAC). As they are not within an SAC, stands of the Annex I habitat around Osney Mead (Botley Meadow) LWS are not strictly protected or recognised as internationally important, but this classification highlights their greater value relative to other types of Lowland Meadows priority habitat within the RLB.

Egrove Park Meadow LWS

This site supports Lowland Meadows priority habitat comprising vegetation referable to the NVC plant community MG1d *Arrhenatherum elatius* grassland, *Pastinaca sativa* sub-community. This grassland type is typical of degraded calcareous grassland, and the criteria for selection of sites supporting this grassland type as SSSI stipulates a greater area (5ha) than that identified during the survey (0.25ha). As such, grassland within this site is valued as Moderate, reflecting its designation as part of a Local Wildlife Site.

Pasture south-east of North Hinksey

Parts of the pasture in this area support Lowland Meadows priority habitat comprising vegetation referable to the NVC plant community MG5b *Cynosurus cristatus-Centaurea nigra* grassland, *Galium verum* sub-community.

Although forb-rich, the habitat was comprised of common species, typical of pastured grassland of this type. Species recorded from this area and characteristic of more botanically diverse grassland of this type, such as

field scabious and quaking-grass, were rare. Moreover, the abundance of perennial rye-grass (*Lolium perenne*) within the sward and land use in the wider area suggest that this area has likely been fertilised in the past. Thus, although the area of this grassland (2.65ha) is over five times the minimum area (0.5ha) for selection of sites supporting MG5 grassland as SSSI, it does not meet the additional criteria of diversity and rarity for sites under 5ha. However, this is a significant area of MG5b within Oxfordshire and would qualify as a Local Wildlife Site (Thames Valley Environmental Records Centre, 2018). The value of this area is therefore considered to be Moderate.

4.1.1.4 Lowland Fens

The habitat survey identified Lowland Fens priority habitat within the RLB along the Jubilee Scrape through Osney Mead (Botley Meadow) LWS. This habitat comprises tall herb fen that has developed in an unmown part of the site and swamp vegetation within the channel. Some less common fen species such as common meadow-rue (*Thalictrum flavum*) and slender tufted-sedge (*Carex acuta*) are present.

This type of habitat is relatively common on riverbanks and other unmanaged areas of floodplain throughout Oxfordshire, although most stands are small and fragmented. Although the stand within the LWS is small and not of county importance in itself, as it lies within and contributes to the diversity of the LWS the value of this area is considered to be Moderate.

4.1.1.5 Wet Woodland

Stands of Wet Woodland priority habitat were found across the floodplain, comprising stands of willow trees around the edges of fields, along rivers and that had colonised unmanaged areas. None of the stands are identified in the Ancient Woodland inventory and most are of post-war origin: the only stands shown on aerial imagery from 1945 are the Willow Walk between North Hinksey and Osney, and the footpath to the east (Google, 2020). Given this recent origin, the vegetation of most stands was species-poor, with canopies dominated by crack willow and field layer dominated by common nettle, vegetation referable to the NVC plant community W6b *Alnus glutinosa-Urtica dioica* woodland, *Salix fragilis* sub-community. This habitat is common across the floodplain around Oxford and does not qualify for selection as LWS (Thames Valley Environmental Records Centre, 2018); the value of such stands of Wet Woodland is therefore considered to be Low. However, many stands include large mature trees, and these may have additional biodiversity value in their own right.

More diverse, stands of Wet Woodland priority habitat were rare, found to the south of the Kennington roundabout and around Kennington Pool LWS. These woodlands had a canopy with frequent alder and field layer with tall herb fen, vegetation referable to W2 *Salix cinerea-Betula pubescens-Phragmites australis* woodland. This is a rare type of Wet Woodland in Oxfordshire, found in situations that are less fertile than are typical of the floodplain around Oxford. Woodland to the south of Kennington roundabout also supported fritillary and that around Kennington Pool LWS supported common valerian (see section 3.3). Given their local rarity and richer flora, these habitats would therefore likely qualify for selection as LWS and their value is considered to be Moderate.

4.1.1.6 Standing open water, rivers and streams

Bodies of standing water were recorded in three sites within the RLB: two small flood culverts within the Willow Walk in North Hinksey; the complex of waterbodies within Hinksey Pools SLINC; and within Kennington Pool LWS. Kennington Pool LWS is included in the Freshwater Habitats Trust inventory of Ponds priority habitat (Freshwater Habitats Trust, n.d.).

4.1.1.7 Rivers and streams

Numerous watercourses were identified within the RLB. None of watercourses are identified in the Rivers priority habitat map (Natural England, 2017). The RLB included watercourses of a range of naturalness, flow, depth and substrate and some reaches of watercourse may be of greater value than others. Further assessment of rivers and streams is being carried out as part of the scheme.

4.1.1.8 Other habitats

The habitat survey identified other grassland habitats of biodiversity value within the RLB:

- the fields to the north ([link to feature](#)) and east ([link to feature](#)) of Seacourt Park and Ride;
- the large abandoned fields to the south of Osney Mead Industrial Estate ([link to feature](#));
- the meadows south-east of Osney (e.g. [link to feature](#));
- parts of the pasture south-east of North Hinksey ([link to feature](#)); and
- the two meadows between the Hinksey Stream and Hinksey Pools SLINC ([link to feature](#), [link to feature](#)).

These sites comprised semi-improved or abandoned grassland but retained reservoirs of plant diversity (and likely other biodiversity) absent from heavily modified areas of the floodplain elsewhere within the RLB. They have likely been derived from or are relicts of former species-rich floodplain meadows. Due to their current condition they are not of county importance and would therefore be of Low value, but due to their potential for enhancement to species-rich grassland (see section 4.1.4) their value is considered to be Moderate / Low.

A range of other habitats were also recorded within the RLB, including tall herb in unmanaged areas around fields and along riverbanks, plantation woodland and artificial habitats such as urban parks. These habitats are ubiquitous and support less biodiversity than the habitats discussed above. The value of these habitats is therefore considered to be Negligible.

4.1.2 Further survey and assessment

The habitat survey is complete with respect to all habitats other than rivers and streams and standing water. Rivers and streams have been further surveyed as part of separate work for the proposed scheme (see River Condition Assessment Results, IMSE500177-CH2-COC-00-RP-EN-0726).

There has also been separate work to assess standing waterbodies associated with the scheme, covering Kennington Pool LWS and the Hinksey Pools SLINC. The other standing waterbodies identified by the survey have not been assessed; of these only the two flood culverts under Willow Walk are within the RLB. Due to the presence of the culverts they are unlikely to constitute Ponds priority habitat, however they will be included in the biodiversity net gain calculation.

The assessment of condition of habitats undertaken during the survey is complete except for rivers and streams, which have been assessed separately as part of the scheme, and the meadows between North and South Hinksey that had been mown shortly before survey in July. For the purposes of assessing biodiversity net gain for the scheme, the latter habitats are assumed to be in 'good' condition, similar to nearby meadows, except for stands of 'g4 Modified grassland' which has the default condition of 'poor'. Based on visits earlier in the season, these assumptions are likely to be accurate so that further survey is not recommended.

4.1.3 Avoidance and mitigation

Avoidance and mitigation measures are recommended for the habitats of Low to High value identified in section 4.1.1.

4.1.3.1 Hedgerows

Fifteen of the hedgerows and lines of trees are 'important' under the archaeological and history or wildlife and landscape criteria of the Hedgerows Regulations 1997, 20 are species-rich, and some include veteran or other old trees. There are 27 hedgerows and lines of trees that are important, species-rich or support veteran trees, and these are likely to be irreplaceable habitat. See Appendix C for further information on the 10 hedgerows which are important on ecological grounds; the 5 important for archaeological/historical reasons are also listed there.

Impacts to hedgerows should be minimised where possible and impacts to irreplaceable features should be avoided by retaining existing vegetation and setting out root protection zones for trees and shrubs. If irreplaceable features were to be lost, then under policy 175 of the National Planning Policy Framework the scheme may not be granted planning permission unless the Local Planning Authority considers that there are wholly exceptional reasons for granting permission and considers that there is a suitable compensation strategy as part of the scheme. Furthermore, impacts to irreplaceable habitats cannot be offset to achieve net gain (CIEEM *et al.*, 2016).

If lengths of hedgerows or lines of trees were required to be removed for construction of the scheme, then suitable compensation habitat would be required. Measuring net gain using the Defra Biodiversity Metric, the total length of habitat to replace that lost would be in excess of the length lost, and this would need to be factored into the design of the scheme. Compensation habitat created within the Scheme area should be designed based on the results of the hedgerow survey, including species composition and abundance, rather than generic hedgerow planting.

Subsequent to the survey, the number of important hedgerows on or within the Red Line Boundary has reduced from 15 to 13, of which only eight are due to be affected by the Scheme.

4.1.3.2 Lowland Calcareous Grassland

The RLB includes an area of Egrove Park supporting Lowland Calcareous Grassland priority habitat. However, this area is included to provide land accessible to the public and no habitat will be lost in this area. Avoidance and mitigation in this area would therefore not be required.

4.1.3.3 Lowland Meadows

Osney Mead (Botley Meadows) LWS and Seacourt Nature Park

The RLB includes a large area of Lowland Meadows habitat within these two sites. As the scheme is proposed to impact grassland within the LWS, an MG4 mitigation strategy has been developed to compensate for loss of grassland of this type. The strategy does not include MG4 grassland within a small meadow to the north of the LWS within Seacourt Nature Park, and tall herb in the fenced-off to north of the LWS that could be restored to MG4, as habitat would not be lost in these areas. These areas are included in the RLB as temporary areas for public access to offset the temporary loss of access to the LWS during construction. However, the fenced-off area to the north of the LWS could be restored to MG4, contributing toward the aims of the mitigation strategy and net gain for the scheme.

The loss of MG4 within the LWS has been minimised as far as possible as part of the scheme design. However, this habitat is irreplaceable habitat, comparable in biodiversity value to Ancient Woodland. Under policy 175 of the National Planning Policy Framework the scheme therefore may not be granted planning permission unless the Local Planning Authority considers that there are wholly exceptional reasons for granting permission and considers the compensation proposals in the MG4 mitigation strategy to be suitable. Furthermore, impacts to irreplaceable habitats cannot be offset to achieve net gain (CIEEM *et al.*, 2016).

Egrove Park Meadow LWS

The RLB includes an area of Egrove Park Meadow LWS supporting Lowland Meadows priority habitat. However, this area is included to provide land accessible to the public and no habitat will be lost in this area. Avoidance and mitigation in this area would therefore not be required.

Pasture south-east of North Hinksey

Alternative locations should be sought for the working area proposed within Lowland Meadows priority habitat in these areas, between hedges 28 and 32 on Figure A.2. Where impacts are unavoidable then the existing vegetation should be retained. Depending on the nature of the works, existing vegetation can be retained by

ground protection such as by using bog matting or low ground-pressure plant, or the removal, storage and reinstatement of grassland turves before, during and following construction, respectively. Reseeding would not be an appropriate method of mitigation for grassland habitat in these areas.

Subsequent to the survey, the area referred to has been removed from the Scheme area, along with hedges 10 and 28.

4.1.3.4 Lowland Fens

The stand of Lowland Fens priority habitat within the Jubilee Scrape in Osney Mead (Botley Meadow) LWS would be impacted by the scheme and habitat would be required to be created as mitigation. Measuring net gain using the Defra Biodiversity Metric 2.0, the total area of habitat to replace that lost would be in excess of that lost, and this would need to be factored into the design of the scheme. Created habitat should be located in an area with appropriate hydrology and comprise tall herb fen similar to that within the LWS, including less common floodplain species such as common meadow-rue and slender tufted-sedge. This could be achieved by retaining vegetation and substrate excavated from the LWS and using it as part of habitat creation.

4.1.3.5 Wet Woodland

Impacts to stands of Wet Woodland priority habitat of Moderate value should be avoided. Some disturbance of tree canopies may be beneficial to biodiversity if temporary, such as if undertaken through coppicing, but permanent loss of these habitats should be avoided.

Impacts to other stands of Wet Woodland are likely to be unavoidable, and where impacts cannot be avoided then suitable mitigation and compensation should be designed. Measuring net gain using the Defra Biodiversity Metric 2.0, the total area of habitat to replace that lost would be in excess of that lost, and this would need to be factored into the design of the scheme. Woodland planting as part of mitigation or compensation should use appropriate native species, such as alder and crack willow, and be located in areas with suitable hydrology and not within grassland or other habitats with existing biodiversity value.

4.1.3.6 Other habitats

Where possible impacts to grassland habitats of Low / Moderate biodiversity value within the RLB should be avoided and those with the greatest potential used as enhancements as part of biodiversity net gain (see section 4.1.4).

Where impacts are unavoidable then in the first instance the retention of existing vegetation should be preferred over reseeded. Depending on the nature of the works, existing vegetation can be retained by ground protection such as by using bog matting or low ground-pressure plant, or the removal, storage and reinstatement of grassland turves before, during and following construction, respectively. Some stands of grassland, such as the meadows south-east of Osney support small species such as adder's-tongue and other species of floodplain grassland that it would be difficult or impossible to re-establish by reseeded disturbed areas, so that seeding is unlikely to be an effective restoration method in these areas.

Where the above mitigation cannot be applied, then reseeded should be undertaken using seed collected from local species-rich meadows, either as green hay or brush-harvested seed. Generic commercial seed mixes should be avoided: areas excavated for and reseeded following archaeological ground investigations for the scheme bear little resemblance to semi-natural floodplain grassland.

4.1.4 Enhancements

In the floodplain within and around the RLB, the habitat survey identified numerous areas of grassland habitats that are of biodiversity value but that are not Lowland Meadows priority habitat. The potential for restoration of abandoned grassland within the fenced area to the north of Osney Mead (Botley Meadow) LWS is discussed in

section 4.1.1.3. Other areas with restoration potential are those listed in section 4.1.1.8 and Dean's Ham in Grandpont, outside the RLB.

These areas of grassland retained elements of the semi-natural floodplain grassland types typical of Lowland Meadows priority habitat, including the NVC plant community MG4, and have likely been derived from this habitat through contemporary land management practices. Given their likely origin and the plant diversity they retain, these grasslands provide opportunity for enhancement through restoration and could contribute toward the scheme's mitigation strategy for MG4 grassland (see section 4.1.3.3).

Restoration at any location should consider at least the following:

- the target vegetation type;
- initial works required to restore vegetation (e.g. green hay spreading);
- existing and required management infrastructure (access points and routes, fences, gates etc.); and
- available resources to carry out management following best practice.

4.2 Notable plants

The survey recorded twenty-three notable plant taxa, populations of 16 of which were within the RLB. The value of the populations recorded are assessed in section 4.2.1 and recommendations for further survey are made in section 4.2.2. In the following sections, recommendations are made for avoidance and mitigation, and enhancements with respect to the notable plants recorded.

4.2.1 Biodiversity value

The value of the populations of notable plants recorded from within the RLB and additional taxa considered relevant are assessed in Table 4.4 and shown in Figure A.3.

Table 4.4: Notable plants recorded and their biodiversity value

Scientific name	Common name	Populations within RLB	Value	Assessment of value
<i>Apium repens</i>	Creeping marshwort	No	Very High	The population in Willow Walk Meadow LWS was introduced to secure the Oxfordshire population of this species, which has declined within the Oxford Meadows SAC and disappeared from other sites. In addition to those around Oxford, there is only one site in the UK where this internationally important species is now known.
<i>Briza media</i>	Quaking-grass	Yes	Low	A local and declining species in Oxfordshire but abundant in suitable habitats throughout the county (Killick <i>et al.</i> , 1997). Only one population within the RLB, and uncommon around Oxford.
<i>Fragaria vesca</i>	Wild strawberry	Yes	Negligible	A common species throughout Oxfordshire (Killick <i>et al.</i> , 1997). Often found as a garden escape in urban areas.
<i>Frangula alnus</i>	Alder buckthorn	Yes	Moderate	A locally scarce species. Plants in hedgerows north-west of South Hinksey have been planted. The single bush recorded in Osney Mead (Botley Meadow) LWS may be bird-sown from a planted population but should be regarded as wild.

Scientific name	Common name	Populations within RLB	Value	Assessment of value
<i>Fritillaria meleagris</i>	Fritillary	Yes	Low	A non-native species of cultural importance in Oxfordshire. The population recorded within the RLB comprised one plant and is not important in a county context compared to those at other sites, e.g. Iffley Meadows SSSI
<i>Galium x pomeranicum</i>	Hybrid bedstraw	Yes	Moderate	A rare hybrid in Oxfordshire, with only four other populations recorded since 2000 (Botanical Society of Britain and Ireland, 2020).
<i>Knautia arvensis</i>	Field scabious	Yes	Negligible	A common species throughout Oxfordshire (Killick <i>et al.</i> , 1997)
<i>Ophioglossum vulgatum</i>	Adder's-tongue	Yes	Moderate	A much-declined species in Oxfordshire, though large populations remain in some of the meadows around Oxford (Killick <i>et al.</i> , 1997). Large populations comparable to that within the meadows south-east of Osney are in designated sites, such as the Oxford Meadows SAC over 5km away. The population recorded within the RLB is therefore of county importance.
<i>Petroselinum segetum</i>	Corn parsley	Yes	Negligible	A local species but one that appears to be increasing in Oxfordshire. Only one plant was recorded within the RLB, in an area disturbed for archaeological ground investigations, and is unlikely to persist.
<i>Salix purpurea</i>	Purple willow	Yes	Negligible	This species remains widespread along rivers in Oxfordshire and is relatively frequent around Oxford.
<i>Sanguisorba officinalis</i>	Great Burnet	Yes	Negligible	This species is abundant in floodplain meadows around the county, though it has declined, and large populations are confined to designated sites. It was abundant in and around Osney Mead (Botley Meadow) LWS within the RLB.
<i>Senecio aquaticus</i>	Marsh ragwort	Yes	Low	This species has declined in the county, but many large populations remain in the floodplains of the Thames and Cherwell. The one population recorded in the RLB at New Hinksey is therefore not of county importance.
<i>Silaum silaus</i>	Pepper saxifrage	Yes	Negligible	This species is abundant in floodplain meadows around the county, though it has declined, and most populations are confined to designated sites. It was abundant in and around Osney Mead (Botley Meadow) LWS within the RLB.
<i>Silene flos-cuculi</i>	Ragged-robin	Yes	Low	This species remains widespread throughout most of Oxfordshire. The population in the meadows south-east of Osney was the only one recorded within the RLB.
<i>Taraxacum tamesense</i>	Thames dandelion	No	High	This dandelion is a characteristic species of floodplain meadows. It is rare in Oxfordshire with

Scientific name	Common name	Populations within RLB	Value	Assessment of value
				only five historic sites, at none of which has it been seen since before 2000. It has no national status but it is rare and appears to have declined, with records in only four 10km squares since 2000 (Botanical Society of Britain and Ireland, 2020).
<i>Trifolium fragiferum</i>	Strawberry clover	Yes	Moderate	This species has declined significantly in Oxfordshire and is now largely restricted to designated sites around Oxford. The populations recorded are new sites and that in Oatlands Road Recreation Ground was quite extensive.
<i>Urtica dioica</i> subsp. <i>galeopsifolia</i>	Fen nettle	Yes	Negligible	This taxon is under-recorded but is frequent through Oxford on the Berkshire side (Crawley, 2005). It was abundant in many parts of the RLB.
<i>Valeriana officinalis</i>	Common valerian	Yes	Negligible	A common species throughout Oxfordshire (Killick <i>et al.</i> , 1997)

4.2.2 Further survey and assessment

Further surveys which have been carried out, including the River Condition Assessment, are reported separately.

The locally rare Thames dandelion was recorded approximately 25m to the north of the RLB, in a floodplain meadow in Botley another part of which is within the RLB. There have been no records of this plant within the RLB; in the event that the species is recorded within the RLB in future, it is recommended that a survey of dandelions be undertaken, with a view to identifying individuals of the rare species and collecting seed for planting when the location is restored to its current use.

4.2.3 Avoidance and mitigation

Avoidance and mitigation measures are recommended for the populations of notable plants of Low to High value identified in section 4.2.1 and recorded from within the RLB. Creeping marshwort, present outside the RLB, is discussed in section 4.2.4.

The populations of adder's-tongue, quaking-grass and ragged-robin occurred in grassland habitats of biodiversity value, avoidance and mitigation for which are discussed in section 4.1.3.3 and 4.1.3.6.

The following notable plants were recorded within the RLB and depending on proposals at specific locations may require avoidance and mitigation:

- alder buckthorn
- fritillary;
- hybrid bedstraw;
- marsh ragwort; and
- strawberry clover.

It is recommended that proposals be reviewed in areas where populations of these species occur in order to identify potential impacts. If populations are likely to be adversely impacted, then proposals should be modified to avoid the impact, or appropriate mitigation should be designed. The populations of alder buckthorn, fritillary and hybrid bedstraw consisted of one plant each, and may therefore be straightforward to avoid. If they cannot

be avoided, then plants and supporting substrate could be excavated whole and transplanted to a suitable receptor site.

4.2.4 Enhancements

Recommendations are made below for creeping marshwort, to be considered as part of the mitigation strategy for this species proposed as part of the scheme. The enhancements for habitats proposed in section 4.1.4 may benefit some of the notable plants recorded during the survey, but otherwise enhancements for other species are not required.

As described in the mitigation strategy for creeping marshwort, locations will be investigated for creating new populations through translocation. From the results of the habitat survey, the following locations could be suitable:

- Existing seasonally flooded depressions within the floodplain, such as in the meadows east of the Seacourt Park and Ride, and south-east of Osney Mead Industrial Estate. There are seasonally flooded depressions and old river channels elsewhere, but they are currently overgrown. The survival of translocated populations at these locations would require a change of land use to pasture, or require regular interventions, such as mowing or rotavating to maintain the vegetation structure creeping marshwort requires.
- Horse pasture in the floodplain east of New Hinksey supports seasonally flooded shortly grazed grassland that could be suitable for creeping marshwort. However, this area is also heavily grazed by geese, which selectively graze creeping marshwort and has led to the failure of other translocations in Oxfordshire (J.A. Webb, personal communication).
- Urban parks in the floodplain may also be suitable for introduction. For instance, Oatlands Road Recreation Ground had very shortly mown vegetation with indicators of damp conditions, such as strawberry clover.

The potential for creation of populations at the above locations would depend on the hydrology, vegetation and land management following construction of the scheme. As identified in the mitigation strategy, it could also be possible to create suitable habitat as part of construction of the scheme.

Due to the limited availability of suitable sites and the exacting ecological requirements of creeping marshwort (crucially, the correct level of grazing and seasonal flooding), it is recommended that an experimental approach should be adopted to minimise the risk of failure, establishing at least three new populations across a range of conditions. As plants can be readily propagated as vegetative clones this should not threaten existing populations. Any approach should acknowledge the long-term commitment necessary to maintain the required vegetation structure, such as by securing suitable levels of grazing.

It is recommended that the results of the habitat survey be reviewed to identify potential introduction sites, such as those described above, and areas where new habitat could be created. This process should identify favourable and unfavourable attributes of sites and how unfavourable attributes (such as unsuitable grazing) might be overcome.

5. Conclusion

This report has presented the results of a habitat and botanical survey for the Oxford Flood Alleviation Scheme. The results have been evaluated to identify habitats and populations of vascular plants of biodiversity value, and recommended further survey, avoidance and mitigation and enhancement for these features. These outcomes are summarized in Table 5.1.

Table 5.1: Baseline habitats and plant populations of Low to Very High biodiversity value and recommendations for further survey, avoidance and mitigation, and enhancements

Ecological feature	Value	Quantity within RLB	Baseline description	Further survey and assessment	Avoidance and mitigation	Enhancement
Habitats						
Priority habitat – Hedgerows	Moderate	5,431m / 51 features	<ul style="list-style-type: none"> Extensive network of hedgerows and lines of trees, including 15 important and 20 species-rich features Hundreds of trees recorded, including one veteran tree Hedgerows and lines of trees that are important, species-rich or contain veteran trees are likely to be irreplaceable Some individual hedgerows may be of Low or Negligible value, such as species-poor hedgerows, hedgerows of recent origin and lines of non-native trees 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Important or species-rich hedgerows and lines of trees, veteran trees should be retained and protected from construction works – there are 27 such hedgerows and lines of trees If irreplaceable features could be lost, then the scheme may not be granted planning permission Compensation of appropriate type and quantity should be provided for features to be lost Design of compensation should be based on the results of the hedgerow survey 	NA
Priority habitat – Lowland Calcareous Grassland	Moderate	0.35ha	<ul style="list-style-type: none"> Grassland of type CG3 <i>Bromus erectus</i> grassland in an undesignated field within Egrove Park 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Not required 	NA
Priority habitat – Lowland Meadows	High	3.39ha	<ul style="list-style-type: none"> Grassland within Osney Mead (Botley Meadow) LWS and Seacourt Nature Park, including grassland of type MG4 <i>Alopecurus pratensis-Sanguisorba officinalis</i> grassland Includes fenced area of the Nature Park degraded from and restorable to MG4 Irreplaceable habitat 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> The Scheme design has been adjusted as far as possible to minimise loss of this irreplaceable habitat. There is a stand-alone mitigation strategy for this habitat, involving translocation of turf from the areas which will unavoidably be lost, a strict ban on the contractor working within the remaining areas and enhancement of other meadow areas to compensate for biodiversity loss. 	<ul style="list-style-type: none"> Fenced area of the Nature Park could be restored to MG4, contributing toward MG4 mitigation strategy for scheme
	Moderate	3.45ha	<ul style="list-style-type: none"> Grassland of type MG5b <i>Cynosurus cristatus-Centaurea nigra</i> grassland, <i>Galium verum</i> sub-community within pasture to the south-east of North Hinksey 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Works within this habitat should be avoided. Where impacts are unavoidable then the existing vegetation should be retained, e.g. by ground protection or the removal, storage and reinstatement of grassland turves Reseeding would not be an appropriate method of mitigation for grassland habitat in these areas. 	NA
			<ul style="list-style-type: none"> Grassland of type MG1d <i>Arrhenatherum elatius</i> grassland, <i>Pastinaca sativa</i> sub-community within Egrove Park Meadow LWS 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Not required 	NA
Priority habitat – Lowland Fens	Moderate	0.57ha	<ul style="list-style-type: none"> Tall herb fen and swamp along the Jubilee Scrape through Osney Mead (Botley Meadow) LWS 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Habitat should be created to mitigate loss, and of appropriate area, hydrology and type Created habitat should incorporate vegetation and substrate lost from impacted habitat, including any less common species such as common meadow-rue and slender tufted-sedge 	NA
Priority habitat – Wet Woodland	Moderate	1.34ha	<ul style="list-style-type: none"> Stands of woodland of type W2 <i>Salix cinerea-Betula pubescens-Phragmites australis</i> woodland, to the south of Kennington roundabout and within Kennington Pool LWS 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Some disturbance of tree canopies may be beneficial to biodiversity if temporary, such as by coppicing, but permanent loss should be avoided. 	NA

Ecological feature	Value	Quantity within RLB	Baseline description	Further survey and assessment	Avoidance and mitigation	Enhancement
	Low	7.20ha	<ul style="list-style-type: none"> Diverse ground flora Stands of woodland of type W6b <i>Alnus glutinosa-Urtica dioica, Salix fragilis</i> sub-community Widespread across the RLB, with species-poor ground flora Many stands include large mature trees, which may have additional biodiversity value in their own right 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Where impacts cannot be avoided suitable mitigation and compensation should be designed Woodland planting should be of sufficient extent, use native species appropriate to habitat, and be located in areas with suitable hydrology and not within habitats with existing biodiversity value 	NA
Standing open water	NA	1.81ha	<ul style="list-style-type: none"> Standing waterbodies recorded from flood culverts within the Willow Walk in North Hinksey, Hinksey Pools SLINC and Kennington Pool LWS 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> To be included in the pond creation which compensates for loss of other pond habitat (Hinksey Pools SLINC and Kennington Pool LWS).
Rivers and streams	NA	4.75ha	<ul style="list-style-type: none"> Numerous watercourses were identified within the RLB, including Bulstake Stream, Eastwycke Ditch, Hinksey Stream, Seacourt Stream and the River Thames 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> To be determined based on results of separate survey and assessment carried out for the scheme 	<ul style="list-style-type: none"> To be determined based on results of separate survey and assessment carried out for the scheme
Non-priority habitat grassland with restoration / enhancement potential	Low / Moderate	22.41ha	<ul style="list-style-type: none"> Semi-improved and abandoned grassland with greater plant diversity compared to other areas within RLB: <ul style="list-style-type: none"> fields north and east of Seacourt Park and Ride; abandoned fields south of Osney Mead Industrial Estate; meadows south-east of Osney; parts of pasture south-east of North Hinksey; meadows between Hinksey Stream and Hinksey Pools SLINC; and Dean's Ham, adjacent and outside the RLB. Have likely been derived from or are relicts of species-rich floodplain meadows 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Impacts should be avoided where possible and areas with greatest potential restored/enhanced Where impacts unavoidable, mitigation in first instance should retain existing vegetation using ground protection and/or turf removal/reinstatement. If turf removal/reinstatement not possible, reseedling should be undertaken using seed collected from local species-rich meadows. Commercial seed mixes should be avoided. 	<ul style="list-style-type: none"> Restore / enhance grassland to species-rich floodplain grassland by e.g. green hay spreading, installation of management infrastructure Could contribute toward MG4 mitigation strategy for scheme
Vascular plants						
Adder's-tongue (<i>Ophioglossum vulgatum</i>)	Moderate	1,000s of plants	<ul style="list-style-type: none"> Large population spread over several meadows south-east of Osney 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> As for supporting habitat, 'non-priority habitat grassland with restoration / enhancement potential' above 	NA
Alder buckthorn (<i>Frangula alnus</i>)	Moderate	1 plant	<ul style="list-style-type: none"> One small wild plant at edge of Osney Mead (Botley Meadow) LWS. Planted in hedgerows in South Hinksey. 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Review proposals in order to identify potential impacts to population If impact likely then proposals should be modified to avoid the population, or it could be translocated to a suitable receptor site 	NA
Creeping marshwort (<i>Apium repens</i>)	Very High	NA	<ul style="list-style-type: none"> Population within Willow Walk Meadow LWS, outside the RLB 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Creeping marshwort mitigation strategy 	<ul style="list-style-type: none"> Establish at least three new populations by introduction Review results of habitat survey to identify potential introduction sites

Ecological feature	Value	Quantity within RLB	Baseline description	Further survey and assessment	Avoidance and mitigation	Enhancement
						and sites where new habitat could be created <ul style="list-style-type: none"> Identify favourable and unfavourable attributes of sites and how unfavourable attributes might be overcome
Fritillary (<i>Fritillaria meleagris</i>)	Low	1 plant	<ul style="list-style-type: none"> One plant in woodland south of Kennington roundabout 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Review proposals in order to identify potential impacts to population If impact likely then proposals should be modified to avoid the population, or it could be translocated to a suitable receptor site 	NA
Hybrid bedstraw (<i>Galium x pomeranicum</i>)	Moderate	1 plant	<ul style="list-style-type: none"> A small population in an unmanaged field south of Osney Mead Industrial Estate 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Review proposals in order to identify potential impacts to population If impact likely then proposals should be modified to avoid the population, or it could be translocated to a suitable receptor site 	NA
Marsh ragwort (<i>Senecio aquaticus</i>)	Low	100s of plants	<ul style="list-style-type: none"> Locally abundant in horse pasture by the Thames in New Hinksey 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Review proposals in order to identify potential impacts to population If impact likely then proposals should be modified to avoid the population, or appropriate mitigation designed 	NA
Quaking-grass (<i>Briza media</i>)	Low	50-100 plants	<ul style="list-style-type: none"> Confined to a small area of pasture east of Hinksey 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> As for supporting habitat, 'non-priority habitat grassland with restoration / enhancement potential' above 	NA
Ragged-robin (<i>Silene flos-cuculi</i>)	Low	100-200 plants	<ul style="list-style-type: none"> Locally frequent in meadows south-east of Osney 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> As for supporting habitat, 'non-priority habitat grassland with restoration / enhancement potential' above 	NA
Strawberry clover (<i>Trifolium fragiferum</i>)	Moderate	2 populations	<ul style="list-style-type: none"> Populations in Oatlands Road Recreation Ground and horse pasture by the Thames in New Hinksey Difficult to quantify population due to clonal growth form and small size, but population in Oatlands Road Recreation Ground covered several square metres 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Review proposals in order to identify potential impacts to population If impact likely then proposals should be modified to avoid the population, or appropriate mitigation designed 	NA
Thames dandelion (<i>Taraxacum tamesense</i>)	High	NA	<ul style="list-style-type: none"> Population in meadow east of Seacourt Park and Ride, outside the RLB 	<ul style="list-style-type: none"> Survey of dandelions should be undertaken, in the event that this species is recorded within the Scheme area 	<ul style="list-style-type: none"> If the species is found, collection of seeds for planting in the ame location after completion of the works would be appropriate 	NA

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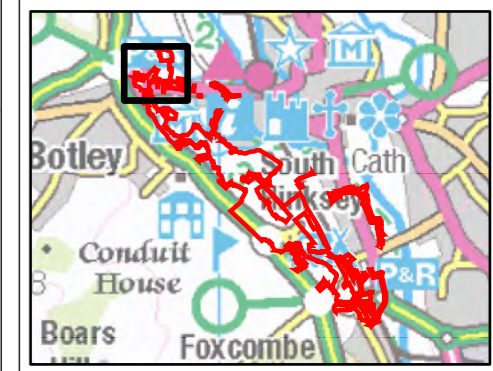
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Appendix A. Figures

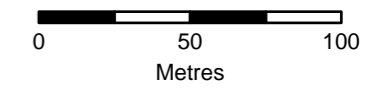
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- Scheme Area
- Notable plant

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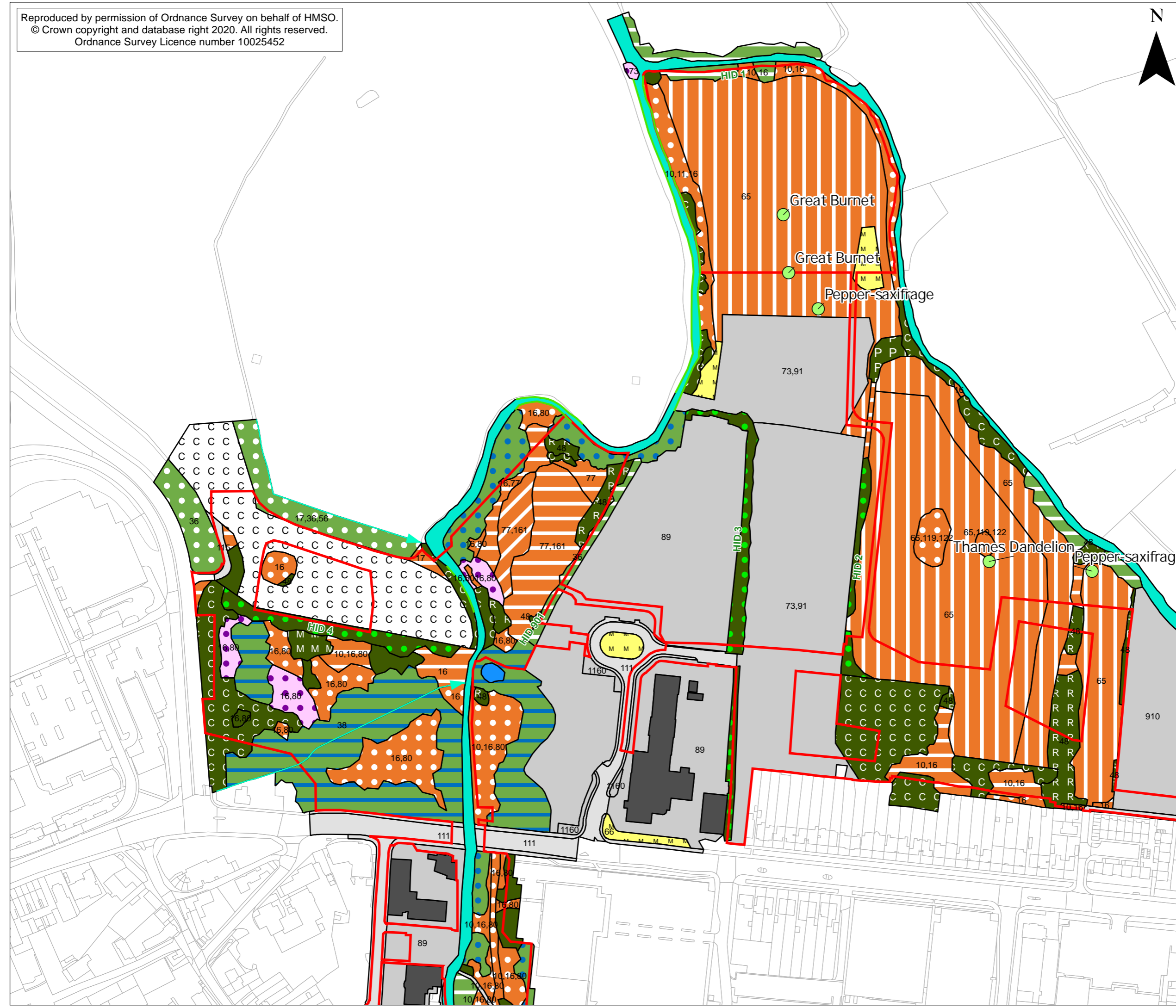
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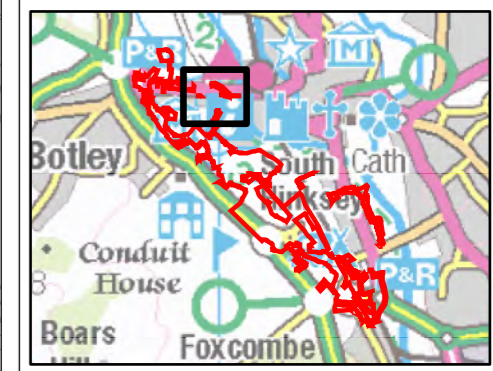
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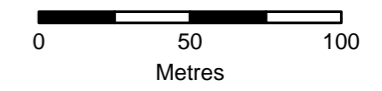




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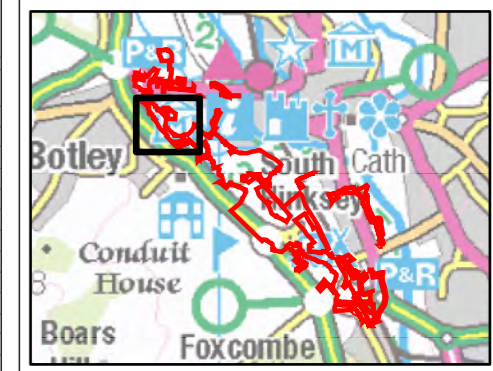
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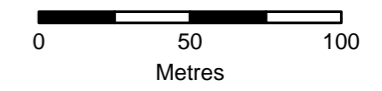




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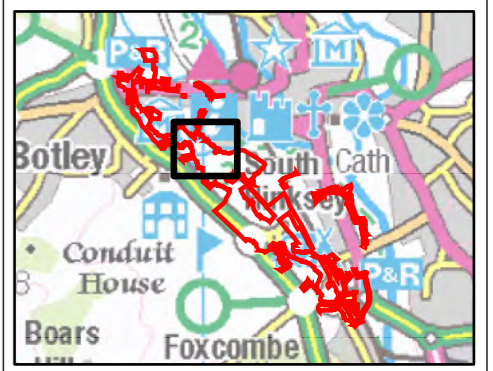
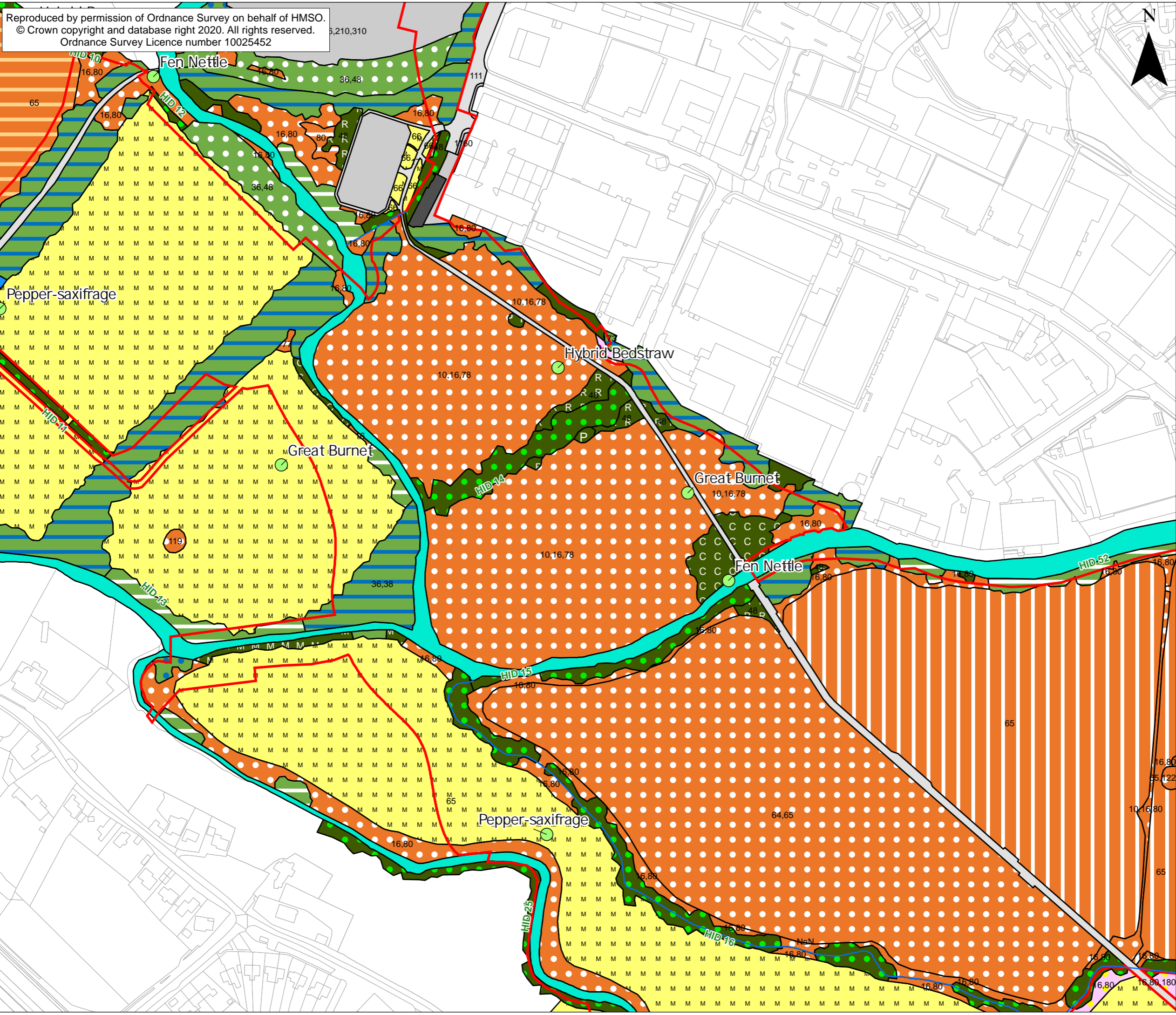
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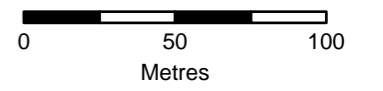


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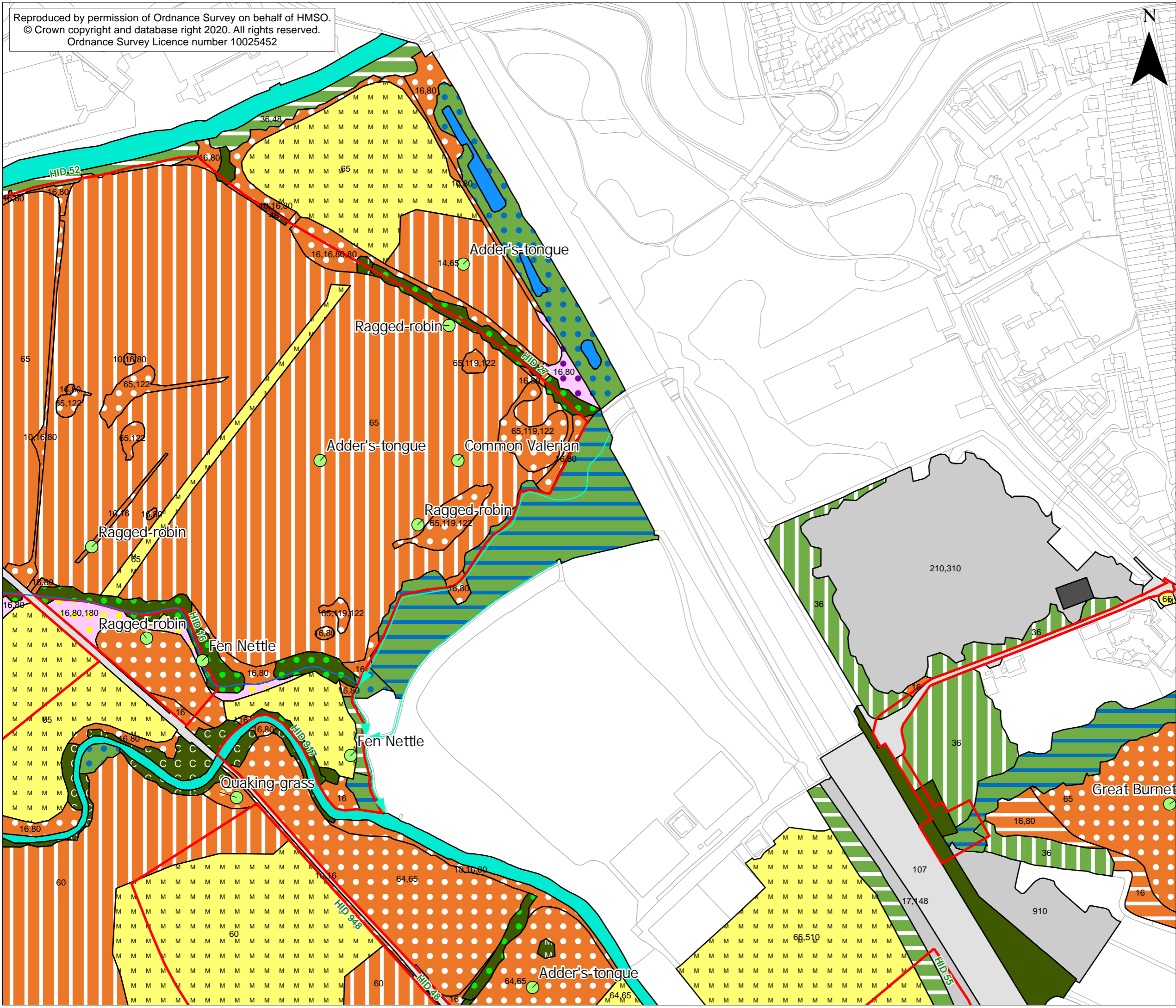
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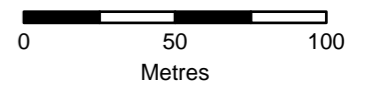
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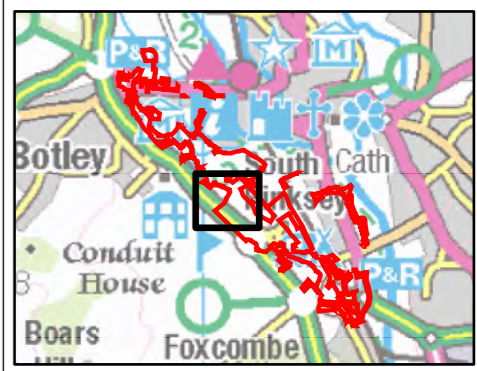
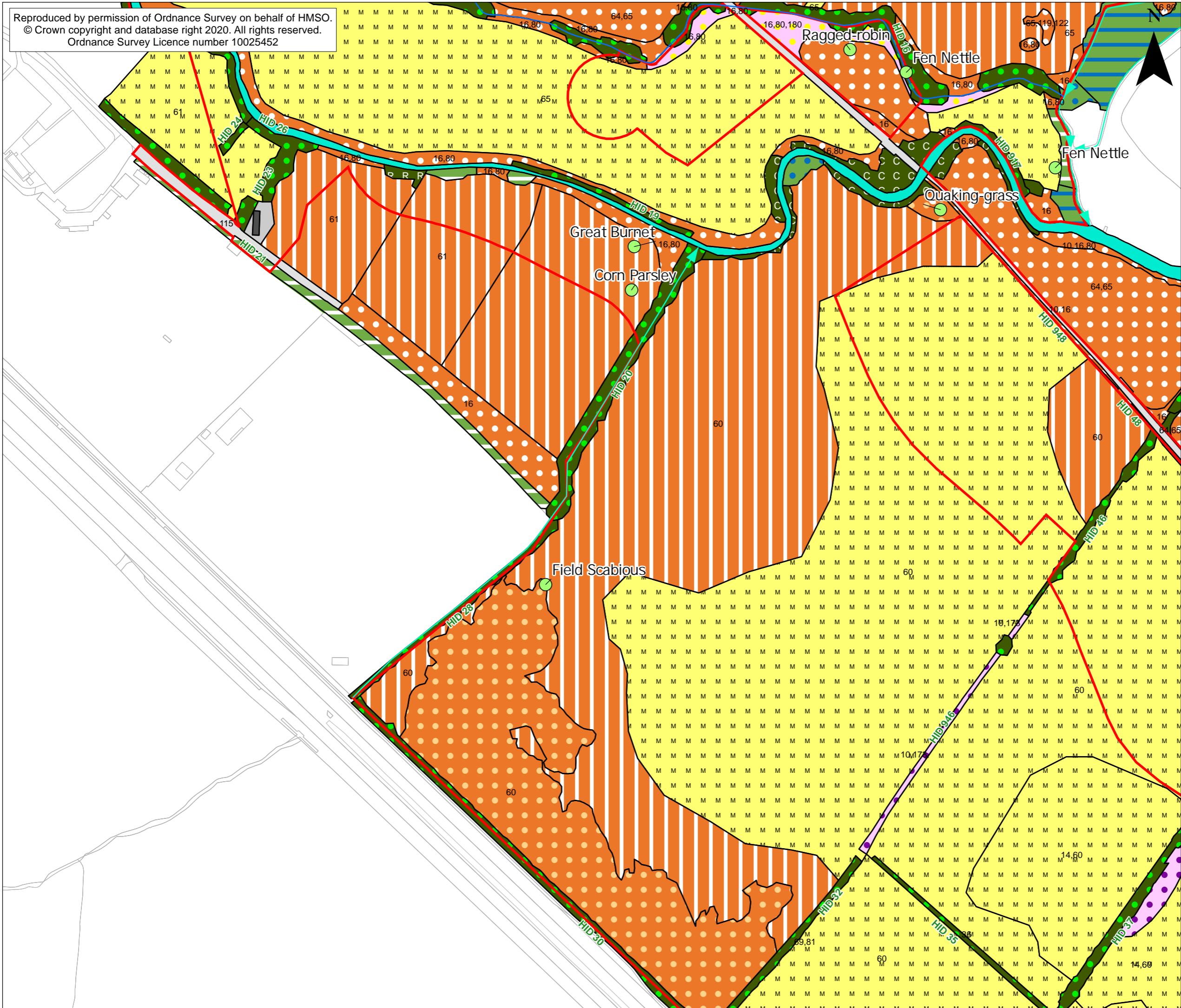
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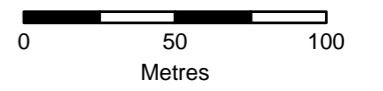
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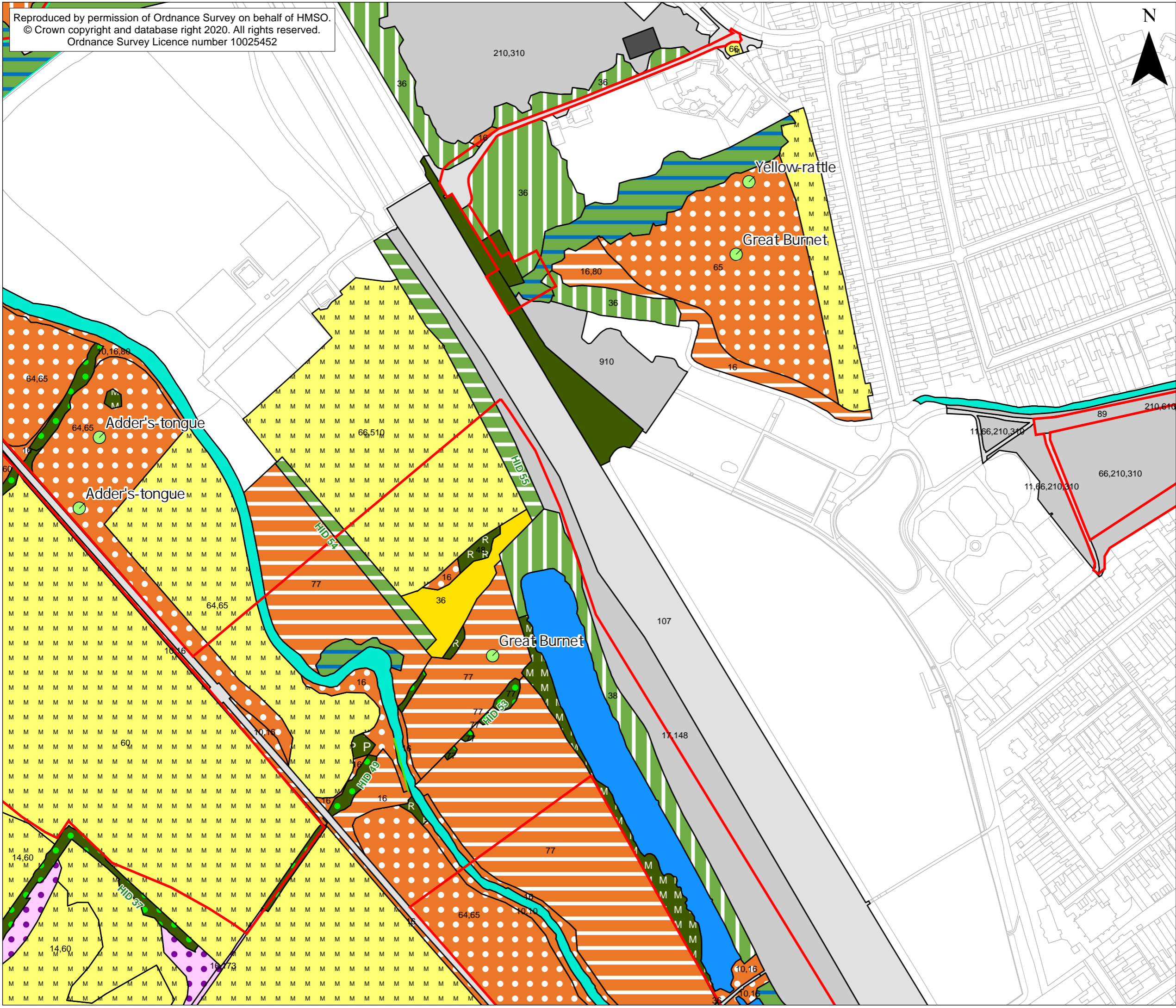
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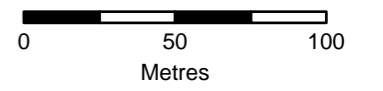
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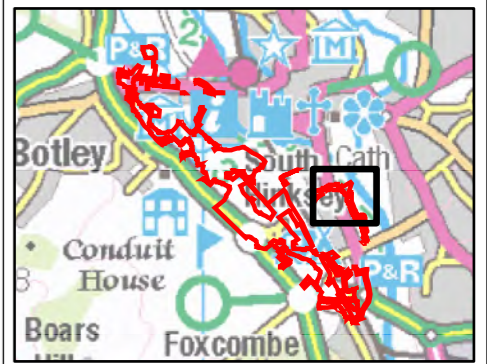
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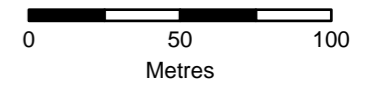
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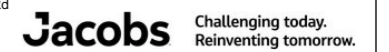


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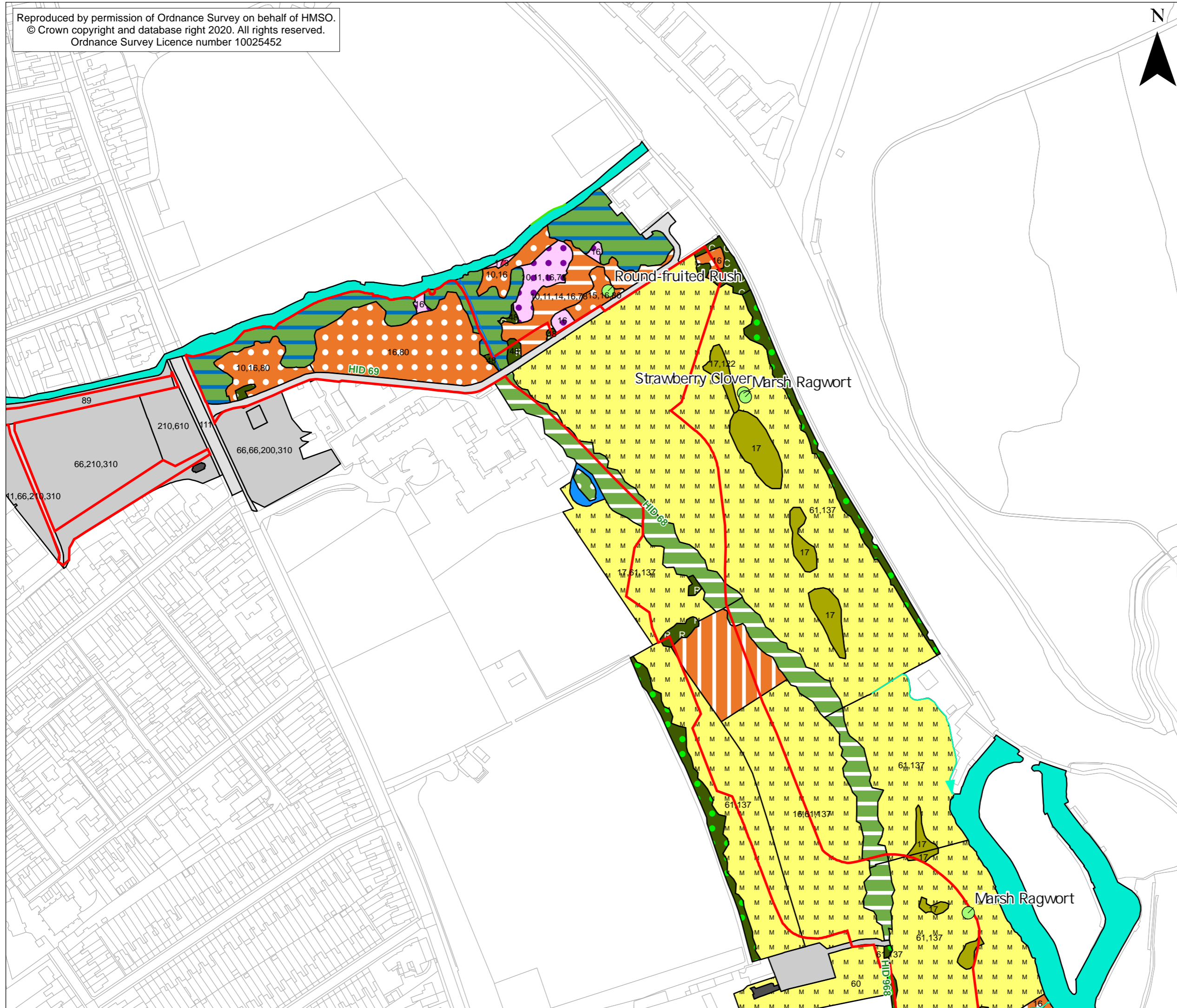
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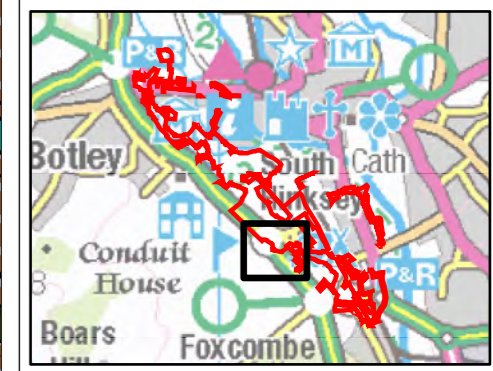
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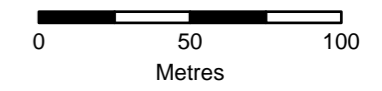


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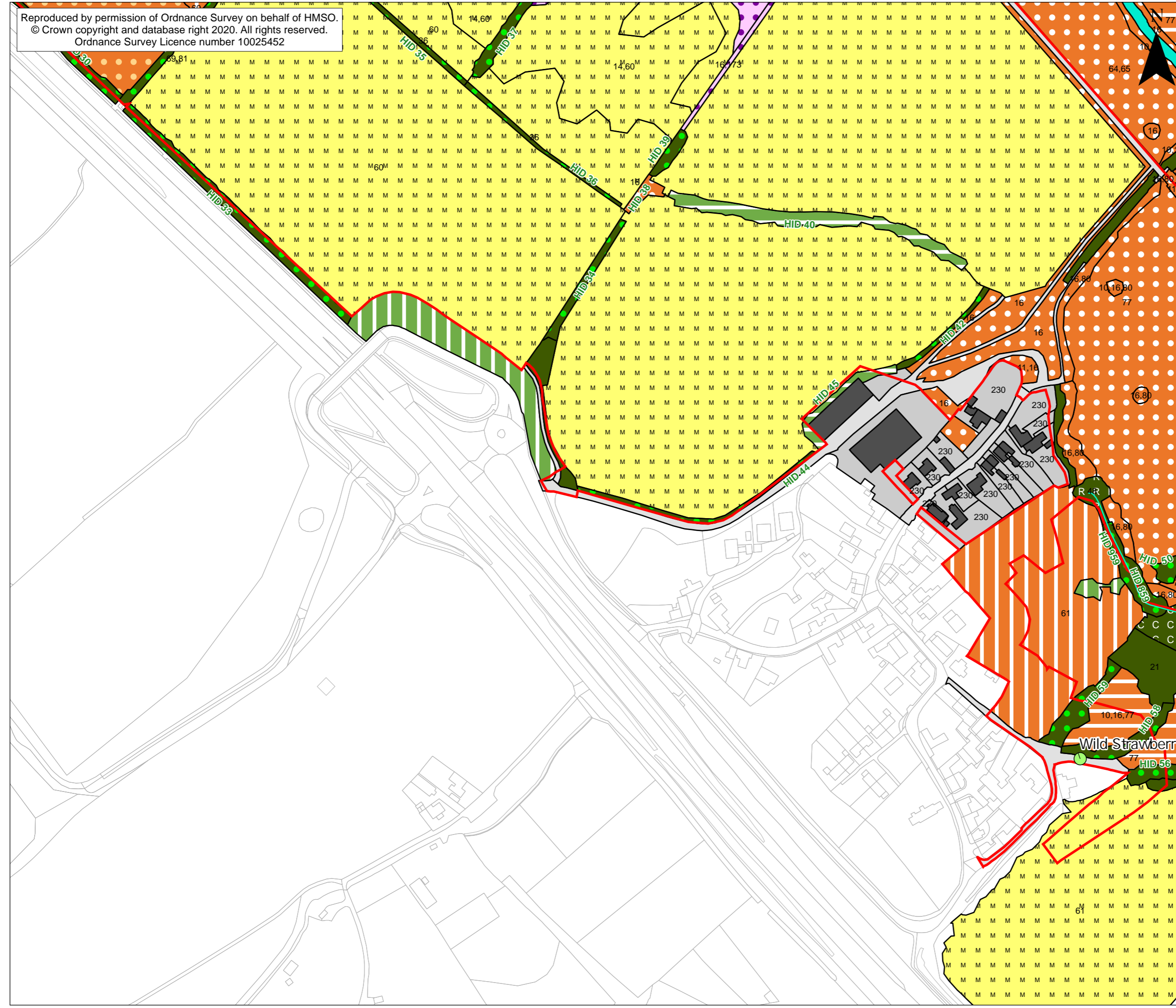
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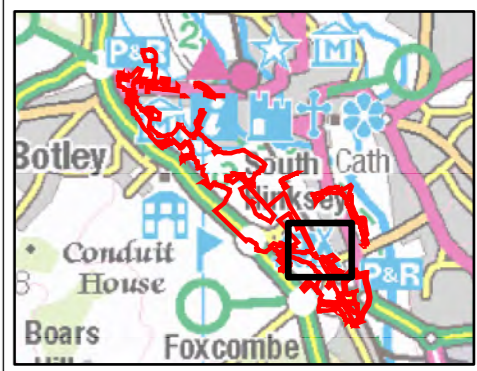
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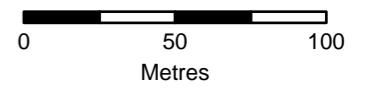


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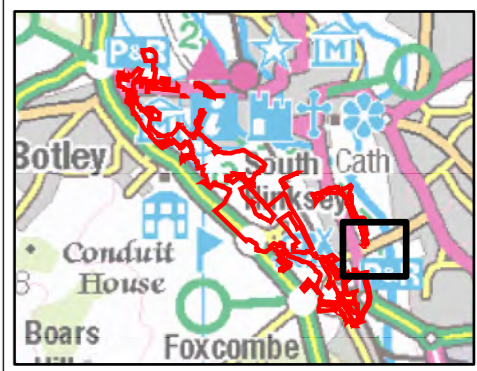
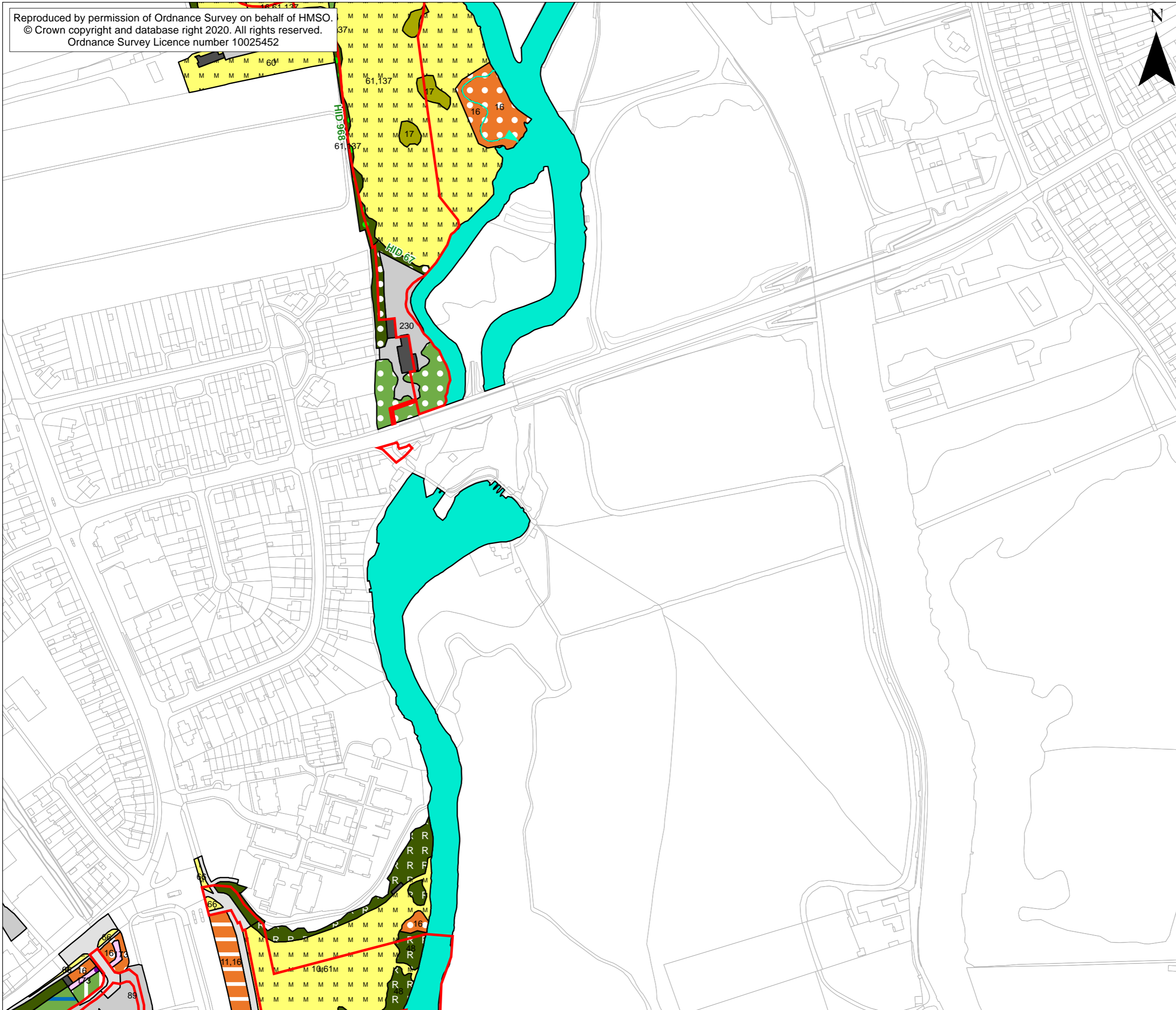
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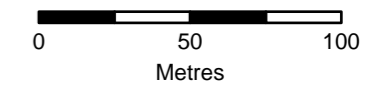


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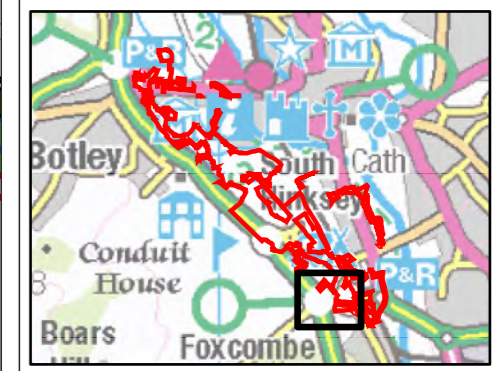
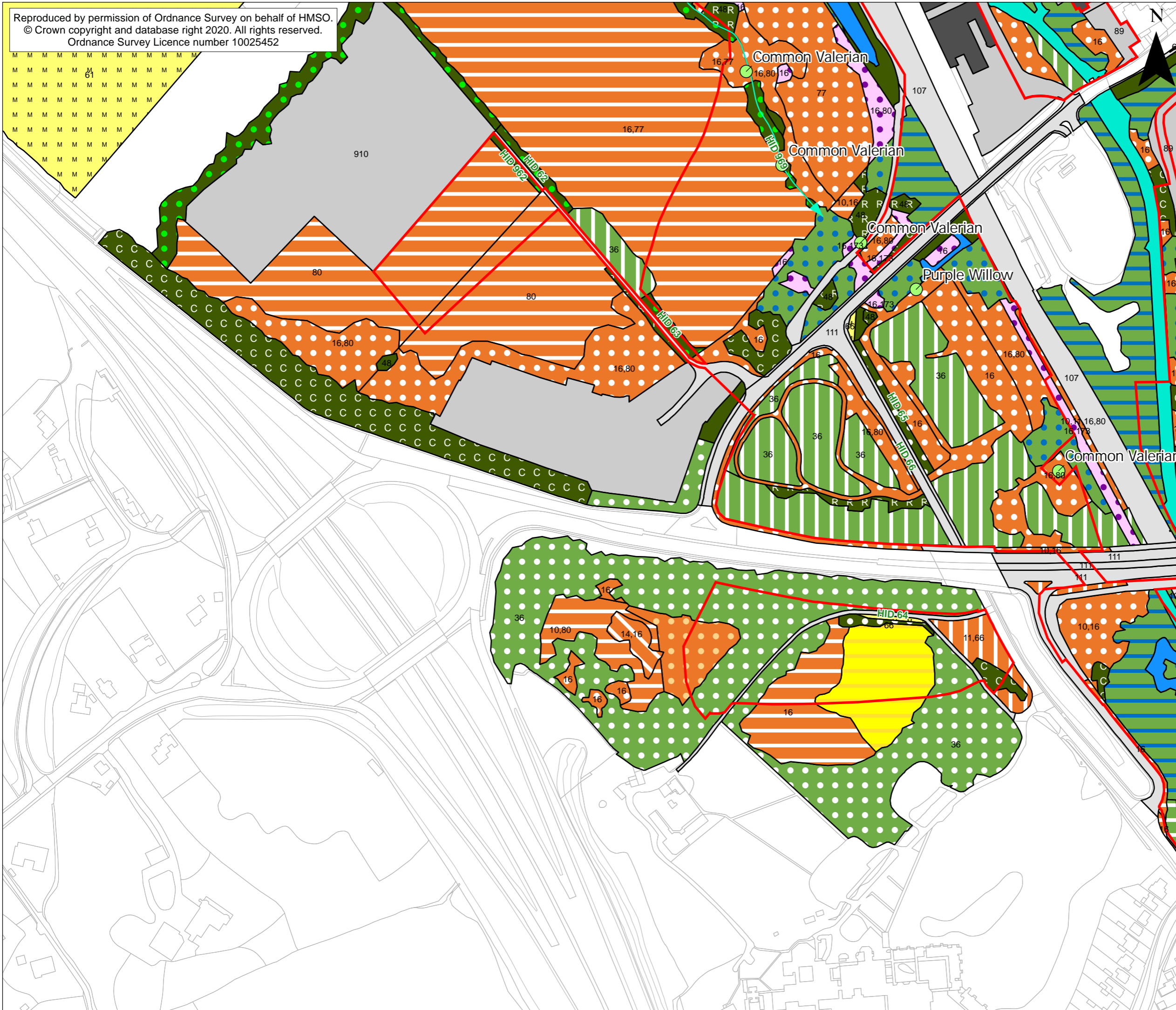
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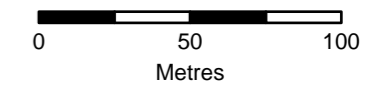
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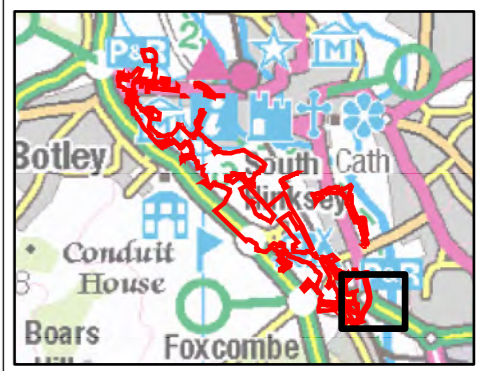
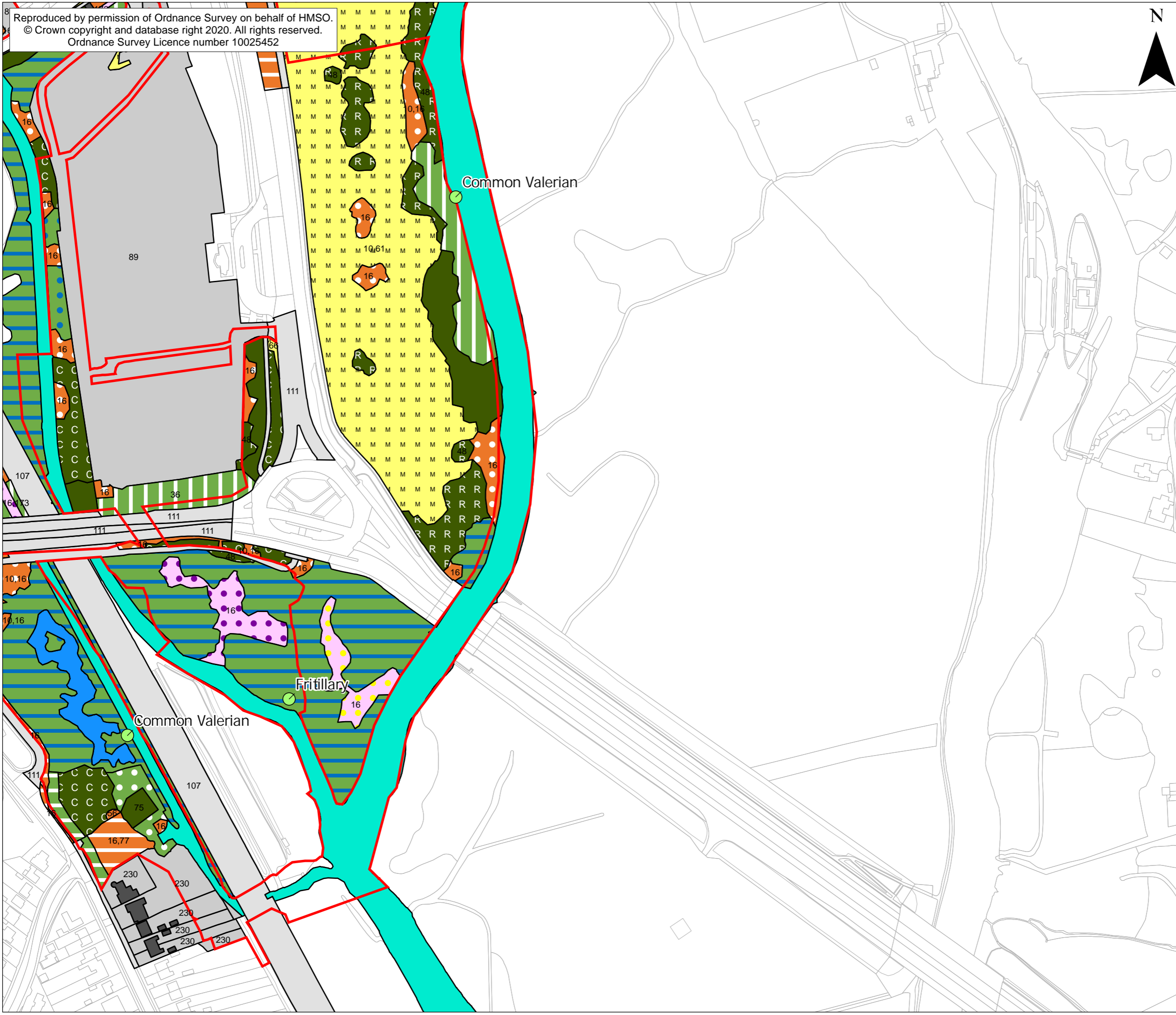
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 Figure A.1: Survey Results
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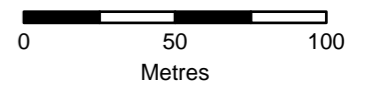
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- Legend**
- Scheme Area
 - Notable plant

Note:
 See page 14 for full legend.



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Legend

UK Habitat Classification primary habitat

f2d - Aquatic marginal vegetation

r1 - Standing open water and canals

r2 - Rivers and streams

c1c - Cereal crops

f2a - Lowland fens

f2d - Aquatic marginal vegetation

f2f - Other swamps

g2a5 - Dry grasslands and scrub on chalk or limestone; lowland (H6210)

g3a - Lowland meadows

g3a5 - Lowland hay meadows (H6510)

g3c - Other neutral grassland

g3c5 - Arrhenatherum neutral grassland

g3c6 - Lolium-Cynosurus neutral grassland

g3c7 - Deschampsia neutral grassland

g3c8 - Holcus-Juncus neutral grassland

g4 - Modified grassland

h2a - Hedgerow (priority habitat)

h2b - Other hedgerows

h3 - Dense scrub

h3a6 - Other blackthorn scrub

h3d - Bramble scrub

h3f - Hawthorn scrub

h3h - Mixed scrub

r1 - Standing open water and canals

r2 - Rivers and streams

s - Sparsely vegetated land

u - Urban

u1 - Built-up areas and gardens

u1b - Developed land; sealed surface

u1b5 - Buildings

u1b6 - Other developed land

u1c - Artificial unvegetated, unsealed surface

u1d - Suburban/ mosaic of developed/ natural surface

u1e - Built linear features

w1d - Wet woodland

w1d5 - Alder woodland on floodplains (H91E0)

w1g - Other woodland; broadleaved

w1g6 - Line of trees

w1g7 - Other broadleaved woodland types

w2c - Other coniferous woodland

Code UKHab secondary

10 Scattered scrub

11 Scattered trees

14 Scattered rushes

15 Rushes dominant

16 Tall herb

17 Ruderal/ ephemeral

19 Ponds (Priority Habitat)

21 Traditional orchards

36 Plantation

38 Secondary woodland

48 Non-native

56 Young trees - planted

58 Grazed

60 Sheep grazed

61 Horse grazed

64 Mown

65 Hay

66 Frequently mown

69 Fence

73 Bare ground

75 Active Management

77 Neglected

78 Abandoned

80 Unmanaged

81 Failed hedgerow

82 Laid hedgerow

89 Car Park

91 Development site

107 Railway

111 Road

115 Track

119 Seasonally wet

122 Inundation vegetation

137 Ridge and furrow

140 Anthills

148 Flower forage abundant

161 Tall or tussocky sward

173 Swamp

180 Flood plain fen

200 Parks and gardens

210 Urban park

230 Garden

310 Grasslands

510 Sports pitches

610 Children's Play Space

910 Allotments

1160 Introduced shrub

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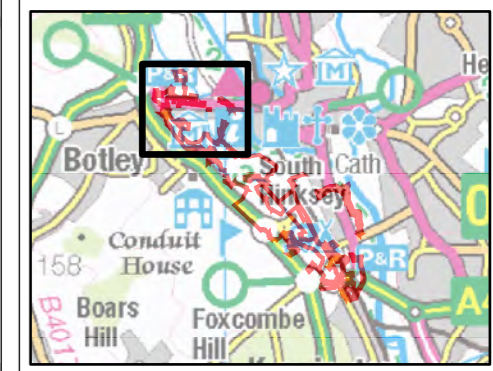
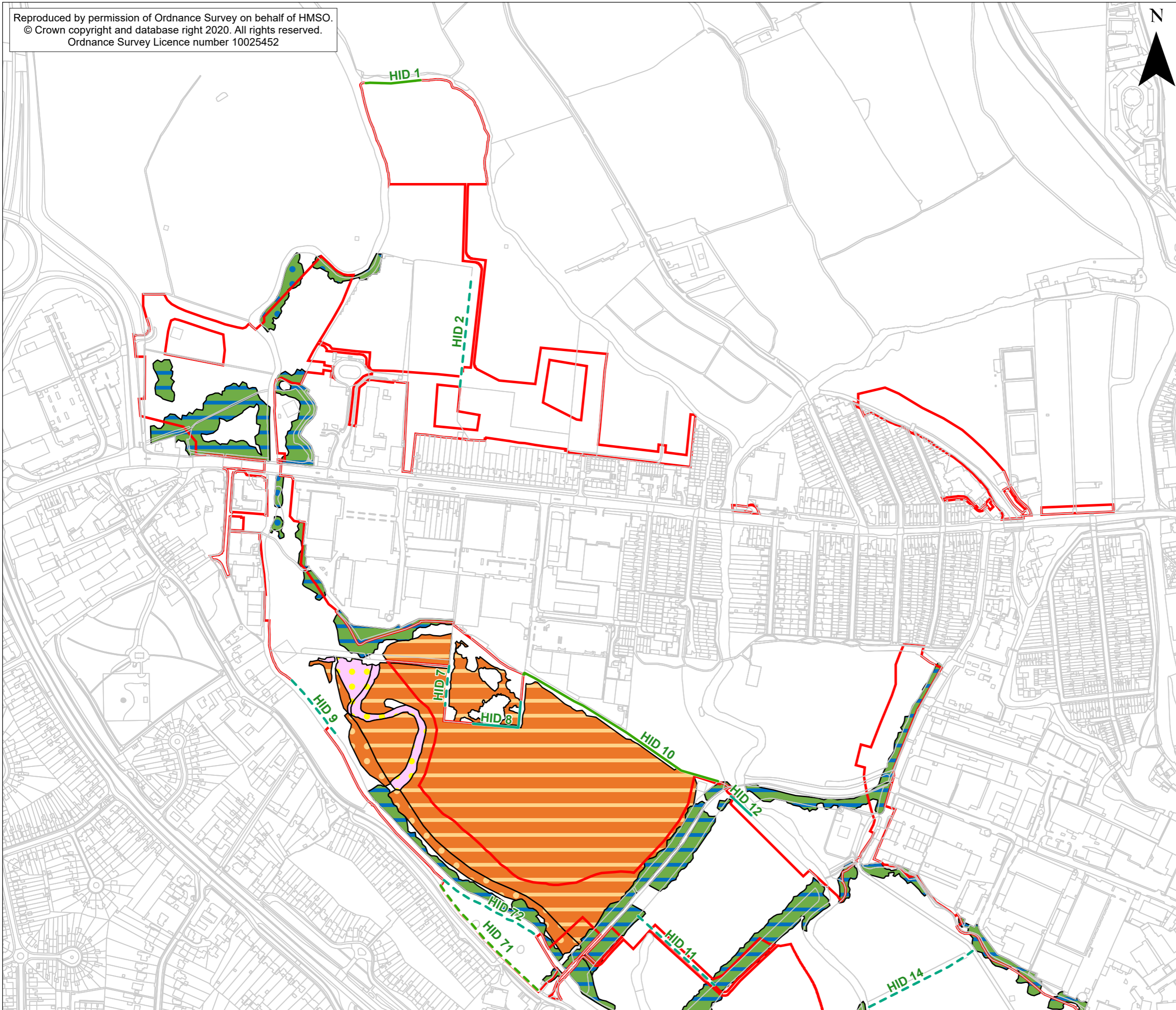
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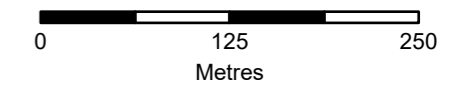
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Figure A.2: Priority habitats



Legend

- Scheme Area
- Hedgerows priority habitat
 - Important - species-rich
 - Important - not species-rich
 - Not important - species-rich
 - Other
- Priority habitat areas
 - Lowland Fens
 - Lowland Calcareous Grassland (H6210)
 - Lowland Meadows
 - Lowland Meadows (H6510)
 - Wet Woodland
 - Wet Woodland (H91E0)
 - Traditional Orchards



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**Figure A.2: Priority Habitats
 (Page 1 of 4)**

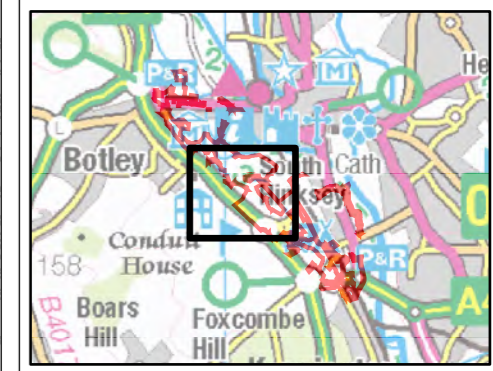
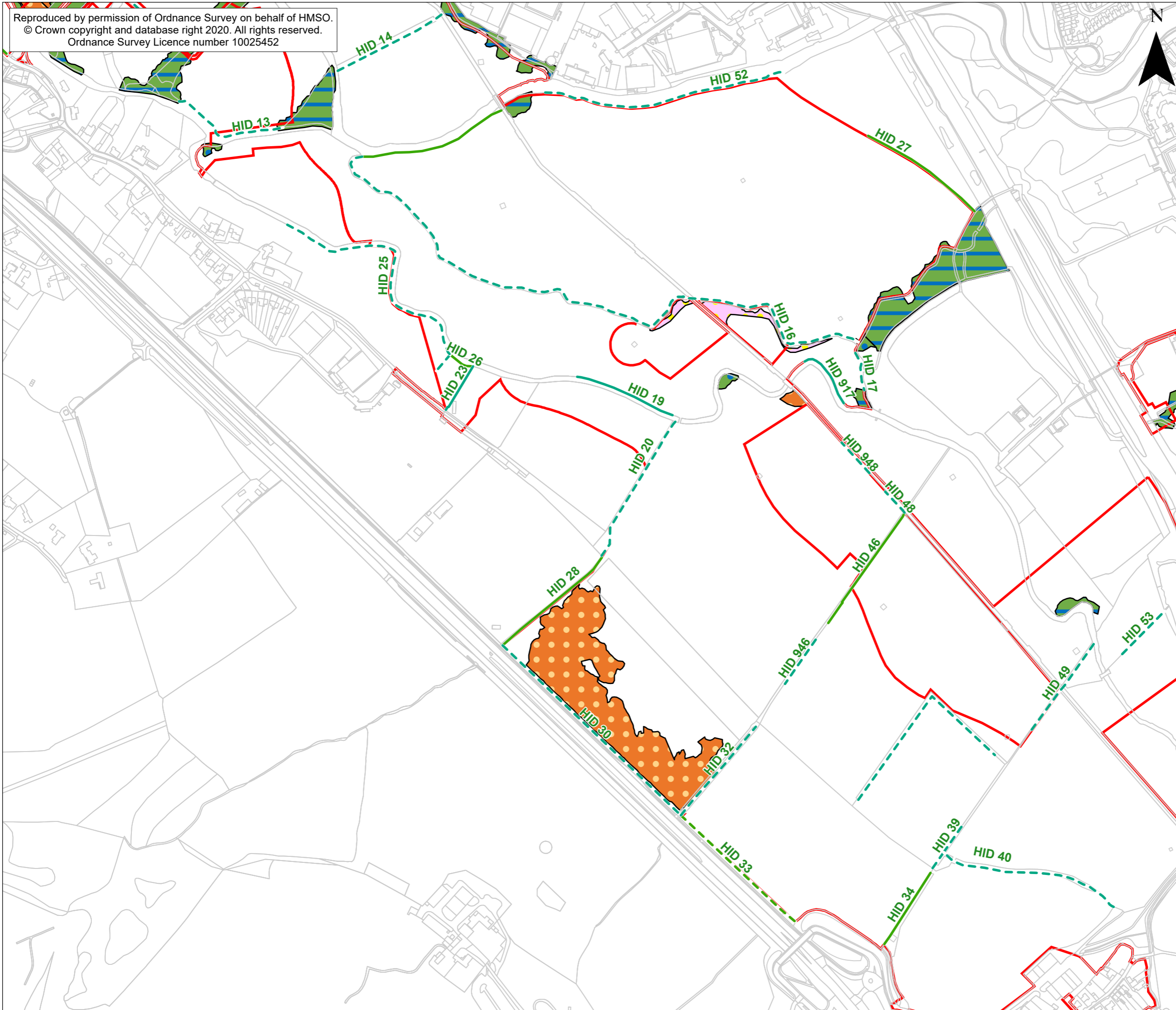
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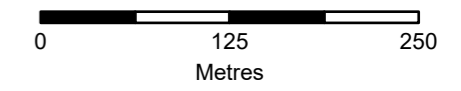
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Legend

- Scheme Area
- Hedgerows priority habitat
 - Important - species-rich
 - Important - not species-rich
 - Not important - species-rich
 - Other
- Priority habitat areas
 - Lowland Fens
 - Lowland Calcareous Grassland (H6210)
 - Lowland Meadows
 - Lowland Meadows (H6510)
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 - Wet Woodland (H91E0)
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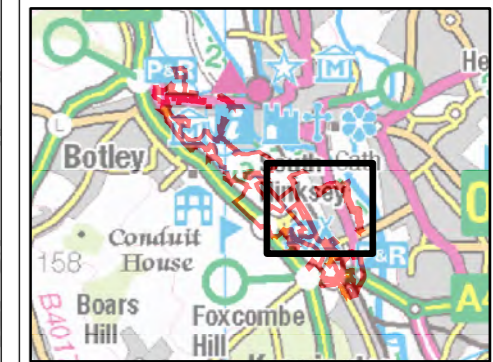
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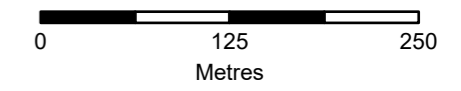
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Legend

- Scheme Area
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 - Important - species-rich
 - Important - not species-rich
 - Not important - species-rich
 - Other
- Priority habitat areas
 - Lowland Fens
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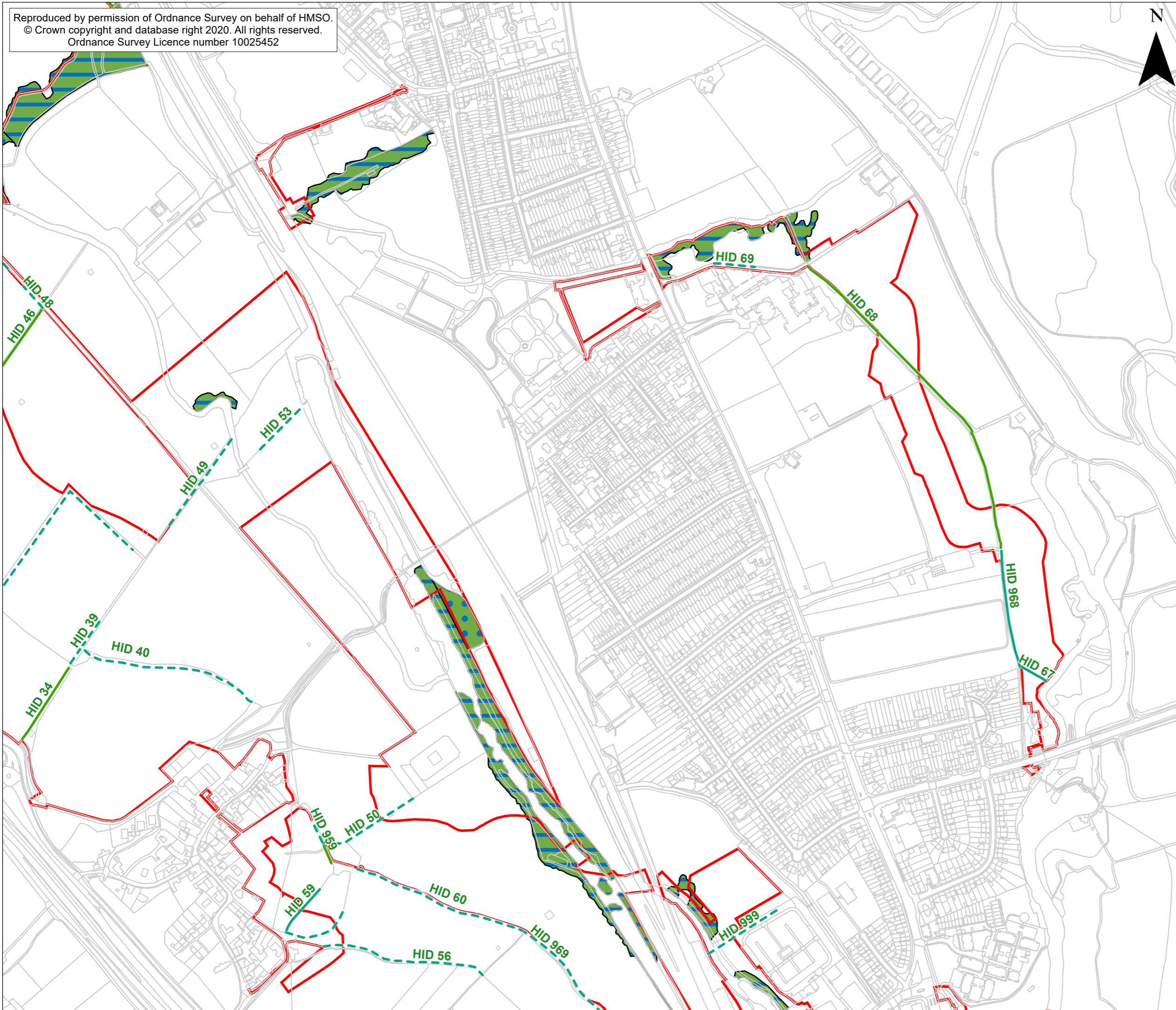
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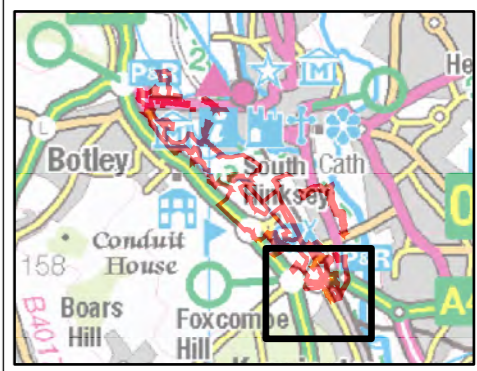
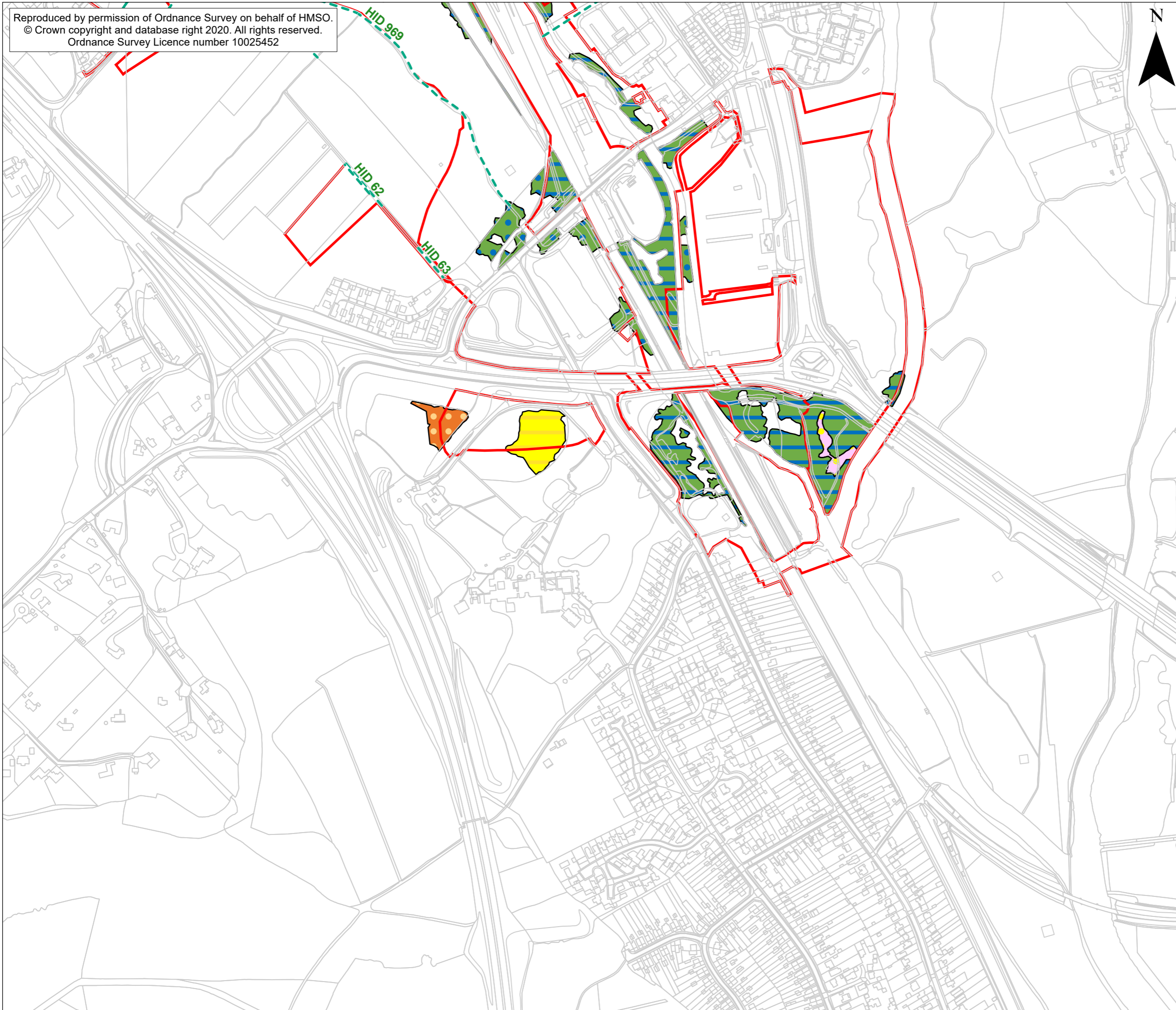
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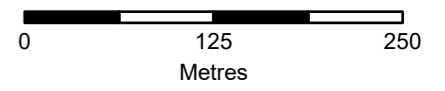
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Legend

- Scheme Area
- Hedgerows priority habitat
 - Important - species-rich
 - Important - not species-rich
 - Not important - species-rich
 - Other
- Priority habitat areas
 - Lowland Fens
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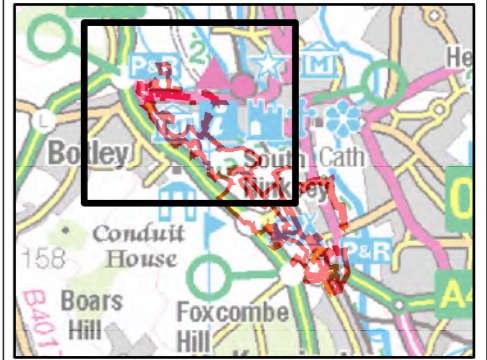
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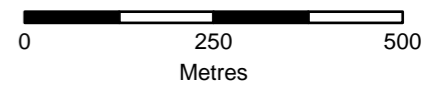
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Figure A.3: Habitat and notable plant values



Legend

- Scheme Area
- Notable plant value
- Very High
- High
- Moderate
- Low
- Habitats - value
- High
- Moderate
- Low / Moderate
- Low
- Unknown
- Negligible / outside RLB



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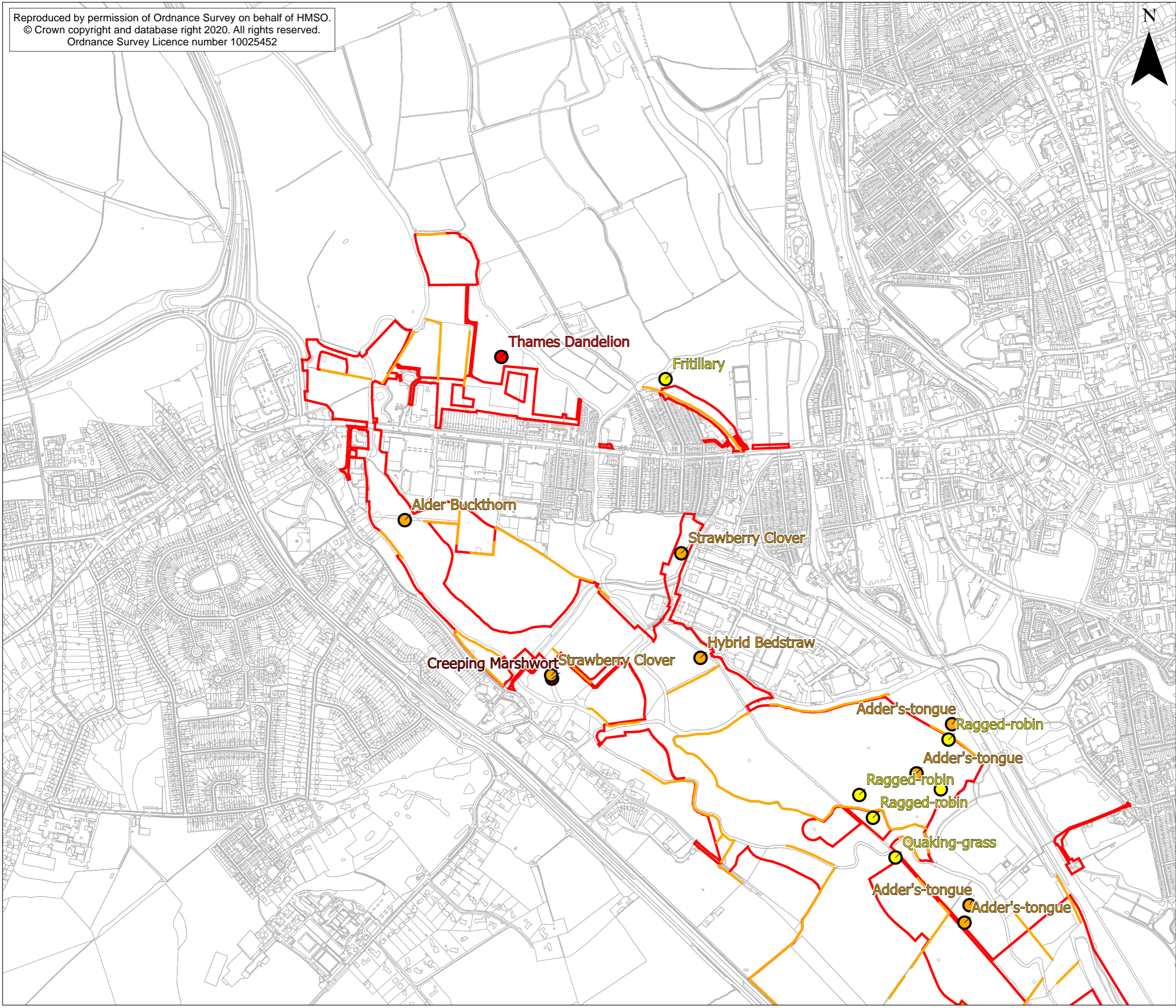
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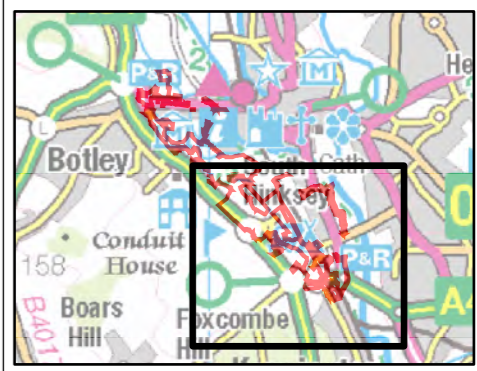
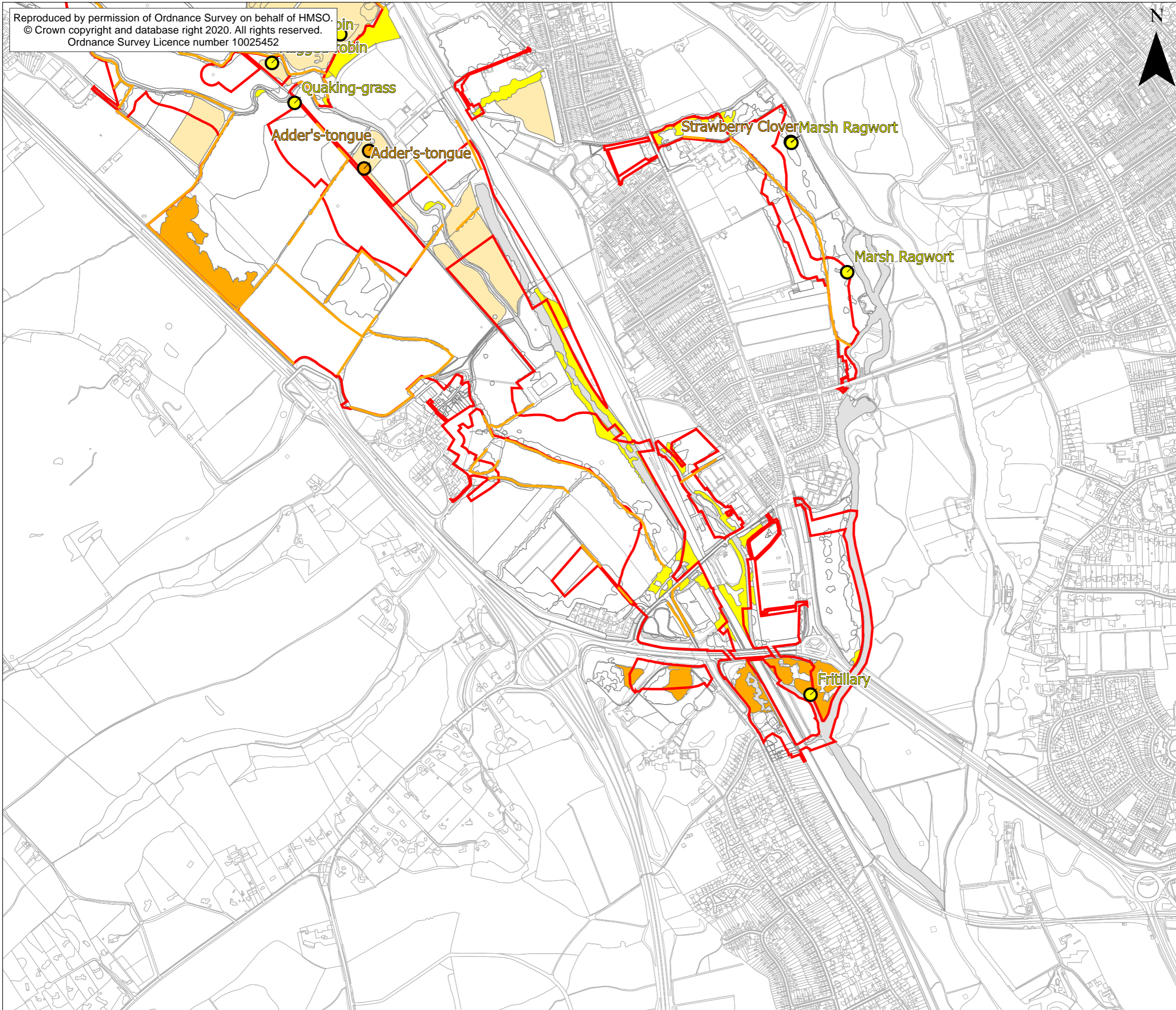
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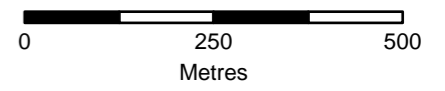
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Legend

- Scheme Area
- Notable plant value
 - Very High
 - High
 - Moderate
 - Low
- Habitats - value
 - High
 - Moderate
 - Low / Moderate
 - Low
 - Unknown
 - Negligible / outside RLB



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Appendix B. Hedgerow survey design

Table B.1: Hedgerow survey fields and correspondence with wildlife criteria in Schedule 1 of Hedgerow Regulations 1997 and condition assessment in Biodiversity Metric 2.0

Field name	Display name	Assessment criteria		
		Hedgerows Regulations	Biodiversity Metric 2.0 condition	
			Hedgerows	Lines of trees
HID	HID	-	-	-
S1	Surveyed date	-	-	-
S2	Surveyors	-	-	-
S4_1	Sides surveyed	-	-	-
S4_2_1	Side 1	-	-	-
S4_2_2	Side 2	-	-	-
S5	Survey note	-	-	-
S6	County	Schedule 1 7(2)	-	-
H1	Hedgerow type	-	-	-
H2	Hedgerow shape	-	-	-
H3	Countryside hedgerow	3(3)	-	-
H4	Hedgerow age	4(a)	-	-
H5	Hedgerow note	-	-	-
M1	Management 1	-	-	-
M2	Management 2	-	-	-
M3	Management 3	-	-	-
T1	No. trees	Schedule 1 7(4)(d)-(e)	-	-
T2	No. veteran/ancient trees	-	-	-
T3	Trees > 1/3 expected fully mature height	-	-	All criteria
CN1	Hedgerow connections – end 1	3(1)(b), Schedule 1 7(4)(h)	-	-
CN1_2	Hedgerow connections – end 2	3(1)(b), Schedule 1 7(4)(h)	-	-
CN2	Pond connections	Schedule 1 7(4)(h)	-	-
CN3	Broadleaved woodland connections	Schedule 1 7(4)(h)	-	-
R1	Notable species	Schedule 1 6	-	-
C1	Average height of canopy (m)	-	Criterion A1	-
C2	Average width of canopy (m)	-	Criterion A2	-
C3_1	Gaps – total number	-	-	All criteria
C3_2	Gaps – total % of hedgerow	Schedule 1 7(4)(b)	Criterion B2	All criteria
C3_3	Gaps – are there gaps over 5m in length?	-	Criterion B2	-
C3_4	Gaps – gap between canopy and ground <0.5m for >90% of hedgerow	-	Criterion B1	-
C4_1	Undisturbed adjacent perennial herbaceous vegetation - average width side 1 (m)	-	Criterion C1	-
C4_2	Undisturbed adjacent perennial herbaceous vegetation - average width side 2 (m)	-	C1	-
C5	Plants indicative of nutrient enrichment dominate <20% of undisturbed ground	-	Criterion C2	-
C6	Non-native species absent for >90% of hedgerow and undisturbed ground	-	Criterion D1	-
C7	No human-caused damage for >90% of hedgerow and undisturbed ground	-	Criterion D2	-
B1	Wall % length	Schedule 1 7(4)(a)	-	-
B2	Bank % length	Schedule 1 7(4)(a)	-	-
B3	Parallel hedge % length	Schedule 1 7(4)(i)	-	-
B4_1	Ditch location	-	-	-
B4_2	Ditch % length	Schedule 1 7(4)(g)	-	-
B4_3	Ditch width	-	-	-

Field name	Display name	Assessment criteria		
		Hedgerows Regulations	Biodiversity Metric 2.0 condition	
			Hedgerows	Lines of trees
B4_4	Ditch depth	-	-	-
B4_5	Ditch flow	-	-	-
B5	Highways etc.	Schedule 1 8(a)	-	-

Figure B.1: Arcade code used to calculate habitat condition of hedgerows and lines of trees

```
//Check hedgerow has been surveyed
if($feature.S1 < Date(2020,02,27)) return "not surveyed"

//Lines of trees
if($feature["H1"] == 2){
  //Condition criteria for lines of trees
  if($feature["C3_2"] < 10 && $feature["C3_3"] ==0 && $feature["T3"] == 1) return "good";
  if($feature["C3_2"] < 10 && $feature["C3_3"] ==0) return "moderate";
  return "poor";
}

//Shrubby hedgerows
else{
  //Define condition criteria for hedgerows
  var a1 =0;
  if($feature.C1>=1.5) a1=1;
  var a2=0;
  if($feature.C2>=1.5) a2=1;
  var b1 = $feature["C3_4"];
  var b2 =0;
  if($feature["C3_3"] == 0 && $feature["C3_2"]<10) b2=1;
  var c1=0;
  if($feature["C4_1"]>=1 || $feature["C4_2"]>=1) c1=1;
  var c2 = $feature.C5;
  var d1 = $feature.C6;
  var d2 = $feature.C7;

  //Functional groups
  var y = [a1+a2,b1+b2,c1+c2,d1+d2];
  var i = 0;
  for (var k=0;k<4; k++){
    if(y[k] == 0) i++
  }

  //Calculate condition
  if((a1+a2+b1+b2+c1+c2+d1+d2)>=6 && i==0) return "good";
  if((a1+a2+b1+b2+c1+c2+d1+d2)>=4 && i<=1) return "moderate";
  return "poor";
}
}
```

Figure B.2: Arcade code used to calculate woody species richness

```
var l = $feature["Shape__Length"];
var n=1;
if(l>100){n=2};
if(l>200){n=3}; // number of sections to sample

var s = [0,0,0];
var hid = $feature.HID;
var x = Filter(FeatureSetByName($datastore, "Species"), "DAFOR>0 AND HID_spp=@hid");

if(Count(x) == 0) return 0;
var w =[];
var i =0;
for (var k in x){
  var sp = k.taxon;
  var regs = First(Filter(FeatureSetByName($datastore, "Taxon_HedgeRegs"), "Code=@sp"));

  if(!IsEmpty(regs) && regs.Schedule == "S3") {w[i] = [regs.Species,k.DAFOR1,k.DAFOR2,k.DAFOR3];
    ++i;}
}
}
```

```

var x1 = [];
var x2 = [];
var x3 = [];
var i1 = 0;
var i2 = 0;
var i3 = 0;
for (var z in w){
  if(w[z][1]>0) {x1[i1] = w[z][0]; ++i1;}
  if(w[z][2]>0) {x2[i2] = w[z][0]; ++i2;}
  if(w[z][3]>0) {x3[i3] = w[z][0]; ++i3;}
}

var s=[Count(Distinct(x1)),Count(Distinct(x2)),Count(Distinct(x3))];
var wdy=0;
for (var i=0;i<n;++i){
  wdy+=s[i]/n;
}

return wdy;

```

Figure B.3: Arcade code used to automate Hedgerow Regulations assessment

```

//Check hedgerow has been surveyed
if($feature.S1 < Date(2020,02,28)) return "not surveyed";

//Section 3 - check hedgerow is a countryside hedgerow and check length and connections
if($feature.H3 == 1) return "NA";
if($feature["Shape__Length"] <20 && $feature.CN1_1 == 0 && $feature.CN1_2 == 0) return "NA";

//Section 4 - check hedgerow age
if($feature.H4 == 1) return "NA";

//Schedule 1 Part II Wildlife and landscape
//paragraph 6 - red listed species
if($feature.R1 == 1) return "important";

//paragraph 7
//calculate numbers of woodland herbs and woody species recorded in table "Species" and listed in table
"Taxon_HedgeRegs" corresponding to those listed on Schedules 2 and 3 of Regulations, and trees in 7(1)(b)
var l = $feature["Shape__Length"];
var n=1;
if(l>100){n=2};
if(l>200){n=3}; // number of sections to sample

var s = [0,0,0];
var hid = $feature.HID;
var x = Filter(FeatureSetByName($datastore, "Species"),"DAFOR>0 AND HID_spp=@hid");

if(Count(x) == 0) return "not important";
var w =[];
var h =[];
var i =0;
var j =0;
var specialtrees = 0;
for (var k in x){
  var sp = k.taxon;
  var regs = First(Filter(FeatureSetByName($datastore, "Taxon_HedgeRegs"),"Code=@sp"));

  if(!IsEmpty(regs) && regs.Schedule == "S3") {w[i] = [regs.Species,k.DAFOR1,k.DAFOR2,k.DAFOR2];
    ++i;}
  if(!IsEmpty(regs) && regs.Schedule == "S2") {h[j]=regs.HedgeRegs;
    ++j;}

  if(k.Taxon == "2cd4p9h.7mm4e9" || k.Taxon == "2cd4p9h.ft4" || k.Taxon == "2cd4p9h.w3q" || k.Taxon ==
"2cd4p9h.frz") specialtrees = 1
}

var x1 = [];
var x2 = [];
var x3 = [];
var i1 = 0;
var i2 = 0;
var i3 = 0;

```

```

for (var z in w){
  if(w[z][1]>0) {x1[i1] = w[z][0]; ++i1;}
  if(w[z][2]>0) {x2[i2] = w[z][0]; ++i2;}
  if(w[z][3]>0) {x3[i3] = w[z][0]; ++i3;}
}

var s=[Count(Distinct(x1)),Count(Distinct(x2)),Count(Distinct(x3))];
var wdy=0; //Number of woody species recorded from Schedule 3
for (var i=0;i<n;++i){
  wdy+=s[i]/n;
}

var hrb = Count(Distinct(h)); //Number of woodland herbs recorded from Schedule 2

//conditions in 7(4)
var a = 0;
var b = 0;
var cde = 0;
var f = 0;
var g = 0;
var h = 0;
var i = 0;
if($feature.B1>=50 || $feature.B2>=50) a = 1;
if($feature["C3_2"]<=10) b = 1;

if($feature["Shape__Length"] <= 50 && $feature["T1"]>= 1) cde = 1;
if($feature["Shape__Length"] >50 && $feature["Shape__Length"]<=100 && $feature["T1"] >= 2) cde =1;
if($feature["Shape__Length"] > 100 && 50 * $feature["T1"] / $feature["Shape__Length"] >=1) cde = 1;

if(hrb >= 3) f = 1;
if($feature["B4_2"]>=50) g = 1;
if( ($feature.CN1 + $feature.CN1_2 + 2*$feature.CN2 + 2*$feature.CN3)>=4 ) h = 1;
if($feature.B3==100) i = 1;

var f1 = a + b + cde + f + g + h +i;
var f2 = a + b + cde + f + g;

//adjust number of woody species in 7(1) in accordance with 7(2)
var q;
IIf($feature.S6 ==0, q = [7,6,6,5], q=[6,5,5,4]);

//conditions in 7(1)
//7(1)(a)
if(wdy >=q[0]) return "important";
//7(1)(b)
if(wdy >= q[1] && f1>=3) return "important";
//7(1)(c)
if(wdy >= q[2] && specialtrees == 1) return "important";
//7(1)(d)
if(wdy >= q[3] && f1>=4) return "important";

//paragraph 8
if($feature.B5 == 1 && wdy>=4 && f2>=2) return "important";

//failure
return "not important";

```

Appendix C. Summary of hedgerow survey results

Table C.1: Summary of assessment of hedgerows and lines of trees

HID	Hedgerows priority habitat	Species-richness	Condition	Hedgerow Regulation 1997
1	priority	7.00	good	important
2	priority	2.00	poor	not important
3	-	0.00	not surveyed	not surveyed
4	-	5.00	moderate	NA
5	-	2.50	good	NA
6	-	1.00	moderate	NA
7	priority	3.00	good	NA
8	priority	5.00	good	NA
9	priority	0.00	good	NA
10	priority	5.33	good	not important
11	priority	4.50	good	NA
12	priority	5.00	good	NA
13	priority	0.00	good	not important
14	priority	4.50	moderate	not important
15	priority	5.67	moderate	important
16	priority	2.67	good	not important
17	priority	4.00	good	not important
19	priority	5.00	good	not important
20	priority	4.67	good	not important
21	-	0.00	good	NA
23	priority	5.00	good	not important
24	priority	3.00	moderate	not important
25	priority	3.00	good	not important
26	priority	5.00	good	important
27	priority	7.50	moderate	important
28	priority	6.50	good	important
30	priority	1.67	good	not important
32	priority	4.00	good	not important
33	priority	4.00	good	important
34	priority	7.50	good	important
35	-	5.00	good	NA
36	-	5.00	good	NA
37	priority	4.33	good	not important
38	priority	3.00	moderate	NA
39	priority	2.00	good	NA
40	priority	4.33	poor	not important
42	-	4.00	moderate	NA
44	-	4.00	good	NA
45	-	4.00	moderate	NA

HID	Hedgerows priority habitat	Species-richness	Condition	Hedgerow Regulation 1997
46	priority	7.50	good	important
48	priority	4.00	poor	NA
49	priority	0.00	good	not important
50	priority	4.50	good	not important
52	priority	3.00	good	not important
53	priority	3.00	moderate	not important
54	-	0.00	good	NA
55	-	0.00	good	NA
56	priority	0.00	moderate	not important
58	priority	2.00	moderate	not important
59	priority	5.00	moderate	not important
60	priority	3.00	good	not important
62	priority	2.00	good	NA
63	priority	1.00	poor	NA
64	-	0.00	moderate	NA
65	-	0.00	poor	NA
66	-	0.00	poor	NA
67	priority	5.00	moderate	not important
68	priority	7.33	good	important
69	priority	0.00	good	NA
70	-	0.00	good	not important
71	priority	4.00	good	not important
72	priority	3.00	good	not important
859	priority	9.00	good	important
901	-	4.00	good	NA
917	priority	6.00	good	NA
946	priority	1.00	moderate	NA
948	priority	4.00	poor	NA
959	priority	3.00	good	not important
962	priority	1.00	good	NA
968	priority	6.50	moderate	not important
969	priority	2.33	moderate	not important
999	priority	0.00	good	NA

The above table summarises the results leading to the identification of 10 hedges as important hedges using ecological criteria. A further 7 were identified as important using historical criteria in the Heritage Desk-based Assessment by Oxford Archaeology in December 2016 (report number IMSE500177-HGL-00-ZZ-RE-I-000083). The ID numbers of these hedges are HID 23, 37, 40, 58, 59, 62 and 63. For historical purposes HID 62 and 63 were identified as two fragments of a single historic hedge, however this habitat survey identified them as two separate recent replacements. They are therefore excluded from the final total of 15.

Table C.2: Summary of plant taxa recorded from hedgerow survey

Scientific name	Common name	Life form	Native status ⁴	Hedgerows Regulations 1997	
				Schedule	Listed taxon
<i>Acer campestre</i>	Field Maple	Woody	Native	3	Maple, field (<i>Acer campestre</i>)
<i>Acer campestre</i> subsp. <i>campestre</i> var. <i>lobatum</i>	-	Woody	Non-native	-	-
<i>Acer campestre</i> var. <i>leiocarpum</i>	-	Woody	Non-native	-	-
<i>Acer platanoides</i>	Norway Maple	Woody	Non-native	-	-
<i>Acer pseudoplatanus</i>	Sycamore	Woody	Non-native	-	-
<i>Aesculus hippocastanum</i>	Horse-chestnut	Woody	Non-native	-	-
<i>Alnus glutinosa</i>	Alder	Woody	Native	3	Alder (<i>Alnus glutinosa</i>)
<i>Alnus incana</i>	Grey Alder	Woody	Non-native	-	-
<i>Berberis gagnepainii</i>	Gagnepain's Barberry	Woody	Non-native	-	-
<i>Bryonia dioica</i>	White Bryony	Woody	Native	-	-
<i>Buddleja globosa</i>	Orange-ball-tree	Woody	Non-native	-	-
<i>Cornus sanguinea</i>	Dogwood	Woody	Native	3	Dogwood (<i>Cornus sanguinea</i>)
<i>Cornus sanguinea</i> subsp. <i>australis</i>	Southern Dogwood	Woody	Non-native	-	-
<i>Corylus avellana</i>	Hazel	Woody	Native	3	Hazel (<i>Corylus avellana</i>)
<i>Cotoneaster simonsii</i>	Himalayan cotoneaster	Woody	Non-native	-	-
<i>Crataegus laevigata</i>	Midland Hawthorn	Woody	Native	3	Hawthorn, midland (<i>Crataegus laevigata</i>)
<i>Crataegus laevigata</i> x <i>monogyna</i> = <i>C. x media</i>	-	Woody	Native	-	-
<i>Crataegus monogyna</i>	Hawthorn	Woody	Native	3	Hawthorn (<i>Crataegus monogyna</i>)
<i>Cupressus macrocarpa</i> x <i>Xanthocyparis nootkatensis</i> = <i>X Cuprocyparis leylandii</i>	Leyland Cypress	Woody	Non-native	-	-
<i>Euonymus europaeus</i>	Spindle	Woody	Native	3	Spindle (<i>Euonymus europaeus</i>)
<i>Euonymus europaeus</i> f. <i>intermedius</i>	-	Woody	Non-native	-	-
<i>Forsythia suspensa</i> x <i>viridissima</i> = <i>F. x intermedia</i>	Forsythia	Woody	Non-native	-	-
<i>Frangula alnus</i>	Alder Buckthorn	Woody	Native	3	Buckthorn, alder (<i>Frangula alnus</i>)
<i>Fraxinus excelsior</i>	Ash	Woody	Native	3	Ash (<i>Fraxinus excelsior</i>)
<i>Juglans regia</i>	Walnut	Woody	Non-native	3	Walnut (<i>Juglans regia</i>)
<i>Ligustrum ovalifolium</i>	Garden Privet	Woody	Non-native	-	-
<i>Ligustrum vulgare</i>	Wild Privet	Woody	Native	3	Privet, wild (<i>Ligustrum vulgare</i>)
<i>Mahonia aquifolium</i>	Oregon-grape	Woody	Non-native	-	-

⁴ Following Preston *et al.* (2002)

Scientific name	Common name	Life form	Native status ⁴	Hedgerows Regulations 1997	
				Schedule	Listed taxon
<i>Malus pumila</i>	apple	Woody	Non-native	-	-
<i>Malus sylvestris</i> s.s.	crab apple	Woody	Native	3	Apple, crab (<i>Malus sylvestris</i>)
<i>Philadelphus</i> sp.	Mock-Orange	Woody	Non-native	-	-
<i>Populus alba</i>	White Poplar	Woody	Non-native	3	Poplar, white (<i>Populus alba</i>)
<i>Populus deltooides</i> x <i>nigra</i> = <i>P. x canadensis</i>	Hybrid Black-poplar	Woody	Non-native	-	-
<i>Populus nigra</i> 'Italica'	Lombardy-poplar	Woody	Non-native	-	-
<i>Prunus avium</i>	Wild Cherry	Woody	Native	3	Cherry, wild (<i>Prunus avium</i>)
<i>Prunus cerasifera</i>	Cherry Plum	Woody	Native	-	-
<i>Prunus domestica</i>	Wild Plum	Woody	Non-native	-	-
<i>Prunus domestica</i> subsp. <i>insititia</i>	Bullace	Woody	Non-native	-	-
<i>Prunus spinosa</i>	Blackthorn	Woody	Native	3	Blackthorn (<i>Prunus spinosa</i>)
<i>Quercus robur</i>	Pedunculate Oak	Woody	Native	3	Oak, pedunculate (<i>Quercus robur</i>)
<i>Rhamnus cathartica</i>	Buckthorn	Woody	Native	3	Buckthorn (<i>Rhamnus cathartica</i>)
<i>Ribes nigrum</i>	Black Currant	Woody	Native	-	-
<i>Ribes rubrum</i>	Red Currant	Woody	Native	-	-
<i>Rosa canina</i> agg.	A Dog-rose	Woody	Native	3	Rose (<i>Rosa</i> species)
<i>Rosa canina</i> group 'Dumales'	-	Woody	Native	3	Rose (<i>Rosa</i> species)
<i>Rosa canina</i> group 'Lutetianae'	-	Woody	Native	3	Rose (<i>Rosa</i> species)
<i>Rosa canina</i> group 'Pubescentes'	-	Woody	Native	3	Rose (<i>Rosa</i> species)
<i>Rosa canina</i> x <i>micrantha</i> = <i>R. x toddiae</i> (f x m)	-	Woody	Native	3	Rose (<i>Rosa</i> species)
<i>Rosa canina</i> x <i>obtusifolia</i> = <i>R. x dumetorum</i>	-	Woody	Native	3	Rose (<i>Rosa</i> species)
<i>Rosa canina</i> x <i>rubiginosa</i> = <i>R. x nitidula</i> (f x m)	-	Woody	Native	3	Rose (<i>Rosa</i> species)
<i>Rosa obtusifolia</i> x <i>micrantha</i> (f x m)	-	Woody	Native	3	Rose (<i>Rosa</i> species)
<i>Rosa obtusifolia</i> x <i>rubiginosa</i> = <i>R. x timbalii</i> (f x m)	-	Woody	Native	3	Rose (<i>Rosa</i> species)
<i>Rosa rubiginosa</i>	Sweet-briar	Woody	Native	3	Rose (<i>Rosa</i> species)
<i>Rubus armeniacus</i>	Giant Blackberry	Woody	Non-native	-	-
<i>Rubus caesius</i>	Dewberry	Woody	Native	-	-
<i>Rubus conjugens</i>	-	Woody	Native	-	-
<i>Rubus fruticosus</i> agg.	Bramble	Woody	Native	-	-
<i>Rubus ulmifolius</i>	Elm-leaved Bramble	Woody	Native	-	-
<i>Rubus vestitus</i>	-	Woody	Native	-	-
<i>Salix alba</i>	White Willow	Woody	Non-native	3	Willow (<i>Salix</i> species)
<i>Salix alba</i> x <i>babylonica</i> = <i>S. x sepulcralis</i>	Weeping Willow	Woody	Non-native	-	-
<i>Salix caprea</i>	Goat Willow	Woody	Native	3	Willow (<i>Salix</i> species)

Scientific name	Common name	Life form	Native status ⁴	Hedgerows Regulations 1997	
				Schedule	Listed taxon
<i>Salix caprea x cinerea x viminalis</i> = <i>S. x calodendron</i>	Holme Willow	Woody	Native	3	Willow (<i>Salix</i> species)
<i>Salix cinerea</i>	Grey Willow	Woody	Native	3	Willow (<i>Salix</i> species)
<i>Salix fragilis</i> s.l.	Crack Willow	Woody	Native	3	Willow (<i>Salix</i> species)
<i>Sambucus nigra</i>	Elder	Woody	Native	3	Elder (<i>Sambucus nigra</i>)
<i>Sorbus intermedia</i> s.s.	Swedish whitebeam	Woody	Non-native	-	-
<i>Tilia cordata x platyphyllos</i> = <i>T. x europaea</i>	Lime	Woody	Native	-	-
<i>Ulmus procera</i>	English Elm	Woody	Native	3	Elm (<i>Ulmus</i> species)
<i>Viburnum lantana</i>	Wayfaring-tree	Woody	Native	3	Wayfaring-tree (<i>Viburnum lantana</i>)
<i>Viburnum opulus</i>	Guelder-rose	Woody	Native	3	Guelder rose (<i>Viburnum opulus</i>)
<i>Viburnum opulus</i> subsp. <i>trilobum</i>	High Bush Cranberry	Woody	Non-native	-	-
<i>Calystegia sepium</i> s.l.	Hedge Bindweed	Climber	Native	-	-
<i>Calystegia silvatica</i>	Large Bindweed	Climber	Non-native	-	-
<i>Clematis vitalba</i>	Traveller's-joy	Climber	Native	-	-
<i>Fallopia baldschuanica</i>	Russian-vine	Climber	Non-native	-	-
<i>Hedera helix</i>	Common Ivy	Climber	Native	-	-
<i>Humulus lupulus</i>	Hop	Climber	Native	-	-
<i>Parthenocissus quinquefolia</i>	Virginia-creeper	Climber	Non-native	-	-
<i>Solanum dulcamara</i>	Bittersweet	Climber	Native	-	-
<i>Tamus communis</i>	Black Bryony	Climber	Native	-	-
<i>Alliaria petiolata</i>	Garlic Mustard	Herb	Native	-	-
<i>Arum maculatum</i>	Lords-and-Ladies	Herb	Native	2	Lords-and-ladies (<i>Arum maculatum</i>)
<i>Aster</i>	Michaelmas-Daisy	Herb	Non-native	-	-
<i>Brachypodium sylvaticum</i>	False Brome	Herb	Native	2	Wood false-brome (<i>Brachypodium sylvaticum</i>)
<i>Bromopsis ramosa</i>	Hairy-brome	Herb	Native	-	-
<i>Carex pendula</i>	Pendulous Sedge	Herb	Native	-	-
<i>Carex remota</i>	Remote Sedge	Herb	Native	-	-
<i>Chaerophyllum temulum</i>	Rough Chervil	Herb	Native	-	-
<i>Elymus caninus</i>	Bearded Couch	Herb	Native	-	-
<i>Equisetum telmateia</i>	Great Horsetail	Herb	Native	-	-
<i>Geranium robertianum</i>	Herb-Robert	Herb	Native	2	Herb-robert (<i>Geranium robertianum</i>)
<i>Geum urbanum</i>	Wood Avens	Herb	Native	2	Wood avens/Herb bennet (<i>Geum urbanum</i>)
<i>Impatiens glandulifera</i>	Indian Balsam	Herb	Non-native	-	-
<i>Iris foetidissima</i>	Stinking Iris	Herb	Native	-	-

Scientific name	Common name	Life form	Native status ⁴	Hedgerows Regulations 1997	
				Schedule	Listed taxon
<i>Mercurialis perennis</i>	Dog's Mercury	Herb	Native	2	Dog's mercury (<i>Mercurialis perennis</i>)
<i>Schedonorus giganteus</i>	Giant Fescue	Herb	Native	2	Giant fescue (<i>Festuca gigantea</i>)
<i>Stachys sylvatica</i>	Hedge Woundwort	Herb	Native	-	-
<i>Viola reichenbachiana</i>	Early Dog-violet	Herb	Native	2	Early dog violet (<i>Viola reichenbachiana</i>)

Figure C. 1: Relationship between average and total diversity of woody taxa recorded from hedgerows and lines of trees. Data labels are HID numbers.

