Natural Capital and Ecosystem Assessment

England Ecosystem Survey

Field Manual: 2023 Version 1.7

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VERSION HISTORY			
Version	**Revision Date**	**Status**	**Summary of Changes**
1.0	31 March 2021	Draft for consultation	
1.1	11 May 2021	Version for training development	Changes in response to consultation comments Removal of soils protocol Addition of England Peat Map protocol
1.2	15 July 2021	Version for field testing	Changes following delivery of training and initial surveyor feedback
1.3	6 August 2021	Updated version for field testing	Addition of SSSI general avoidance measures and updated Living England and England Peat Map protocols
1.4	22nd February 2022	Updated 2022 field testing consolidation year	Multiple protocol theme updates including changes to Square sampling and introduction of Low resolution Vs High resolution variables
1.5	6th July 2022	Updated 2022 field testing consolidation year	incl. Component habitats (Traditional orchards, Coastal floodplain grazing marsh, Wood Pasture) and habitats below minimum mappable area (<20mx20m)
1.6	2nd December 2022	Updated	Buffer zones included. Updated ToW protocol, with tree in feature now included in this protocol
1.7	13th April 2023	Updated	Quality control changes incorporated; low resolution, landscape fixed point photography and EPM protocols revised; protocol for assessing soil plots added.

APPROVALS			
Group/Person	**Role**	**Recommendations**	**Date**
Sarah Escott	Natural England NCEA SRO	Sign off v1.0 for internal consultation	29 March 2021
Andy Nisbet	Natural England NCEA Technical Lead	Sign off v1.1 for training and sharing with potential contractors	12 May 2021
Andy Nisbet	Natural England NCEA Technical Lead	Sign off v1.2 for 2021 field testing	15 July 2021
Andy Nisbet	Natural England NCEA Technical Lead	Sign off v1.3 for 2021 field testing	6 August 2021
Andy Nisbet	Natural England NCEA Technical Lead	Sign off v1.4 for 2022 field testing	23 February 2022

1. Introduction

The Natural Capital and Ecosystem Assessment (NCEA) programme is a comprehensive and long-term programme that aims to transform landscape decision-making in England. The programme will gather and integrate data to address critical evidence gaps. It will provide high quality data to assess the state and condition of biodiversity, ecosystems, and natural capital assets in terrestrial, freshwater and marine environments. The data will provide information on

- what we have and how much of it we have
- where it is and what it does
- what condition it is in and why it is changing

1.1 The England Ecosystem Survey

The England Ecosystem Survey (EES) will collect data on the condition of terrestrial habitats, ecosystems, and natural capital assets. This will be the main data source for the NCEA to assess the quality of assets and how quality changes over time. The EES will collect field data on land, landscape, soil, ecosystem processes, ecological communities and some species.

Data from the EES will be used to:

- enable reporting on the state of our natural capital
- report on the 25 Year Environment Plan (YEP) indicators, including:
    - quantity, quality and connectivity of habitats (D1)
    - healthy soils (E7)
    - natural functions of water and wetland ecosystems (B6)
    - changes in landscape and waterscape character (G1)
- provide ground data for Living England and for remote sensing applications for condition assessments
- support the monitoring and evaluation of policy
- support interventions including Environmental Land Management schemes, Nature Recovery Networks, Protected Sites and Net Gain

1.2 Ecosystems and habitats covered

Table 1 shows the ecosystems (high-level asset classes) that the NCEA will cover. The classification is used in the UK National Ecosystem Assessment, Natural England's natural capital indicator work, and the Office for National Statistics natural capital accounting. The NCEA programme also wants to maximise its ability to report on more specific high value asset classes such as priority habitats. EES will cover most of the habitats in Table 1 in depth.

Habitats that will not be covered are:

- woodlands - National Forest Inventory will cover this
- lakes, rivers and streams - the Environment Agency surveillance surveys will cover this

Table 1: Ecosystems and habitat covered by the EES Underlined habitats will be covered by other parts of the wider NCEA programme although they will be mapped where they occur within the sample 1ha squares.	
Ecosystem	**Component habitats**
Mountains, moorland, and heath	Bracken, dwarf shrub heath, upland fen, marsh and swamp, blanket bog, montane, inland rock
Semi-natural grasslands	Neutral, acid and calcareous grassland, purple moor-grass and rush pastures
Enclosed farmland	Arable and horticultural, modified grassland and hedgerows
Woodland	Broadleaved, mixed, and coniferous woodland Wood pasture and parkland Traditional orchards Commercial and intensively managed orchard Small woods
Freshwater and wetlands	Lakes, rivers and streams, ponds, lowland raised bog, fen, marsh and swamp
Urban	Built environment, brownfield, and gardens
Coastal margins	Sand dunes, vegetated shingle, sea cliffs, saltmarsh, and coastal lagoons
Marine	Intertidal and subtidal rock and sediment, deep sea habitats

1.3 The Field Manual

This version of the field manual sets out the protocols and methods to be used when collecting data for the EES during the 2023 field testing season. The protocols have been produced by adapting existing methods and developing new ones. Section 12 contains a full list of references.

There will be consultation on this version during 2023. Feedback and lessons learnt during the field season will be used to revise it for subsequent survey.

Soil surveys and sampling will be tested alongside the vegetation, habitat and ecosystem survey in 2023. The protocol for assessing the suitability of soil plots and choosing alternative plots are included in this manual. The soil sampling itself is detailed in the 'EES Soil Survey Manual' available in the surveyor library.

All additional documents that are referred to in the field manual, such as supplementary guidance and risk assessments, can be found on the External Surveyors' Site and, for Natural England surveyors, the Surveyor Library 2.0.

2. Survey design

The basic sampling unit will be a 1km^2 also known as a monad.

The sample selection will aim to provide representative data. It will also use inclusion probabilities which increase the likelihood of particular features being selected, such as priority habitats.

Sampling units will be surveyed over a 5-year cycle and resurveyed in subsequent cycles. Repeat surveys will provide data on change in the condition and quality of assets.

The monad will be subsampled for detailed, high-resolution data and sample collection whilst a range of less detailed or low-resolution data will be captured for certain features throughout the monad.

2.1 Types of sub-sample and recording

Table 2 has a list of sub-samples that will be located within the monads.

Table 2: Sub-samples located in the monads

Sub-sample	ID	Description
England Peat Map plots	EPM	When the vegetation plot is on peat soil, data will be collected for the EPM project. Five peat depth measurements will be recorded in a 10x10 metre plot centred on the EES 2x2 metre vegetation plots.
Landscape assessments	LD	Points within the monad where surveyors will take fixed point photographs and record: • condition of landscape and historic environment features • overall landscape condition Some of these points may be aligned or associated with the squares.
Living England segments	LE	Broad habitat information will be collected from homogenous segments as depicted by satellite imagery. This will provide ground data for Living England. Each LE point is taken from within a representative homogenous area or patch of vegetation of at least 30 metres by 30 metres from within the larger segment. There will usually be at least one point suitable for collecting LE ground data within each segment. The aim will be to complete all segments within the 1ha square.
Point features	P T	Ponds **(P)** and Trees **(T)**.
Soil plots	S	Information on soils will be collected within a 16 metres by 16 metres plot associated with the 2 metres by 2 metres vegetation plot
Square	SQ	A 1ha square centred on the vegetation plot. Habitat stands or habitat mosaics within the square will be mapped, and vegetation attributes and variables recorded separately for each habitat type.

Vegetation plots	V	Detailed information on vegetation species composition and structure will be collected from vegetation plots. These will comprise 2 metres by 2 metres square plots - usually one per square - and linear plots for recording in hedgerows **(H)** and riparian habitat **(R).** The hedgerow plot is a 30 metres length of hedge with a 2 metre by 4 metre vegetation plot at its centre. The riparian plot is 10 metres by 1 metre.

In addition to the subsampling, less detailed or low-resolution data will be captured across the monad (where possible) for:

- hedgerows (HLR)
- small woods (SW)
- groups of trees (GT) - both tree clusters (GTC) and linear tree features (GTL)
- riparian habitat (RLR)
- ponds (PLR)

2.2 Subsampling within the monad

Within each monad there will be:

- four randomly pre-selected 2 metres by 2 metres vegetation plots and four 1ha square samples. Each vegetation plot will be nested within each of the squares.
- four 16 metres by 16 metres soil plots nested within the squares, one in each square
- up to two additional 2 metres by 2 metres vegetation plots with associated ha squares and soil plots targeted at priority habitats that were not recorded in the random subsampling.
- four linear vegetation plots located closest to each of the randomly selected 2 metres by 2 metres vegetation plots. These may be hedgerows or riparian plots.
- two ponds located closest to vegetation plots 1 and 2.
- up to twelve lone trees that may be associated with the squares, linear plots, in ponds or at other locations in the monad.
- six landscape assessments, four of which will be associated with the randomly selected squares and two of which will be at other locations in the monad. These may coincide with the locations of targeted squares.
- Living England segments associated with the squares and incorporated into a route around the monad.

Table 3. shows the preferred relationship between subsamples. Squares 1 to 4 each contain:

- a 2 metres by 2 metres vegetation plot
- a soil plot
- Living England segments
- a landscape and linear feature assessment associated with them

The linear feature may be a hedgerow or strip of riparian vegetation depending on which feature is closest to the vegetation plot.

Squares 1 and 2 also have a pond associated with them.

Squares 5 and 6 are targeted at other high value habitats not recorded in the random subsamples. They can be used as replacement squares should the random subsamples need to be abandoned (see Section 3.3). They may also be used as points from which to carry out landscape assessments.

There will also be additional Living England segments, landscape assessments and tree surveys, associated with the monad but not with a square.

In addition to the subsampling, low resolution data will be captured for small woods, groups of trees (including linear tree features), watercourses and ponds across the monad.

Table 3: Relationship between subsamples within a monad and features to be captured at low resolution within monad.

Monad									
Subsamples	**Naming convention**							**Low resolution**	**Naming Convention**
Square	SQ1	SQ2	SQ3	SQ4	SQ5	SQ6			
Living England	LE1	LE2	LE3	LE4	LE5	LE6	LE+		
Vegetation plot	V1	V2	V3	V4	V5	V6			
Ponds	P1	P2						Ponds	PLR∞
Hedgerow	H1	H2	(H3)	(H4)				Hedgerow	HLR∞
Linear feature								Linear Tree Features	GTL∞
Riparian	R1	R2	(R3)	(R4)				Riparian	RLR∞
Landscape (Square)	LD1	LD2	LD3	LD4					
Landscape (targeted)					(LD5)	(LD6)			
Trees							**T≤** 12	Small woods Cluster of trees	SW∞ GTC
Soils	S1	S2	S3	S4	S5	S6			

Naming conventions for illustrative purposes

Key: ∞ = unlimited number of LR features within the monad

3. Completing a survey

This section provides an overview of the survey process at a monad. Pre-survey preparation and health and safety are covered in Sections 4 and 5. Sections 6 to10 provide the detailed protocols for collecting data within subsamples and Section 11 the protocols for recording features at low resolution.

The time taken to survey a monad will depend on many factors, including location, terrain and complexity. The time it takes to complete elements of the survey should be recorded in Sweet.

3.1 Locating the monad and familiarisation

As the surveyor, Natural England will provide you with an Ordnance Survey grid reference for the south-west corner of the monad. A 12-character grid reference will also be provided for the centre of each 2x2m vegetation plot. This will start with the OS 100km square letters and followed by 10 digits. For example, SU0380004500. The monad, 1ha squares and the 2x2m vegetation plots associated with the squares will be visible in Sweet.

During your survey preparation, familiarise yourself with the monad (section 4.4). Plan your route based on the distribution of the various plots.

When you arrive on site, spend some time familiarising yourself with the monad on the ground. Identify the location of key features, including:

- the random and targeted sub-samples
- possible points for landscape assessments
- the features to be recorded at low resolution
- areas of under recorded and priority habitat suitable for Living England ground data collection points, Use the Priority Habitat Inventory and Living England ground data dashboard to do this (see section 4.7 for details)

You may need to change your planned route as a result of your findings.

3.2 Survey workflow

Figure 1 illustrates how the different levels of survey may be located within a monad. Four 2 metres by 2 metres vegetation plots will be located at random in the monad, each nested within a 1ha square plot. Within each 1ha square there will also be Living England segments and a soil plot.

Your survey should include:

- a suitable linear feature closest to each of the four randomly selected 2 metres by 2 metres vegetation plots.
- two ponds, closest to plots 1 and 2
- up to two additional 2 metres by 2 metres plots and associated squares targeted at priority habitat

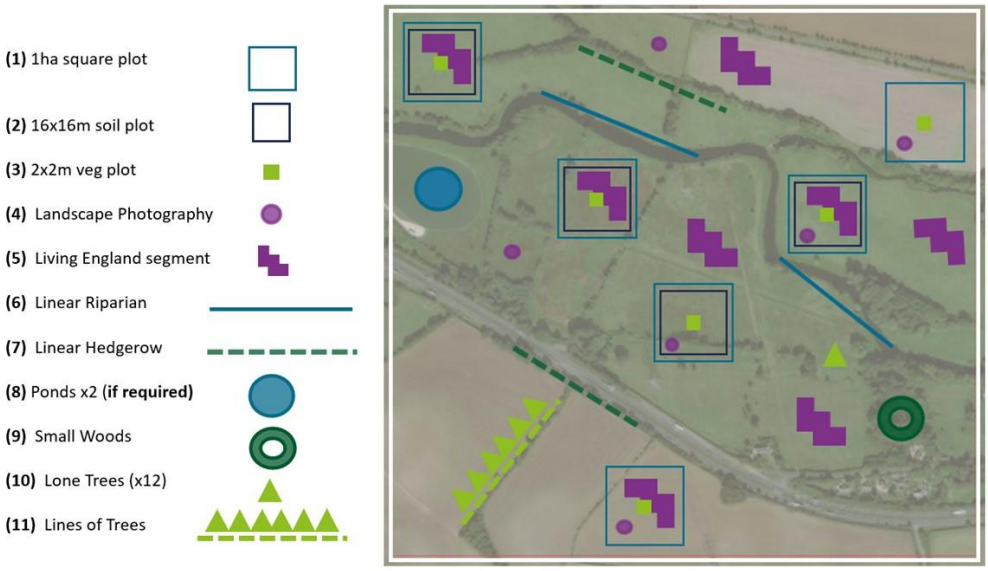


Figure 1 Diagrammatic example of features subsampled within a monad showing: 1ha square plot (1), 16 metres by 16 metres soil plot (2), 2 metres by 2 metres vegetation plot (3), landscape photography (4), Living England segment (5), linear riparian feature (6), linear hedgerow feature (7), pond feature (8), small woods (9), lone tree (10) and line of trees (11). Please note that these features are not to scale.

The details of the soil plot sampling are not included in the workflow as it will be carried out by separate teams. It is also likely to occur in the spring and autumn rather than in summer. See the 'EES Soil Survey Manual' available in the surveyor library for more information.

Steps 1 to 26 (below) set out the sequence to follow during a survey. You can change the order to match local circumstances, accessibility and timing as required. In following the steps, refer to figures 1 and 2.

Steps 3, 4 and 5 will be carried out separately from the soil sampling.

If the vegetation is on peat soil, then additional data will be collected for the England Peat Map (EPM) project. This will be done after step 9. That is after the plot and square have been surveyed. The EPM protocol is summarised in Section 8 of the manual.

Avoid trampling the soil or vegetation plots before starting the survey. Mark the plots out to help you avoid them.

1. Locate 2 metres by 2 metres vegetation plot 1 **(V1).**
2. Mark, photograph, and survey vegetation plot 1 **(V1).**
3. Locate 16 metres by 16 metres soil plot 1 **(S1).**
4. Assess suitability of soil plot using set criteria, unless the plot has already been assessed by the soil surveyors
5. If the soil plot is unsuitable, select an alternative plot, or navigate to the alternative selected by the soil surveyors. Mark, photograph and survey an additional 2 metres by 2 metres vegetation plot at its centre.

6. Survey square 1 **(SQ1),** - map vegetation stands and linear features. Record attributes and variables.
7. Record data points for Living England **(LE)** for the segments that are contained within square 1 **(SQ1).**
8. Identify location for landscape assessment **(LD1).**
9. Complete fixed-point photography and landscape assessment **(LD1).**
10. Determine location of nearest linear feature **(H1 or R1)** to the vegetation plot to be surveyed at high resolution.
11. Mark, photograph, and survey selected linear features **(H1 or R1)**
12. Photograph and survey any lone trees associated with **H1** or **R1**, either as a tree in feature (low resolution data) or as a subsample of the lone trees on the monad (high resolution data)
13. Determine location of pond 1 **(P1)** - closest to vegetation plot 1 **[V1].**
14. Photograph and survey pond 1 **(P1)**
15. Photograph and survey any lone trees within **P1** either as a tree in feature or as a subsample of lone trees

16. Repeat steps 1 to 12 for squares 2 to 4 **(SQ2, SQ3, SQ4).** Repeat steps 13 to 15 for square 2 **(SQ2).**
17. Locate targeted vegetation plot **(V5)** if required, see section 3.4.
18. Repeat steps 2 to 7 for **V5.**
19. Repeat 8 and 9 if doing a landscape assessment **(LD5)** for your targeted vegetation plot **(V5).**
20. Locate targeted vegetation plot **(V6)** if required, see section 3.4. Repeat steps 2 to 7. If doing a landscape assessment **(LD6**) repeat steps 8 and 9.
21. Survey lone trees at high resolution (up to 12) (**T**) across the monad - both within the squares and when moving between them.
22. Record additional Living England points when moving between the squares.
23. Take additional fixed-point photography and landscape assessments **(LD5 and LD6)**
24. Determine location of remaining linear features across monad **(HLR and/or RLR)**
25. Survey remaining linear features across monad at low resolution **(HLR and/or RLR)**
26. Survey small woods **(SW)** and groups of trees **(GTC and GTL)** across monad at low resolution.

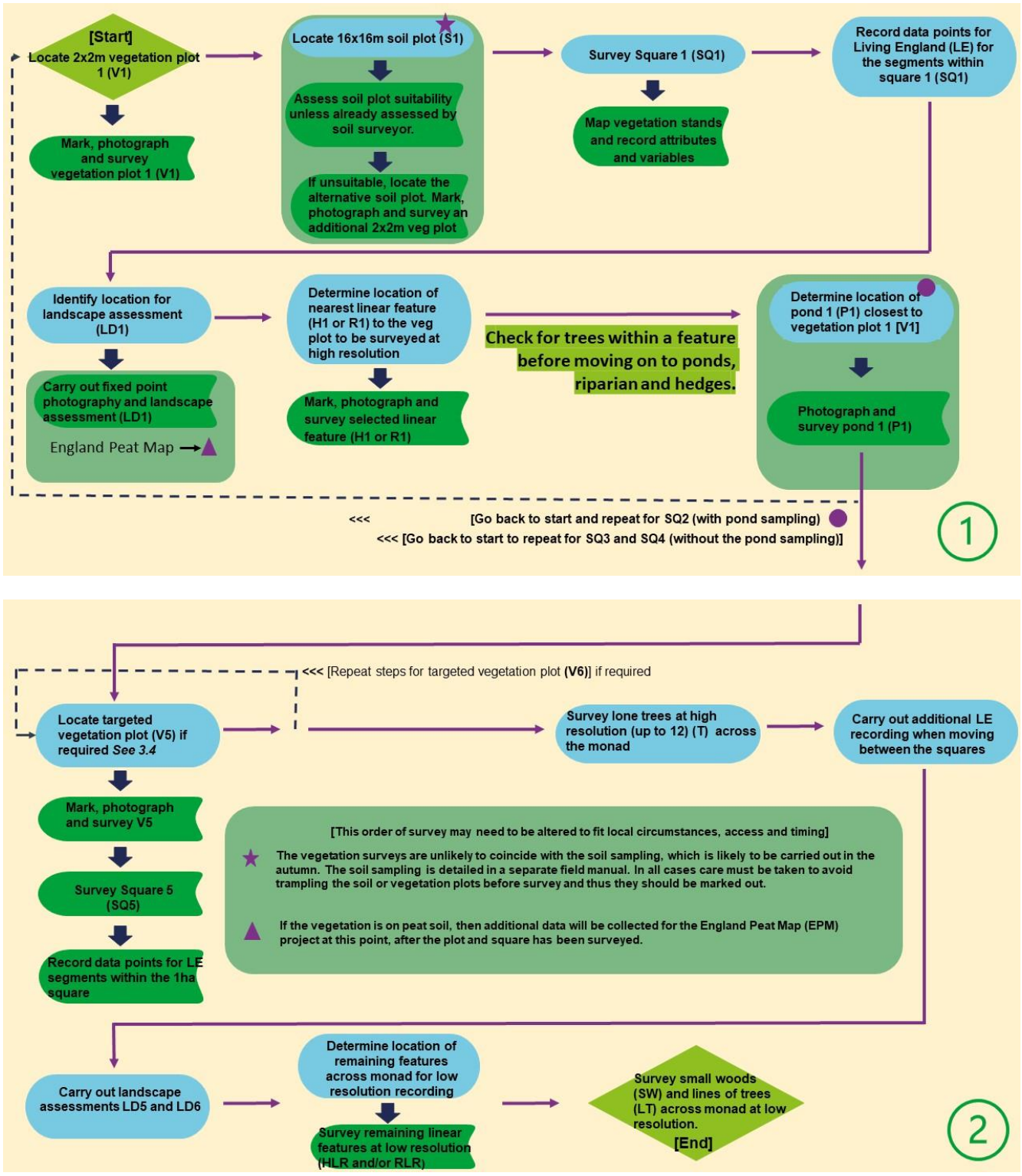


Figure 2 Survey Workflow

3.3 Moving or abandoning a subsample

3.3.1 Two metres by two metres vegetation plots

You may not be able to survey at one of the subsample locations because:

- access has been refused
- the habitat is not suitable
- the habitat is outside the scope of the EES survey

A vegetation survey is not suitable if the 2 metres by 2 metres vegetation plot is in:

- woodland or dense scrub
- a river, lake, or coastal lagoon
- marine habitat
- a built-up area or curtilage

Curtilage is defined as an area of land attached to a building, forming one enclosure with it, and with a use linked to the building such as a garden.

The plot is also unsuitable if it falls on for example

- a supplementary feeding area
- a storage area including for manure, soil or hay
- a sealed surface
- a constructed or unvegetated track or path
- a linear feature such as a hedgerow, ditch or watercourse

Should it fall on a vegetated track/path and the vegetation is representative of the surrounding habitat, it can be used for a vegetation plot.

Sealed surfaces, tracks or paths (if publicly accessible) can be used and are desirable for taking fixed-point photography and recording the landscape.

In many cases the unsuitability of a vegetation plot will have been identified during pre-survey preparation and alternative locations will have been chosen. Sometimes this will only become apparent once on site. If the location of the vegetation plot is not suitable then one of the following alternatives should be selected.

The order of choice is as follows.

1. A point 16 metres to the west of the original location (from the centre of the vegetation plot).
2. A point 16 metres to the north of the original location.
3. A point 16 metres to the east of the original location.
4. A point 16 metres to the south of the original location.

If none of these alternatives are suitable then the point should be abandoned.

If the reason for the plot being moved is not evident, please make a note in the comments box found in the ‘My Surveys’ window in Sweet. Conditions may change between visits, for example the plot may have been flooded at the time of survey but dry at the time of the QA.

You can only move the vegetation plot within the 1ha square. The square itself is to remain fixed and the stands mapped and surveyed even if the vegetation plot has been abandoned.

3.3.2 Soil plots

The co-location of soil sampling points and vegetation plot provides valuable information about the relationship between the plants and the soil.

A Natural England pre-survey desk study to identify suitable 16mx16m soil plot locations will not include an assessment of suitability for the vegetation surveys. If the vegetation and landscape survey precedes the soil survey, you will need to assess this in the field.

Once you have surveyed your 2x2m vegetation plot you will need to identify and assess the suitability of the associated soil plot. If unsuitable, you will need to choose an alternative plot using the soil plot grid and survey an additional 2x2m plot at its centre.

If you had to abandon your 2x2m plot, the soil plot at this location will also have to be abandoned and an alternative found

If the soil surveys have already been completed, you will need to check which plot the soil surveyors used. If they used an alternative plot you will need to navigate to this and survey the 2x2m plot at its centre

Use the soil plot suitability criteria and the protocol for selecting an alternative soil plot in Appendix 5

3.4 Targeted subsamples and data collection

In addition to the 4 randomly selected subsamples, targeted subsamples will be used to record vegetation or landscape data from areas of interest. The vegetation subsamples will be generated from the 'Priority Habitats Inventory' during the sample selection process.

Within most monads there will be up to two additional 2 metres by 2 metres vegetation plots and associated square plots targeted at priority habitat.

You do not need to record these plots if the targeted habitats (as depicted on the PHI layer) are already being recorded within the randomly selected 2 metres by 2 metres vegetation plots. They can be abandoned

Should the targeted habitats not be present in the randomly selected vegetation plots you will need to record the targeted plot and square regardless of the habitat present.

Follow the procedure set out in section 3.3 if you need to move the targeted plot. For example, it falls on a hard surface. Do not move the plot just to capture a more representative area of the targeted habitat.

Record Living England data points while collecting data for the targeted subsamples.

If other areas of priority habitat are identified during the survey which are not already recorded in the PHI, record these as Living England data points where possible.

In monads with low amounts of suitable habitat, one or more of the subsamples may have to be abandoned. In these monads, the additional targeted subsamples can be used as substitutes for the rejected subsamples, even if the targeted habitat has already been sampled.

The two additional landscape assessment points (LD5 and LD6) can be:

- associated with the two additional targeted squares
- located at points of interest
- located on public rights of way or other public vantage points

4. Pre-survey preparation

4.1 Surveyor Library

The surveyor library lies within the EES SharePoint site. It contains all the documents and forms that are referenced in this field manual and that are required for completing a survey. There are also handy guides including guidance on using tablets, and supplementary advice about veteran trees, ponds, and other survey features.

See:

External surveyor library

Surveyor Library 2.0 for NE surveyors

4.2 Obtaining permission and agreeing dates for survey

All landowners, land managers or tenants within each monad will have received a letter from Natural England requesting permission for their land to be surveyed as part of the EES. The following land information will be provided to surveyors in a 'Surveyor Report':

- The different land parcels in monads.
- Owner details.
- Where we have permission to access.
- Any conditions or restrictions on access.

If there are multiple landowners across a monad, contact details for each landowner will be provided. The surveyor report will be found on the SharePoint site. This should be used in conjunction with the 'Surveyor Planning Map' in ArcGIS online. Log into your AGOL account and use the search bar in the top left to search for your monad. You will find a map of the land parcels and can click on these to see the permission status and owner identity. The land parcel and contact ID should match those in the surveyor report. You should cross-reference both sources and must comply with all conditions,

You must not enter or collect data on land for which you do not have access permission.

The lead surveyor must make further contact with landowners or occupiers to agree a date and time for the survey. This should be at least a week prior to the start of the survey but ideally as early as possible. There may be many different people to contact, and it may take numerous attempts to reach them.

If you have arranged a date far in advance of the survey it is a good idea to call or email (or both) in the week running up to the first planned visit as an important reminder to the landowner to expect you on site.

As the lead surveyor, confirm you already have permission to do the survey and are phoning to arrange a specific date and time. Refer to the initial access letter and FAQ documents to help answer any questions the landowners or occupiers may have. You can find these documents in the surveyor library. Explain that this work is being done by or on behalf of Natural England (as appropriate). Also explain it is part of the England Ecosystem Survey.

If you cannot answer any queries immediately, explain that you will come back to them.

When speaking to the landowner, land manager, or tenant, establish:

- if you can use permanent markers to mark the corner of the plots to aid relocation
- any areas that should be avoided, for example dangerous ground or dangerous features or unpredictable livestock (see Section 5.1)
- how to access the survey plots and suitable parking places
- if it will be necessary to access someone else's land
- if access is through any locked gates, if yes, find out how they can be opened
- any other important information about their land that you will need to know beforehand

Landowners, land managers or tenants do not need to be present for the survey, but they might wish to meet you beforehand.

Refer to current guidance on working during any Covid-19 coronavirus outbreaks.

4.3 Training and technical manuals

As part of pre-survey preparation, you must have attended the necessary training courses. Training covers all aspects of the EES and includes guides, videos, and technical manuals. These are available for reference in the surveyor library.

You will collect data using data collection applications. These are ArcGIS Sweet (EES vegetation and landscape); ArcGIS Field Maps (Living England and EPM); and ArcGIS Survey 123 (EES soils). User training on these is part of the provided pre-survey training, and 'Surveyor User Guides' can be found in the surveyor library.

You must familiarise yourself with this field manual and the Sweet user guidance.

4.4 Pre-survey monad familiarisation and checks

Monad subsampling is described in Sections 2 and 3. In addition to the subsampling, data will be collected for features across the monad. A full set of data will normally be collected from:

- four nested, randomly selected 2 metres by 2 metres vegetation plots and four 1ha square samples (one plot within each square).
- up to two additional plots and squares targeted at priority habitats not recorded in the random subsampling.

- four high resolution linear plots, located closest to each of the 2 metres by 2 metres vegetation plots.
- remaining linear features across monad, recorded at low resolution.
- two high resolution ponds closest to subsamples 1 and 2.
- remaining ponds across the monad, recorded at low resolution.
- up to twelve lone trees at high resolution.
- all lone trees that occur in the hedgerow, riparian or pond plots as a low resolution tree in feature, if not selected as one of the twelve trees recorded at high resolution
- small woods and lines of trees across the monad, recorded at low resolution.
- six landscape assessments
- two to six soil plots

Natural England will provide you with the centroids of the 4 vegetation plots and the surrounding squares within Sweet.

During pre-survey preparation you should familiarise yourself with the monad and identify the likely location for:

- linear plots - a suitable mix of riparian and hedgerow plots (see section 6.3)
- ponds including dry ponds
- lone trees including veteran trees
- small woods and groups of trees (including clusters of trees and linear tree features)
- watercourses
- targeted landscape assessments

These can be identified using

- the OS map,
- aerial photographs
- the 'Priority Habitat Inventory'

on ArcGIS online (AGOL) and the Multi-Agency Geographical Information for the Countryside (MAGIC) map at MAGIC (defra.gov.uk) or, for Natural England Surveyors, WebMap2.

As part of the survey preparation also check:

- the surveyor report and the surveyor information pack
- the number of ponds present within 1km of each pond to be surveyed at high resolution (a radius measurement not a 1km square). This may have to be completed post survey for a pond only identified once on site
    - use online OS mapping resources at a scale of 1:25,000 or greater.
    - do not include the surveyed pond.
    - only include ponds on the near side of any major barriers to wildlife dispersal, such as main roads or large expanses of bare habitat.
    - include ponds within 1km even if they fall outside the monad, but do not visit these in the field.

    - include ponds present on the OS map even if they are known to be dry at the time of the desk study.
- if you have access to a geology map, check the likely base to your pond
- whether streams in the monad are headwaters, that is within 2.5km of their furthest source. The source can be taken as the start point of the blue line delineating the watercourse on the OS 1:50,000 map
- coastal modifications, sea defences, flood management infrastructure and drainage systems outside of, but potentially affecting, the squares.
- designated sites, and landscape and historic environment features including 'Scheduled Monuments' using MAGIC map or WebMap2. This is described more fully in the following sections
- whether the soil plot has been moved and you need to survey an additional 2x2m plot at the centre of the relocated soil plot

National datasets are currently being developed (2022) that might help with assessing the impact of flood defences. There is guidance on assessing the impacts of drainage, including from aerial photography, in the surveyor library.

Supporting information

In AGOL, you will find:

- information on the location of the monad
- land ownership parcels
- OS map layer
- aerial photography
- Priority Habitat Inventory layer

In WebMap2 and MAGIC, you will find:

- designated sites boundaries – biodiversity, historical and landscape sites

4.5 Surveying on Protected Sites

The general avoidance measures (below) apply to the recording of:

- vegetation in square and linear plots
- stand mapping and recording
- the capturing of data for Living England
- surveys of ponds, trees and linear features
- landscape recording and photography

The taking of soil samples is not covered here but considered separately in the 'EES Soil Survey Field Manual'.

If you follow the methodology and general avoidance measures listed below, the proposed operations are deemed unlikely to damage any of the flora, fauna, geological features or physiographical features that make the SSSI of special interest. This means no individual or collective assent is required from Natural England. Supporting documentation of this decision can be found in the surveyor library.

General avoidance measures

Avoid damage to any SSSI sampled during the survey. Measures put in place to include:

- Vehicular access and parking ideally off site or restricted to surfaced tracks and hard standing areas within the SSSI. All other access to be on foot.
- All materials and equipment used on site to be removed daily including any food remains.
- Largely non-invasive survey methods to be used as detailed in the manual, the exception being the temporary use of four pegs to mark out each plot, and canes to mark the corner of the plot and squares, plus the taking of water and eDNA samples from any ponds. Disturbance when carrying out these tasks to be kept to a minimum.
- Except for eDNA samples taken from the pond, no plant or animal material, alive or dead to be removed from the site.
- Pond surveys will be carried out from the banks, there is to be no entry into the water.
- Damage to the vegetation to be restricted to minor trampling around the vegetation plots and within the wider Square, whilst mapping and recording its features. This is to be kept to a minimum. There is to be no cutting or removal of vegetation including to facilitate access.
- All plants should be identified in situ if possible. Should a closer look at identifying features be necessary, the smallest possible portion of the plant is to be taken. On no account is the whole plant to be removed or uprooted. Plants pulled from water in the pond for identification purposes are to be replaced.
- Great care is to be taken to avoid disturbance to wildlife, including ground nesting birds, by being vigilant, avoiding areas around any breeding sites and moving away quickly if causing disturbance.
- Care to be taken that no organisms are released on site including plant seed and micro-organisms carried from other sites on boots, clothing, bags and equipment.
- Biosecurity measures to be in place in accordance with NE biosecurity guidance and the guidance within the ‘Biosecurity’ section of the surveyor library.
- Training to include awareness of these measures and the latest guidance on biosecurity measures.

Similarly, no strategic or site-based appropriate assessment by Natural England (as the competent authority) is required as the operations are considered unlikely to have a significant effect, either alone or in-combination on any:

- Special Protection Area (SPA)
- Special Area of Conservation (SAC)
- Ramsar site

The rapid HRA screening tool that is designed to record the screening of lower risk projects will be used to record the judgement that no likely significant impacts are foreseen from the

EES on SAC's, SPA's or Ramsar sites. This preliminary screening will be carried out by Natural England in advance of the survey

Following liaison between the survey co-ordinators, the 'Protected Sites and Nature Recovery' team and local area teams, any issues or constraints will be flagged up in the surveyor information pack.

Before surveying on a protected site, you should also familiarise yourself with its character and designated features by using Site Search (naturalengland.org.uk) or the interactive MAGIC map.

4.6 Landscape assessments

Before undertaking a landscape assessment, you should identify and familiarise yourself with:

- key landscape characteristics and features for the survey area and wider context. These are described in the relevant National Character Area Profile (NCA). Refer to the OS Map and aerial data gathered. You will find the named NCA in the surveyor information pack.
- key landscape attributes for the survey area and the local context as described in relevant Landscape Character Assessments. Use The landscape character assessment database for the UK and Ireland is now available | Landscape Institute . Identify features by studying the OS Map for the monad, supported by the aerial photograph.
- landscape and other features on the OS Map that cannot be identified on the aerial map, such as PRoW and marked heritage assets. Note new activities on the aerial map that do not yet appear on the OS map, such as new development.
- the historic environment data layer and mapping, and relevant archaeological, heritage features, monuments and listed buildings that are in the monad. Using MAGIC or, for Natural England surveyors, WebMap2, you should identify

    - scheduled monuments
    - listed buildings
    - registered parks and gardens
    - registered battlefields

    and utilise existing data including National Historic Landscape Characterisation and landscape character typology to ascertain the historical context of the monad.

- non-designated heritage assets. Guidance called 'Knowing the past to understand the present and plan for the future' is available in the surveyor library.

Familiarise yourself with, and test, fixed point photography equipment and procedure for taking panoramic sequences.

Identify potential survey and photo points in the monad using aerial photographs and OS mapping.

4.7 Living England

Prior to the survey, you must have:

- read the latest version of the 'Living England Specification for Ground Data Collection' (see the 'Living England' section of the surveyor library)
- read the latest version of the 'Living England Quick Start Guide to Ground Data' Collection (see the 'Living England' section of the surveyor library)
- attended online or in-person training on how to undertake Living England data collection
- ArcGIS Field Maps installed on a device that has GPS capability and a working camera.
- a DEFRA ESRI ArcGIS Online user account (email Data.Services@naturalengland.org.uk).
- membership of the 'Living England, NEFU and SSSI Monitoring' Group, contact earth.observation@naturalengland.org.uk to request membership.
- downloaded the relevant 'offline area' map as there may not be a good mobile data signal for the monad site

You must also be familiar with the Living England classification and under-recorded habitats in the monad, using the 'ArcGIS Online Ground Data Dashboard' and 'LE Permissions Map'. This will help plan your route to, from and between your monad plots.

Further details and links can be found in Section 7.3 and Appendix 1.

4.8 Pre-survey checklist

For Health and Safety presurvey checks', refer to Section 5.1.

You must have:

- attended pre-survey training courses and familiarised yourself with online training materials, field manuals and user guides
- all the equipment required, as set out in the various equipment lists
- all the required apps on the device and updated to the latest version
- prepared all required electronic maps and paper maps
- contacted each of the landowners, land managers or tenants who have granted permission and whose land will need to be accessed
- noted any access conditions or restrictions
- completed a desktop study of your monad to inform the field survey

You must also check:

- electronic devices and battery-packs are fully charged the day before the survey
- applications and software on the device work
- the screening for any likely significant effects has been done using the HRA rapid screening tool before working within SPA/SAC/Ramsar sites (including candidate, proposed and potential sites).

You must not enter land parcels if we have not received permission to access.

4.9 Equipment

There is an extensive equipment list for the survey which has been broken down into topic areas to make it more user friendly. You must take all the equipment listed to undertake the survey.

General

- Fully charged tablet (iOS or Android)
- Fully charged mobile phone
- Hand-held GPS preloaded with the plot locations
- Battery pack and charging cable
- Camera - if using iOS camera ensure it is set to 'Most Compatible' (JPG)
- Compass and clinometer
- 30m or 50m measuring tape
- Land details document (digital or hard copy)
- OS maps for navigation to monad (digital or hard copy)
- Paper and digital maps showing detailed location of plots on aerial photos, OS detail and soil type boundaries.
- Printed and digital maps of known buried services
- Printed or digital copies of plot photos
- Weather writer/folder for maps, photos, and forms
- Field recording sheets
- Field ID guides/aids
- Hand lens
- Enough food and fluids for the day
- Suitable clothing footwear and other protective materials such as additional layers and tick proofing (such as gaiters), sunhat, sun cream, waterproofs, wellies, insect repellent

Health and safety

- First-aid kit including tick remover
- Risk assessment (digital copy)
- Blank accident forms (digital copy)
- Information sheet on ticks and Lyme Disease (digital copy)
- Hand wipes, hand sanitiser and plastic bags to dispose of used wipes
- Biosecurity and boot washing kit (to be left at vehicle).
- Spotgen 3 device (for sites with lack of mobile reception)

Vegetation plots and square surveying

- 2 metres by 2 metres square quadrat, or tape, or cord and pegs to mark out quadrat
- 1m ruler
- Five 1m canes,1 for marking the corner of the 2x2m plot and four1m canes for marking out the soil plot and then the square
- Hammer and permanent markers (metal plates) if used

Landscape survey equipment – further information on iPad mounts and tripod models in surveyor library

- iPad 9th Generation
- Tape measure (or piece of cord/string cut to 140 cm)
- Tripod in carry case. Lightweight, quick-lock, fully adjustable legs which fold down and fit easily into a carrying case. Spirit level bubble on tripod. Extendable to height of 160cm max. Example tripod model is Hahnel 40 lite
- iPad mount for tripod. A dovetail sliding plate with ¼ inch screw and 2-stage lock-in system on a ball head (that can lock into a portrait format). A press of the button releases the sliding plate, both safely and quickly. Suggested models; Ulanzi U-Pad Pro Metal Tripod Mount, Cenawin Tablet mount for iPad
- 360 degree rotating head with degree markings (ideally at 5-degree intervals and numbered 0, 45, 90)
- Recommend a free Bubble Level App is downloaded onto surveyor's iPads, such as Pocket Bubble Level
- Binoculars (if you have them)

Pond survey equipment

- Small net
- pH strip
- Nitrate strip, phosphorous strip, alkalinity strip
- Small sampling tray
- Aquatic vegetation guide
- 1m ruler and 50m measuring tape
- eDNA sampling kit

Hedgerow and riparian survey equipment

- Two 2m canes

England Peat Map (if included in survey)

- Set of peat probes - further details in NCEA EPM field protocol: 2021 pilot, Version 1, Natural England, 2021
- 4x1m minimum ranging poles or canes
- 3 measuring tapes, extending to at least 20m
- 2x5m retractable tape measures
- Trowel
- Soil auger for some sites (a 1.2m Dutch auger is recommended)
- Kitchen knife

5. Health and Safety

Surveying can involve navigating over open countryside carrying heavy equipment (up to circa 20Kg). It may also take place during periods of poor weather conditions and poor visibility. You must be mindful of any medical or other conditions that may impact on you or others during the surveys.

External surveyors must have robust health and safety procedures in place, including:

- lone-working procedures
- risk assessments
- up-to-date biosecurity measures

Internal surveyors must be familiar with and follow NE policies relating to health and safety, including lone and remote working. This is detailed in the health and safety section of the surveyor library and on the intranet. Internal surveyors must complete:

- personal assessments
- site risk assessments (lead surveyor)
- dynamic risk assessment, once on site.
- the required mandatory training

All surveyors are expected to be familiar with their site risk assessments. You must carry a copy with you when surveying. Be prepared to produce it if asked.

5.1 Pre-survey checks

You should:

- find out and make note of the nearest A&E dept (name, distance from).
- make a note of the grid reference/s (or What 3 Words, etc) of sampling locations.
- ensure lone working/buddy system is in place including note of location and return time.
- familiarise with the risk assessment (RA) and any precautions to take – take a copy of the RA for reference.
- check the weather forecast and postpone survey if facing hazardous weather conditions.
- wear clothing appropriate for location and weather. Detail this in your site risk assessment.
- make colleagues and buddy aware of any medical conditions or allergies – bring any necessary medication (for example insulin and epi-pens).
- have completed a personal risk assessment if you have any relevant medical conditions including pregnancy.
- check the contents of 1st aid kit and refresh if necessary.

Additionally, you will need to:

- check to see if survey involves accessing a military firing range.

- have checked with landowner, land manager or tenants if they are aware of any hazards see section 4.2.
- confirm if the site has known historical or current military use or if it was a military target. If so, additional control measures will be needed prior to any soil sampling work (see soils protocol in the EES soil survey field manual).
- plan route to site – note any potential hazards such as livestock, farm buildings, watercourses, mineshafts, spoil heaps, boggy areas, cliffs.
- be aware of restrictions because of plant or animal health – contact APHA
- plan disinfection when moving between sites belonging to different landowners.
- print-off and bring a paper OS map in case of electronic device failure.
- make sure mobile phone is fully charged.
- check local mobile coverage – plan to avoid areas with no coverage or spend minimal time there (detail this in site specific risk assessment). https://www.vodafone.co.uk/network/status-checker
- check for any issues flagged up in the surveyor report and surveyor information pack.
- perform vehicle checks (including fuel levels) before setting-off.
- complete any mandatory training and refresher courses
- ensure you have and can transport all equipment that is stipulated in the site-specific risk assessment.

5.2 Biosecurity

Enhancing biosecurity is one of the goals of the 25 Year Environment Plan. It sets targets for managing and reducing the impact of existing plant and animal diseases, lowering the risk of new ones, and tackling non-native species. You will be actively supporting the delivery of these targets by:

- being vigilant for non-native species, pests, and diseases
- practicing good biosecurity in the field

You should be familiar with Natural England's good practice guidance on biosecurity. You must adhere to strict biosecurity measures when carrying out surveys, particularly when surveying ponds, vegetation and soils. These measures must be detailed in site-specific risk assessments prior to site visits.

Further information on biosecurity can be found in the surveyor library.

5.3 Dynamic risk assessment

If you come across a hazard that is not covered by the risk assessment, you must make a 'dynamic risk-assessment' and decide whether to proceed. Dynamic risk assessment should be practiced throughout every survey undertaken, ensuring iterative assessment of tasks before acting in the field.

Everyone who works on this survey has both the authority and responsibility to stop any task that could put someone in serious and immediate danger.

5.4 Accidents and near hits

NE surveyors: if you experience an accident or near hit, you must complete an accident form upon return to the office. An ‘OHS1a’ health and safety incident report form can be found in the ‘Health and Safety’ section of the intranet. Once completed, you can either email it to mailto:healthandsafety@naturalengland.org.uk or call 0300 060 0100.

External surveyors can find a similar form in the external surveyor library. Once completed, you should email it to EnglandEcosystemSurvey@naturalengland.org.uk. Ensure that accident or near hit appears in the subject line.

5.5 Surveys during the Covid-19 Coronavirus outbreak

You must be fully coherent in Covid-19 protocols and adherence is mandatory as stated by government guidelines.

6. Vegetation plots

This section covers the recording of:

- 2 metres by 2 metres vegetation plots nested in the 1ha squares (up to 6 per monad)
- 30 metre hedgerow linear plots with a 2 by 4 metre vegetation plot at their centre (up to 4 per monad)
- 10 by1metre linear riparian plots (up to 4 per monad)

Within Sweet there is the opportunity to record notes at the monad level, using the comments box found in the 'My Surveys' window. Be concise as there is a 500 character limit.

You should use this to add

- if you were unable to survey a plot or other feature for any reason.
- if you have had to move a plot for reasons that might not be apparent to the Quality Assurance (QA) team.
- incidental records for INNS species not on the lists associated with plot recording

And for future reference,

- If there are several ponds in the monad that you cannot record because they fall under the 25 m^2 size limit
- the only pond or other single feature in the monad is bisected by the monad boundary meaning it cannot be recorded

Please record the start and end times for each survey feature

6.1 Recording plot locations

Make sure your GPS unit is properly calibrated and is at the maximum accuracy level. Use Sweet to map your vegetation plots or to move your 2 metres by 2 metres vegetation plot if unsuitable.

Place a visible marker in south-west corner of the plot and mark out the plot with for example pegs and measuring tape or cord. Avoid standing in the plot while marking it out, as this will affect any sward height measurements.

Following the instructions in Appendix 7, you should:

- take photographs of the plot. If using an iOS camera, ensure it is set to 'most compatible' (JPEG) not 'high efficiency' (HIEC).
- make a sketch map describing its location
- note the position of any permanent markers used

Should the geode not be working, you will need to manually select the internal GPS option from the menu as a GPS source. Once selected it is advisable to open the 'Status' tab and

let the GPS log run for 10 seconds before clicking geolocate. Refer to the Sweet User Guidance for more information

6.2 Two by two vegetation plots

Four random subsamples and up to two targeted plots within the monad will be visible in Sweet. If the original location is unsuitable and must be moved, record the new location. See Section 3.3 ‘Moving or Abandoning a Subsample’.

Photography

- Take a close-up photograph from the edge of the plot looking down on the vegetation and record from which side of the plot it has been taken.
- Take photographs to aid relocation, including a sketch map and up to four supporting directional photographs, at least one of the photographs showing the whole plot with the tape in place.

Then record the variables identified in Table 4

If a sample point lands on an arable crop, you should use tramlines where possible to access it. This is to minimise disturbance to the crop or where the crop may be on a future visit.

You should minimise trampling in a hay or silage field by using field edges and taking the shortest route through the crop where possible.

Table 4: Variables to be recorded for 2 x 2 metres vegetation plots

Variable	**Method and comments**
Presence of vascular plants, bryophytes and lichens	Record all vascular plants rooted in the plot except for those growing on rock or wood. Record to species level where possible. Some difficult groups such as *Euphrasia*, *Callitriche*, *Hieracium*, *Rubus* and *Taraxacum* will be recorded to genus. Record the presence of key bryophytes and lichens from the list in Appendix 3. Include those on soil in the plot and growing on vascular plants such as heather rooted in the plot but not those growing on rock, trees or deadwood. Your focus should be on recording vascular plants accurately rather than spending time on identifying bryophytes. You should attach a higher priority to recording total bryophyte cover and the cover of coarse *Sphagnum* categories Record invasive non-native plant species separately

<table>
<tr><td colspan="2">Table 4: Variables to be recorded for 2 x 2 metres vegetation plots</td></tr>
<tr><td>Variable</td><td>Method and comments</td></tr>
<tr><td></td><td>against the list provided in Sweet and available in the surveyor library.</td></tr>
<tr><td>Cover of vascular plants and listed bryophytes and lichens</td><td>Looking down vertically at the vegetation assess by eye the total percentage cover of each species. This is foliar cover for each species, the % of the plot that is covered by live, above-ground growth for that species.

The combined covers from all species can exceed 100% because plants may be overtopping each other.

Record as follows

<table><tr><td>% Cover</td><td>Scale</td></tr><tr><td>10-100%</td><td>Record in increments of 5%</td></tr><tr><td>1-10%</td><td>Record in increments of 1%</td></tr><tr><td><1%</td><td>Record as 1%</td></tr></table></td></tr>
<tr><td>Total cover of bryophytes</td><td>Record total % cover of all bryophytes using the scale above</td></tr>
<tr><td>Total cover of lichens</td><td>Record total % cover of all lichens using the scale above</td></tr>
<tr><td>Cover of litter</td><td>Record total % cover of litter (the accumulation of dead plant remains on the soil surface) using the scale above.</td></tr>
<tr><td>Cover of bare ground</td><td>Record total % cover of bare ground using the scale above.</td></tr>
<tr><td>Cover of bare rock</td><td>Record total % cover of bare rock using the scale above.</td></tr>
<tr><td>Cover of dead wood</td><td>Record total % cover of deadwood using the scale above</td></tr>
<tr><td>Cover of open water</td><td>Record total % cover of open water using the scale above. This is only to be recorded for semi-permanent water such as bog pools and edges of water bodies.</td></tr>
<tr><td>Sward height</td><td>Record modal sward height using a ruler in each quarter of the plot. This is the height at which most of the vegetation sits.

Ignoring tall stalks, place a hand or card lightly on the vegetation at a level below which about 80% of it is estimated (by eye) to be growing. Read this value off a</td></tr>
</table>

Table 4: Variables to be recorded for 2 x 2 metres vegetation plots	
Variable	**Method and comments**
	ruler and record it. Four values will provide a measure of heterogeneity within the plot.
Sward structure	Record vegetation surfaces present, one or more from: • Open water • Useable bare ground, Early Successional Surfaces (ESS). • Unusable bare ground (Bare ground that is heavily compacted or churned up would be considered unusable even though it may be used for basking.) • Low bryophytes and lichen • Very short grass, herbs, heathers, and other dwarf shrubs (including gorse) and taller bryophytes and lichens - to ankle height • Medium grass and herbs, building heathers or other dwarf shrubs- ankle to knee height • Tall grass – between knee and head height • Low scrub, tussocks, mature heathers and/or other dwarf shrubs. • Young scrub – around head height to < 2.5m • Mature scrub, trees > 2.5m • Tree canopy
Altitude	If not automatically recorded in Sweet, measure at the centre of the plot using a GPS held at ground level.
Slope	Record with a clinometer as flat, slight slope (0-5 degrees), moderate (5 – 15 degrees) or steep (>15 degrees)
Aspect	Use a compass to measure, from the top of the slope facing the lowest point, or record as flat if there is no discernible slope Do not hold compass immediately above the metal pegs marking the plot, as this can affect the readings.
Shade	Unshaded, light shade, moderate shade, heavy or extensive shade.
Broad and priority habitats present	Record EES broad habitat. Record priority habitat or EES ‘other detailed habitat’ if present. See Appendix 2.

6.3 Selecting linear plots

The following protocol aims to ensure both hedgerow and riparian habitat are selected where possible. You should:

- survey the closest linear plots to vegetation plot 1 (V1) and V2 irrespective of type
- if the first two plots are hedges, choose the nearest riparian plots to V3 and V4 irrespective of whether hedges are closer
- if the first two plots are riparian, choose the nearest hedges to V3 and V4
- if after recording the three closest linear plots, you have recorded only one hedge or riparian plot, select a second at V4 regardless as to whether it is the closest linear.

Only if there is a lack of choice select three or four plots of the same type.

This should have been explored at the pre-survey stage (section 4.4), but suitability of plots will need to be confirmed in the field.

6.4 Hedgerow linear plots

This section sets out the survey method if the linear feature is a hedgerow.

6.4.1 Defining a hedgerow and associated features

A hedgerow is defined as any boundary line of shrubs and sometimes trees that is over 20m long and less than 5m wide at the base, provided that at one time, the trees or shrubs were more or less continuous. Outgrown hedgerows wider than 5m at the base are classified as scrub or a line of trees. For the EES survey, the minimum length of hedgerow to be surveyed is 30m.

This definition of hedgerows includes ‘classic’ shrubby hedgerows, but also gappy hedgerows - where each shrubby section may be less than 20m long, but each gap is also less than 20m. Gaps greater than 20m in the woody shrub layer mean the lengths are classed as separate hedges.

An earth bank, ditch or wall within 2m of the centre of a hedgerow is considered part of the hedgerow habitat.

The above definition of a hedgerow does not include lines of trees lacking a shrub layer or with a shrub layer of less than 20m continuous canopy cover. Whilst there is a natural continuum between a neglected hedgerow and a line of trees, a line of trees is generally judged to have a natural shape resulting from a lack of management with the base of the canopy greater than 2m from the ground. To qualify as a line of trees, and not lone trees, the gaps between the tree canopies must also be less than 20 metres

A hedgerow will be formed into unnatural shapes by trimming coppicing and laying. Typically, the maximum stem width for laying is 15cm diameter at breast height (DBH), where breast height is at 1.3m. Once the stems are becoming too large to lay the hedgerow can be described as overmature and on its way to becoming a line of trees

A hedge starts and ends where:

- there is a gap in the hedge of 20m or more
- the hedge structure changes dramatically for 20m or more
- the hedge meets another feature such as a wall or woodland
- the hedge turns a corner of 90 degrees or more

6.4.2 Surveying the linear hedgerow plot

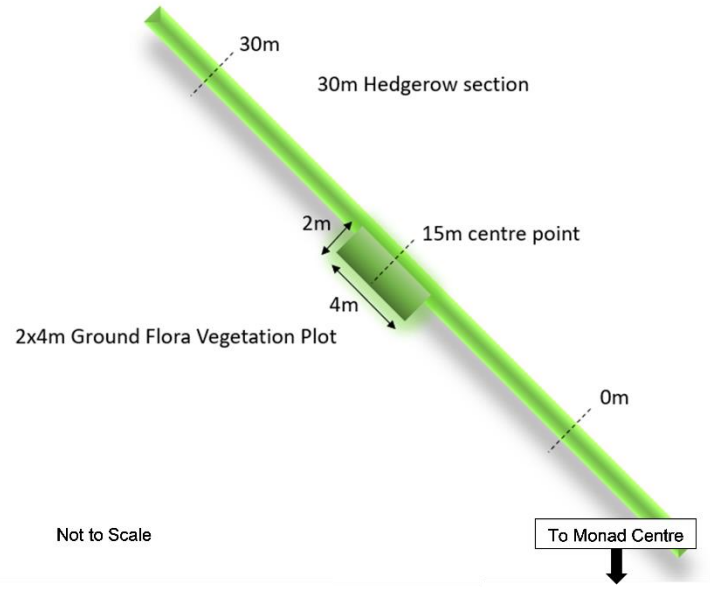


Figure 3. Linear hedgerow plot with vegetation plot at centre

Complete the assessment on a 30m section of continuous woody species cover where possible. Where a gappy hedge is being sampled and gaps cannot be avoided, move the plot to a stretch with as few gaps as possible.

To record the hedgerow feature, follow 6.1 and Appendix 7 on recording plot locations.

Photographs

You should take:

- photographs to aid plot re-location (Appendix 7). Include one that shows the whole plot from the start point, with the tape in place
- a close-up photograph of the hedgerow together with any sections that could be used to estimate fruit and flower density.
- a close-up photograph from the edge of the vegetation plot looking down on the vegetation.

There is currently no option in Sweet for attaching photographs of the vegetation plot. You will need to use one of your four directional photographs and make this clear on the sketch map. It is important to be able to recognise and relocate the vegetation plot accurately, more

so than the 30m length. This is especially important if the vegetation plot has been moved from the centre of the 30m length.

Locate the start point for the 30m linear hedgerow plot to be surveyed. Mark the start and end points of the 30m linear plot, using a tape to measure the distance. The whole plot must fall within the monad.

The hedgerow survey plot will run along the hedgerow from the start point in a direction that continues away from the monad centre for 30m. Only the side of the hedgerow that faces the vegetation plot will be surveyed. Refer to figure 1 for further clarification.

Record the hedgerow ground flora and vegetation within a linear 2x4m plot. The 4m axis runs down the line of the hedgerow and the 2m axis extends out from the hedgerow base as close to the woody stems as possible.

The centre of the 2x4m plot will be positioned at the centre (15m point) of the 30m hedgerow survey length, facing the associated monad vegetation plot. Should the centre of the plot fall in a gateway or other gap move to one side, to the nearest location where a hedge plot can be recorded. Choose the next nearest hedgerow (or riparian feature if closer) as a replacement plot if:

- the hedgerow is not accessible,
- ground truthing confirms it does not meet the criteria of a hedgerow (see 6.4.1 defining a hedgerow)

Record the connectivity of the plot to woody habitats within the wider monad.

If the selected hedgerow includes distinct tree(s) over 3m tall, they are classed as 'Trees outside of Woodland (ToW)'. An isolated or lone tree is one with a canopy that does not overlap those of other trees.

Further information is required on any lone tree occurring in the 30m section of hedge as part of the tree survey protocol (see Section 10.3). High resolution data should be collected if the tree is one of the twelve trees selected from across the monad. If this is not the case lower resolution data should be collected as for a ToW within a feature, in this case a hedgerow.

Table 5: Variables to be recorded for linear hedgerow plots (Further details of attributes are referenced in the 'Hedgerow Survey Handbook' in the surveyor library)

Variable	**Method and comments**
Altitude	Measured at the centre of the 30m section and hedgerow plot using a GPS held at ground level if not automatically recorded in Sweet
Slope	Record along the 30m section with a clinometer as flat, slight slope (0 to 5 degrees), moderate (5 to 15 degrees) or steep (>15 degrees). If this varies choose the most representative point on the 30m stretch
Bearing	Measured along the 30m section using a hand-held compass, from the highest end facing the lowest end or record as flat if there is no discernible slope

Table 5: Variables to be recorded for linear hedgerow plots (Further details of attributes are referenced in the 'Hedgerow Survey Handbook' in the surveyor library)	
Variable	**Method and comments**
Hedgerow height	Height is measured from the stem base to the top of the shrub layer. On a sloping bank, the measurement is taken from the side giving the shortest height (generally bank top). Taken as an average along the transect (don't include gaps when determining hedgerow height). Record height in increments of 50cm
Hedgerow width	Taken as an average width along the transect. If there is considerable variability in width take readings at the start, centre and end of the transect and calculate the mean value Record width in increments of 50cm
Base height	Height in cm from the ground to the base of the hedgerow canopy (the lowest leafy growth) Estimate the average height along the length to the nearest 25cm
Gaps	Estimate the percentage that gaps make up to the nearest 10% (that is gaps of less than 20m in the hedgerow canopy**)**. Note that locally dominant bramble with no other shrubs is included as a gap. Record to the nearest 10 %: 0, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%
Connectivity:	Does the hedgerow connect to other hedgerows within the monad? See the definition of a hedgerow in 6.4.1 to determine the extent of your hedgerow Record Yes/No/ Don't know. If yes, record number of hedgerows connecting with it. Record whether the hedgerow connects to a pond, or a woodland in which most of the trees are broad-leaved. Record Yes/No/Don't know. The hedgerow is defined as connected if it meets or comes within 20m of a pond or predominantly broadleaved woodland
Presence and type of fencing	Within or adjacent to surveyed side of hedgerow, and type. Record none or height in metres Record whether post and rail, netting, rabbit proof, stock (such as post and wire, twin strand barbed), electric, other

Table 5: Variables to be recorded for linear hedgerow plots (Further details of attributes are referenced in the 'Hedgerow Survey Handbook' in the surveyor library)	
Variable	**Method and comments**
Key Structures:	Use the 'People's Trust for Endangered Species' key to hedgerow structure, in the surveyor library, and record the dominant structure of the 30m survey section as H1 – H9 (summarised below) **H1**: Heavily over-trimmed **H2**: Over-trimmed **H3**: Over-trimmed but still with a few healthy stems **H4a**: Rejuvenated – recently laid **H4b**: Rejuvenated – recently coppiced **H4c**: Rejuvenated – recently planted **H5**: Dense and managed – recently trimmed **H6**: Dense and managed – not recently trimmed **H7**: Dense and managed - overgrown version of H6 **H8**: Tall or overgrown – stems getting too large to lay **H9**: Tall or overgrown – collapse possible, may be developing gaps Record the dominant structure of the 30m survey section as H1 – H9.
Evidence of damage by livestock	Record presence of: • bark stripping • browsing of foliage • grazing of ground flora along hedgerow margin • rubbing • soil compaction
Bank height	Record the height of a bank (if present) to the nearest 25cm
Bank type	Record the presence and absence of an earth bank or mound - relating to the hedgerow and distinct from the surrounding landform. Record as either: • no bank • half bank (a bank on one side only – tends to be alongside a road or track, as a form of terrace or cut embankment) • full bank (two-sided bank) • stone-faced bank (earth-filled bank faced with stone, traditional in Cornwall and other western counties)
Ditch width	Record the width of a ditch (if present) on the side surveyed, to the nearest 25cm
Adjacent habitat	Record the dominant adjacent habitat to the plot, on the surveyed side of the hedge.

Table 5: Variables to be recorded for linear hedgerow plots (Further details of attributes are referenced in the 'Hedgerow Survey Handbook' in the surveyor library)	
Variable	**Method and comments**
	Use EES broad habitat Use priority habitats or EES other detailed habitats (see Appendix 2).
Buffer strip	Record the presence of an uncropped margin or buffer strip left alongside the hedge to protect it from cultivation, crop growing, mechanical compaction, the application of pesticides and other damaging activities. (Not applicable in permanent pasture, wooded habitats or adjacent to built-up features.) Record as Yes/No If yes, assess and record: • the average width of the buffer strip, from the centre line of the hedge in metres • the vegetation height of the uncropped margin in centimetres. Choose a typical stretch and using a ruler record modal sward height. This is the height at which most of the vegetation sits, so ignoring tall stalks, place a hand or card lightly on the vegetation at a level below which about 80% of it is estimated, by eye, to be growing. Read this value off a ruler and record it.
Vegetation: Entire 30m section	
Presence of woody species, *Rubus* spp, climbers and non-native species	Record all species in these categories (using *Rubus fruticosus* aggregate for *Rubus* spp) along entire 30m plot
Number of hedgerow trees	Number of hedgerow trees over 3m including those with touching crowns When recording woody species, use the 'number' box in Sweet to record number of trees. You do not need to populate this box for other woody species Any isolated hedgerow trees (crowns not overlapping with others) over 3m must also be recorded as part of the ToW protocol Section 10.3 either at high resolution (table 13), or low resolution ('tree in feature' table 14)
Cover of woody species, *Rubus* spp, climbers and non-native species	Record the total percentage cover of each species in these categories. This is foliar cover for each species; the % of the hedgerow plot that is covered by live, above-ground growth for that species - along the entire 30m plot Note that the combined covers from all species can exceed 100% due to plants overtopping each other.

Table 5: Variables to be recorded for linear hedgerow plots (Further details of attributes are referenced in the 'Hedgerow Survey Handbook' in the surveyor library)	
Variable	**Method and comments**
Presence and cover of invasive non-native species	Record the presence and cover of invasive non-native plant species against the list provided in Sweet and in the surveyor library.
Lichen Bioindicators: See full Opal sheet in surveyor library for further information.	Record any of the following bioindicator lichens if present. • Nitrogen-sensitive; *Usnea, Evernia, Hypogymnia* • Intermediate; *Melanelixia, Flavoparmelia, Parmelia* • Nitrogen-loving; Leafy *Xanthoria*, Cushion *Xanthoria*, *Physcia*
Evidence of suspected pests and diseases	List any present within the hedgerow matrix including any ToW, *(refer to Observatree (2018b) and OPAL (2015a) field identification guides).* • Ash bud moth • Ash Decline • Ash key gall • Asian Longhorn Beetle • Bleeding canker of Horse Chestnut • Chalara ash dieback • Citrus longhorn beetle • Emerald Ash Borer • Horse Chestnut Bleeding Canker • Horse Chestnut leaf blotch • Horse chestnut leaf miner • Horse chestnut scale • Knopper Gall • Nectria canker • Oak decline • Oak mildew • Oak Processionary Moth • Pine processionary Moth • Tortrix roller moth
Vegetation: 2x4m plot	
Slope	Record with a clinometer as flat, slight slope (0-5 degrees), moderate (5 – 15 degrees) or steep (>15 degrees).
Aspect	Measured using a hand-held compass, from the top of the slope facing the lowest point or record as flat if there is no detectable slope.
Presence and cover of vascular plants, bryophytes and lichens	Within the 2x4m plot, record the species and total percentage cover of each species present. Estimate for the entire 2x4m plot as described in 6.2 Table 4. This is foliage cover for each species; the % of the plot that is covered by live, above-ground growth for that species. Note that the combined covers from all species can exceed 100% due to plants overtopping each other.

Table 5: Variables to be recorded for linear hedgerow plots (Further details of attributes are referenced in the 'Hedgerow Survey Handbook' in the surveyor library)	
Variable	**Method and comments**
	Record to species level if possible but some difficult groups such as *Euphrasia*, *Callitriche*, *Hieracium*, *Rubus* and *Taraxacum* can be recorded to genus. Include only climbers and woody plants that occur in the ground layer, as opposed to the shrub layer, for example, ivy and bramble creeping along the ground and tree/shrub seedlings. Record the presence of key bryophytes and lichens from the list in Appendix 3. Include those on soil in the plot and growing on vascular plants rooted in the plot but not those growing on rock, trees or deadwood. You should put maximum effort into recording vascular plants accurately rather than spend time and effort on identifying bryophytes and lichens. Record invasive non-native plants from the INNS list
Cover of all bryophytes	Within the 2x4m plot Record the total % cover of all bryophytes
Cover of all lichens	Within the 2x4m plot Record the total % cover of all lichens

6.5 Riparian linear plots

You can include riparian vegetation plots in the EES if the banks of watercourses support plant communities which are distinct in species composition from adjacent aquatic and terrestrial habitats. In other words, where there is a distinct zone between the water channel and adjacent land use even where this is very narrow.

You should still record the plot even if typical riparian vegetation (fen marsh and swamp species) is not present. We are interested in whatever vegetation lies in this distinct zone.

Riparian zones are referred to in measured distances from a watercourse. Beyond the bank face, the bank top riparian zone extends to 5m from the bank top whilst an outer riparian zone extends 50m from the bank top (Figure 4). The habitats in both zones are being recorded, that in the outer riparian zone will be covered by recording adjacent habitat and Living England segments.

Locate the start point of the riparian vegetation plot, refer to:

- section 6.1 on locating, marking out and recording plot locations
- appendix 7 for instructions on drawing sketch maps

Map the feature within Sweet. Place a linear plot of 1m x 10m along the bank of the selected watercourse. It should be placed at the start point in a direction away from the monad centre (Figure 4) and on the side of the watercourse nearest the vegetation plot.

The long edge of the plot will be parallel to the watercourse. It should be one metre up the bank from the ‘normal’ water’s edge, which is the apparent water level when the watercourse is full but not flooded. Do not sample the aquatic marginal vegetation.

You can move the riparian plot to the nearest suitable location, if the nearest location to the vegetation plot cannot be laid out and marked because for example:

- there is a field boundary or other obstacle within 1m
- the banks are too steep, a health and safety risk, or inaccessible

If this is not possible abandon the plot and record the reason in the comments box found in ‘my surveys’ window of Sweet .

Do not attempt to record a riparian plot if the river is in flood and do not record at high resolution in woodland.

If the nearest riparian plot falls on a watercourse or ditch already sampled and there are alternative watercourses or ditches, then choose the next nearest alternative. If this is not possible, a second plot can be chosen on the same watercourse if it is at least 10m away from the first plot.

General information will be recorded for the riparian plot, to allow resurvey in subsequent years. Plot level information will then be recorded, including species and cover of all vascular and selected lower plants.

Photographs

You should take:

- directional photographs to aid plot re-location, including one showing the whole plot (from the start point, with the tape in place)
- a close-up photograph from the edge of the plot looking down on vegetation representative of the plot, record in Sweet from which side of the plot the photograph has been taken
- a photograph of the sketch map

As a rule, an intensive search at the start of the plot to draw-up a list of species, followed by a walk along the rest of the plot to pick up additional species, is the most effective way to record a full species inventory.

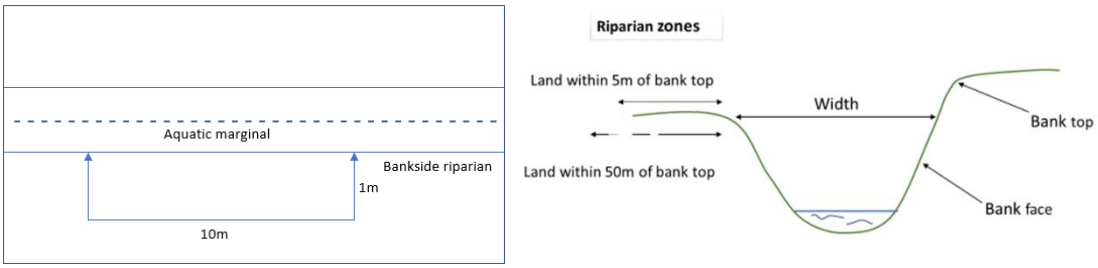


Figure 4 Subsampling for linear riparian plots - plot location and river profile

Table 6: Variables to be recorded for linear riparian plots

Variable	**Method and comments**
Watercourse type	Record as either river (>2.5m), canal (an artificial watercourse for navigation or irrigation), stream (<2.5m) or ditch.
Headwater	Record if headwater (within 2.5km of the furthest source) Y/N
Watercourse condition	Record as either dry, wet, or in flood. If in flood record no further.
Direction of flow	Record direction of flow using one of the 8 compass points – N, NE, NW, S, SE, SW, E, W.
Altitude	Record at the centre of the plot using a GPS held at ground level if not automatically recorded in Sweet.

Table 6: Variables to be recorded for linear riparian plots	
Variable	**Method and comments**
Slope	Record with a clinometer as flat, slight slope (0-5 degrees), moderate (5 – 15 degrees) or steep (>15 degrees).
Aspect	Using a compass, measure from the highest point in the plot facing the lowest point or record as flat if there is no discernible slope. Avoid holding compass immediately above the metal pegs as this can affect the readings.
Watercourse width	Estimate average bankfull width to the nearest 0.5m. Bankfull width is the horizontal distance across the channel at the level where the river first spills out of the channel. Where no distinct breaks in slope occur, estimate using clues such as the winter flood level (Figure 4). To help estimate the width in the absence of a rangefinder, • stick a ranging pole or cane on the bank • walk along the bank until the pole appears to be the same distance away as the far bank • pace the distance to the pole to estimate the channel width
Shade	Record as either unshaded, light shade, moderate shade, heavy shade.
Broad and priority habitats present in riparian plot	Record dominant habitat within the riparian plot (bank face and bank top vegetation). Record EES broad habitat. Record priority habitat or EES other detailed habitat (if present). See Appendix 2
Width of riparian feature	Record the maximum width of the distinct zone between the water's edge and the adjacent land use to the nearest 0.1m and to a maximum width of 20m. This may be smaller or wider than the plot.
Riparian zone – Bank top zone	Record dominant habitat in the 5m width bank top zone where the bank top is the first major break in slope (Figure 4). Record EES broad habitat. Record priority habitat or EES other detailed habitat if present. See Appendix 2.

Table 6: Variables to be recorded for linear riparian plots	
Variable	**Method and comments**
Adjacent land use	This may be the same as the bank top zone if there is no buffer to the bank top but must be different to at least part of the plot (there must be a distinct zone between the watercourse and adjacent land use). Record EES broad habitat and priority or EES other detailed habitat.
Vegetation buffer	Record the presence of an uncropped margin or buffer strip along the watercourse that is kept free from cultivation, crop growing, mechanical compaction, the application of pesticides and other damaging activities (Not applicable in permanent pasture or adjacent to built-up features.) Yes/No If yes, assess and record: • the average true horizontal width of the buffer zone, from the normal water's edge. This is the width as it would be viewed from above, rather than along the ground (to the nearest 50cm) • the estimated average vegetation height in the stretch adjacent to the plot even if it is the same as in the plot (cm)
Presence of vascular plants, bryophytes and lichens in plot	Record as for the vegetation plot (6.2) and to species level where possible. Some difficult groups such as *Euphrasia*, *Callitriche*, *Hieracium*, *Rubus* and *Taraxacum* will be recorded to genus. Record the presence of key bryophytes and lichens on the list in Appendix 3 as for the vegetation plot. Include those on soil in the plot and growing on vascular plants rooted in the plot but not those growing on rock, trees or deadwood. Record the presence of invasive non-native species separately against the list supplied in Sweet and available in the surveyor library.
Cover of vascular plants and listed bryophytes and lichens	Record the total percentage cover of each species present in the plot. This is foliar cover for each species; the % of the plot that is covered by live, above-ground growth for that species. The combined covers from all species can exceed 100% due to plants overtopping each other.

Table 6: Variables to be recorded for linear riparian plots	
Variable	**Method and comments**
	Record % cover as for the 2 x 2m vegetation plot (6.2 Table 4)
Total cover of all bryophytes	Record total % cover as above.
Total cover of all lichens	Record total % cover as above.
Cover of litter	Record total % cover of litter (the accumulation of dead plant remains on the soil surface) as above.
Cover of bare ground	Record total % cover of bare ground as above
Cover of bare rock	Record total % cover of bare rock as above
Cover of dead wood	Record total % cover of dead wood as above
Sward height	Record modal sward height, using a ruler, at 4 equidistant points along the linear plot. This is the height at which most of the vegetation sits, so ignoring tall stalks. Place a hand or card lightly on the vegetation at a level below which about 80% of it is estimated by eye to be growing and read this value off a ruler so providing 4 values and a sense of heterogeneity within the plot.
Sward structure	Record vegetation surfaces present. Choose one or more from: • Open water • Useable bare ground, ESS (Early Successional Surfaces) • Unusable bare ground (ground that is, for example, heavily compacted or churned up) • Low bryophytes, lichen • Very short grass, herbs, heather or other dwarf shrubs, taller bryophytes, and lichens (to ankle height) • Medium grass and herbs, building heather and other dwarf shrubs (ankle to knee height) • Tall grassy (above knee height) • Low scrub, tussocks, mature heather and/or other dwarf shrubs • Young scrub (head height to < 2.5m) • Mature scrub, trees > 2.5m • Tree canopy

Table 6: Variables to be recorded for linear riparian plots	
Variable	**Method and comments**
Evidence of modification and management	Record any of the following if visible from the plot: • bank erosion • bank reinforcement, for example, using wood piling, gabion or stone • bank re-sectioned or re-profiled • bank undercutting • bridges affecting banks and channels, (with in-channel supports or bank abutments) • dredging (recent or historically overdeepened channel) • fenced river/stream side (alongside plot) • flood embankments • in channel structures (weirs, dams sluices, deflectors, culverts and fords, where fords are permanent artificial fording places) • large woody debris left • live trees in channel • poached bank (significant trampling by livestock or people) • realignment (if known) • river habitat restoration structures • scrub encroachment • structures on bank (including boat moorings, jetties, boardwalks, fishing platforms)
Riparian trees	Trees over 2m tall either rooted within the riparian plot or in the watercourse adjacent to the plot must be mapped and recorded as detailed in the ToW lone trees section (10.3). • If recording as a tree in feature, you will need to collect summary data (as listed in table 14) or • If it is one of your twelve trees selected from across the monad, record as for a lone tree (table 13) Do not collect both sets of data

7. Surveying the square

A fixed 1 ha square surrounding the vegetation plot will capture and report on habitat heterogeneity and complexity. It will also provide data on small habitats that might be missed by the random and targeted vegetation plots.

It should be possible to relate an assessment of natural function to different habitat types. For this reason, habitat stands (see 7.1) across the square will be mapped, and the attributes collected for each stand or habitat mosaic (with some exceptions - see Appendix 2).

The 1ha squares surrounding the targeted plots may overlap with the 1ha squares surrounding the randomly selected plots. If this is the case, you can map continuously, but you will still need to record the stand attributes for each square even if this involves repetition. This will be important at the analysis stage.

Note You should continue to map and survey the square even if the vegetation plot has been abandoned.

7.1 Mapping habitat stands across the square

A stand is a relatively homogenous area of vegetation that is likely to have similar underlying soil and be subject to the same management. Such an area will be mapped as a separate polygon of a broad, priority or other detailed habitat (Appendix 2). It may include smaller areas of other vegetation such as scattered scrub.

In enclosed landscapes a stand may be constrained by permanent boundaries such as hedgerows. If the square crosses a permanent boundary, the vegetation across the boundary should be considered a separate stand.

In unenclosed landscapes a stand will be the extent of the square occupied by a homogenous area of vegetation.

The square will be outlined in Sweet and accompanied by a navigation feature. Marking out the corners on the ground with canes and bright coloured flags or tape provides a useful visual aid.

Photography

Take a representative photograph of the stand, a wide view from one side, and record the direction in which you are taking it.

Map each habitat stand in the square using the spatial drawing tool in Sweet and record using the pick list. You will not be able to map habitat beyond the square.

Component habitats

Sweet requires you to provide the % cover of your chosen or primary habitat in the mapped stand. This needs to be recorded as a component habitat even if it provides 100% cover. If less than 100%, record the % cover of the other habitats that make up the stand but are too small to map separately. This might include a combined cover of patches of dense scrub

(where dense means >90% canopy cover), or bracken. It will not include scattered scrub and bracken; this will be captured as a variable in the stand recording. The combined components must total 100%.

Attributes and variables are only collected for the primary habitat unless recording a mosaic or selected small habitats.

When mapping habitats for which attributes and variables are not being collected, for example broad-leaved woodland, do not break down into component habitats; record the habitat type in the properties and move on.

The minimum mappable area (MMA) is 20mx20m or 0.04ha.

Recording mosaics, transitions, and complex habitats

Where there is a habitat **mosaic** and it is not possible to determine a homogenous stand,

- select mosaic at the broad habitat level in Sweet
- record the component habitats that make up the mosaic, with their percentage cover
- record the indicator species for each habitat
- record other variables across the whole mosaic.

Where the habitat is **transitional** between two types, you will not be able to record it as such so record as you would a mosaic. Select the component habitats that the vegetation lies between; record the indicators for both habitat types; and record other variables across the whole transitional habitat. The indicators and cover should help to demonstrate the transitional behaviour

In the current version of Sweet, where you encounter traditional orchards, wood pasture and parkland, ignore the trees for the purpose of mapping.

- Map the open habitat stands beneath the trees and collect the attributes and variables for those habitats.
- For each stand within the orchard select the traditional orchard option against that stand.
- For each stand within the wood pasture and parkland select the land use option for wood pasture and parkland
- You can sample the trees themselves using the ‘Trees outside Woodland protocol’ (see section 10.3)

When recording in coastal and floodplain grazing marsh, map the habitats as you would normally but tick the option that denotes coastal and floodplain grazing marsh when recording non-priority grasslands. Non-priority grasslands include, improved, poor quality semi-improved, good quality semi-improved and other neutral.

Recording small habitats

Some important habitats can often fall below the minimum mappable area. This includes arable field margins and some of the priority habitat feature types. Do not map them separately. To capture these, they can be recorded as a component of the larger surrounding mapped habitat-type. This applies where they occur as discrete features, rather than in a mosaic with other habitats.

The variables should then be recorded across the whole polygon and indicator species recorded for the smaller component habitat.

The smaller habitats that need to be recorded in this way are marked with an asterisk in Appendix 2.

Additional points in relation to recording stand

Record the relevant open habitat where young planted, or self-sown woodlands still retain grassland, heathland, or other open habitats beneath an open canopy. Change will be captured as the canopy closes. Remember there is an option for tree planting when recording land use. To be considered woodland, there must be a canopy cover over 20%

Where areas with permission are inaccessible or unsafe, record the broad or priority habitat as best you can. You do not need to collect variables in the related tables despite their being accessible in Sweet. An incomplete set of variables will be unusable. Similarly, if not visually assessable, just select that option in Sweet, don't try and guess at the habitat, and move on

Standing open waters and river channels are outside the EES remit but you should still survey any fen, marsh and swamp habitats, such as reedbeds, over the MMA.

Sealed routes that are more than 3metres wide should be considered built-up habitat and a boundary to the stands. This includes roads, cycleways, disabled access routes, walkways.

Sealed routes less than 3m wide and unsealed and unsurfaced routes, record as a component of the surrounding habitat. Where the vegetation is representative of the surrounding habitat it can be used for a vegetation plot.

Linear features over 3m wide can be mapped as polygons. Below 3m include them in the adjacent habitat

In line with the Forestry Commissions definitions of 'Trees outside of Woodland' (see section 11.2, figure 10), stands of trees that are:

- between 0.04ha and 0.1ha will be mapped as groups of trees
- greater than 0.1ha mapped as small woods
- greater than 0.5ha mapped as woodland

7.2 Habitat condition and natural function attributes

Table 7 sets out the range of variables that will be recorded for the separate stands or across a habitat mosaic in the 1ha square. This will provide data on habitat composition, condition, natural function, and management. These are based on common variables used

in the ‘Baseline Evaluation of Higher Tier Agreement (BETHA) manual and Biodiversity metric 2.0 to assess the condition of different habitats. They also include measures of structural diversity and natural function.

See Appendix 2 for details of habitats for which you need to collect variables. You do not need to record variables against all the mapped habitat types, including stands of woodland or scrub, dense bracken, or built-up features.

Once you have mapped the extent of each stand or mosaic in the square, you should conduct a walk-through survey of the habitats for which variables are being recorded. Walk in a ‘W’ or similar across the stand, to ensure you get a good overview of the vegetation and record the values for the variables. Be sure to include the edges of the stand as the interface between different habitats is structurally important.

Vegetation structural diversity is measured using the roundrat method (see Appendix 4 for details). For small areas, up to 40mx40m, a 6m diameter roundrat is acceptable (allowing for some overlap). For larger areas use a 6m radius.

Where there is a mosaic of habitats, record the variables across the whole mosaic including the measure of structural diversity.

Even where there are multiple stands or polygons of the same habitat-type in the same land parcel, the variables must be recorded for each polygon separately. This is because of the limitations in Sweet.

7.2.1 Recording Variables – Indicator species

Lists of positive and negative indicators have been drawn up for a range of priority and other detailed habitats. Some of the priority habitats have been further broken down into feature types. Appendix 2 has guidance on which lists to use against which habitat type. The lists are directly related to the habitat types in Sweet and can also be found in the surveyor library.

Familiarise yourself with the indicator lists. Once you’ve determined, mapped, and recorded the habitat stands, walk back through the stand. As you walk, list the indicator species relating only to the recorded habitat and provide a percentage cover as described in Table 7.

For a habitat mosaic, record the indicator species and their cover for each of the habitat types that make up the mosaic.

For a transitional habitat**,** perhaps occupying a whole field or monad**,** record indicator species and their cover for the habitats between which the stand sits. Examples might include vegetation that is transitional between neutral grassland and fen or neutral and calcareous grassland

Table 7: Variables to be recorded at stand level	
Variable	**Method and comments**
EES broad, priority and other detailed habitats present	Record EES broad habitat. Record priority habitat if present or EES 'other detailed' habitat. In the related features, record component habitats that make up the mapped stand and % cover of each. If there is only one habitat record as 100% here. Do not record for map only habitats Where there is a mosaic of habitats, record as such and record the percentage of each habitat. See Appendix 2
Cover of bare ground	**Record total % cover in 5% increments.** **< 5% record in 1% increments** **<1% record as 1%**
Cover of scattered scrub	Record total % cover of all scrub species, as above (apart from western and dwarf gorse that are part of the heathland habitat) Areas of dense scrub should have been recorded as a % component of the primary habitat or mapped separately if above MMA.
Cover of scattered trees	Record total % cover of scattered trees.
Cover of positive indicator species	Record the positive indicator species for the habitat surveyed and assign a % cover value for each species, as above.
Cover of negative indicator/undesirable species	Record the total % cover of all negative indicator species for the habitat surveyed, as above.
Cover of invasive non-native plant species (INNS	Record species and cover on the INNS plant list
Cover of non-native species	Record total % cover of all other non-native species, as above. Listed invasive non-native species are recorded separately.
Cover of scattered bracken	Record total % cover of scattered bracken, as above Areas of dense or continuous bracken (>95% cover) should have been recorded as a % component of the primary habitat or mapped if above MMA.
Cover of dwarf shrubs	Record total % cover of dwarf shrubs, as above.
Cover forbs	Record total % cover of all forbs, as above.
Cover of grasses	Record total % cover of all grasses, as above.
Cover of bryophytes	Record total % cover of all bryophytes, as above.

Table 7: Variables to be recorded at stand level	
Variable	**Method and comments**
Cover of lichens	Record total % cover of all lichens, as above (not including on deadwood or rock).
Cover of rushes and sedges	Record total % cover of all rushes and sedges, as above.
Dwarf shrub age structure	If ericaceous dwarf shrubs are present then record the proportion in different age classes – Pioneer, Building, Mature and Degenerate. Total should come to 100%.
Structural diversity	Record the presence of the different vegetation surfaces at ten, 6m radii roundrats across the stand or, in areas below 40x40 m, ten 6m diameter roundrats. This enables the overall frequency of each surface and average number of surfaces to be calculated at the analysis stage. Different surfaces are: • Open water • Useable Bare ground, ESS (Early Successional Surfaces) - in terms of invertebrate use • Unusable bare ground (such as ground that is heavily compacted or churned up, even though it might be used for basking) • Low bryophytes, lichen • Very short grass, herbs, heather and other dwarf shrubs, taller mosses and lichens (up to ankle height) • Medium grass and herbs, building heather (ankle to knee height) • Tall grassy (above knee height) • Low scrub, tussocks, mature heather • Young scrub around head height to < 2.5m • Mature scrub, trees > 2.5m • Tree canopy Note: • The same plant species can occur in two or more surfaces. • A uniform surface punctuated by sparse taller pieces of the same vegetation only counts as one surface. • The surface needs to be big enough to stand in to count as a separate surface • If you cannot easily see a surface, it is probably not there.

Table 7: Variables to be recorded at stand level	
Variable	**Method and comments**
Presence of fallen deadwood	Record level as absent, low, moderate, high localised or high widespread.
Presence of standing deadwood	Record level as absent, low, moderate, high localised or high widespread.
Disturbance from permitted recreation	Record level as absent, low, moderate, high localised or high widespread.
Disturbance from other non-management activities	For example, vehicular damage from off roading, vandalism, unauthorised camping, fly-tipping Record level as absent, low, moderate, high localised or high widespread.
Evidence of continuity of traditional management (from visual clues and data search or personal communication)	Record as: Yes/No/Don't know For example, • low input farming without the intensive use of artificial fertilizers or herbicides • light or extensive grazing regimes and - sometimes in heathland - small scale burning and cutting that provide structural diversity. • control of water levels that allow for seasonal flooding rather than extensive drainage systems • traditional hay meadow management with a cut for hay at the end of the summer (in contrast to regular cuts of lush grass for silage) • features such as anthills that are a clue to lack of ploughing, harrowing
Anthills	Record presence of anthills Yes/No
Molehills	Record presence of molehills Yes/No

Land Use	Select relevant options from: Unmanaged Grazing – check for dung if stock is not present • cattle • sheep • horses and ponies • mixed • goat • rabbit • deer • llamas/alpacas • pig • other grazing Note grazing intensity as slight, moderate, major, heavily poached and almost bare Cutting and if known • silage • hay - where the grassland will be shut up from about May to July. Following a cut there will be remnant of hay left behind • frequent mowing - as for amenity grassland • heather cutting Burning or swaling Supplementary feeding Arable • crop if known and to include grass leys (both short-term and long term (up to 5 years) usually comprising a mix of sown grasses - mostly rye grasses - and clovers) Set-aside Wood pasture and parkland Tree planting Tree felling Scrub control Bracken control Rush cutting Game management Managed for nature Grassland enhancement – including sown wild flower mixes Military Golf course Country Park

Table 7: Variables to be recorded at stand level	
Variable	**Method and comments**
	Other recreational
Presence of field drainage and sub-surface features	Record level as none, historic (non-functioning), low, moderate, high*
Coastal modification and sea defences	Record the level of effect on the stand as none, low, moderate or high*
Presence of abstraction, water level management or flood management infrastructure	Record the level of effect on the stand as none, low, moderate or high*
Evidence of Plastics	Record presence of any of the following • Geotextile tracks, such as used on grouse moors • Discarded plastic tree guards • Discarded agricultural packaging, such as silage bags • Dog waste bags • Other plastic littering

* For further guidance refer to ‘Assessing the extent & impact of artificial’ drainage’ in the surveyor library and external surveyor SharePoint.

7.3 Living England Ground data points

Living England (LE) is a national satellite-derived habitat map that uses satellite imagery and machine learning to classify England into different habitat and landcover classes (see Figure 5).

England has been divided into fourteen Biogeographic Zones of similar environmental, geological and landscape characteristics. Then each zone is further divided into ‘segments’ of like vegetation derived from Sentinel-2 satellite imagery. The collection of broad habitat information from these homogenous segments provides ground data for informing the habitat classification modelling process.

The regular provision of high-quality field survey data is fundamental to the Living England project. It is required in good enough numbers, and ideally recently collected, to accurately train the machine learning model across each zone, for each habitat, and for model validation.

You should use the Living England ArcGIS Field Maps app to collect the data and classify the habitat class for each segment in the field. This process is called ‘Ground Data Collection’.

The ‘Ground Data Collection’ requires data to be collected from an area of homogenous vegetation (with a minimum size of 30x30m) within a segment. To provide useful data for the habitat classification, points should only be taken where the primary habitat for the

segment comprises 60 – 100% cover (where its wholly or predominantly covering the segment).

Collect suitable ground data points from segments within the squares and, time-permitting, from around the monad. Concentrate on areas of under-recorded and priority habitat outside of the squares.

Use the ‘Living England Quick Start Guide to Ground Data Collection’ document to guide you through how to identify which habitats should be targeted for data collection. It also covers:

- whether you will need additional access permissions
- the procedure you must use if acquiring permission for access and data collection from a new landowner

Further details on the Living England method can be found in Appendix 1 and in the Living England Guidance documents found in the surveyor library. These documents provide all the required information on planning your Living England surveys including:

- identifying under-recorded habitats for data collection
- collecting data points in the field using the LE Field Maps App

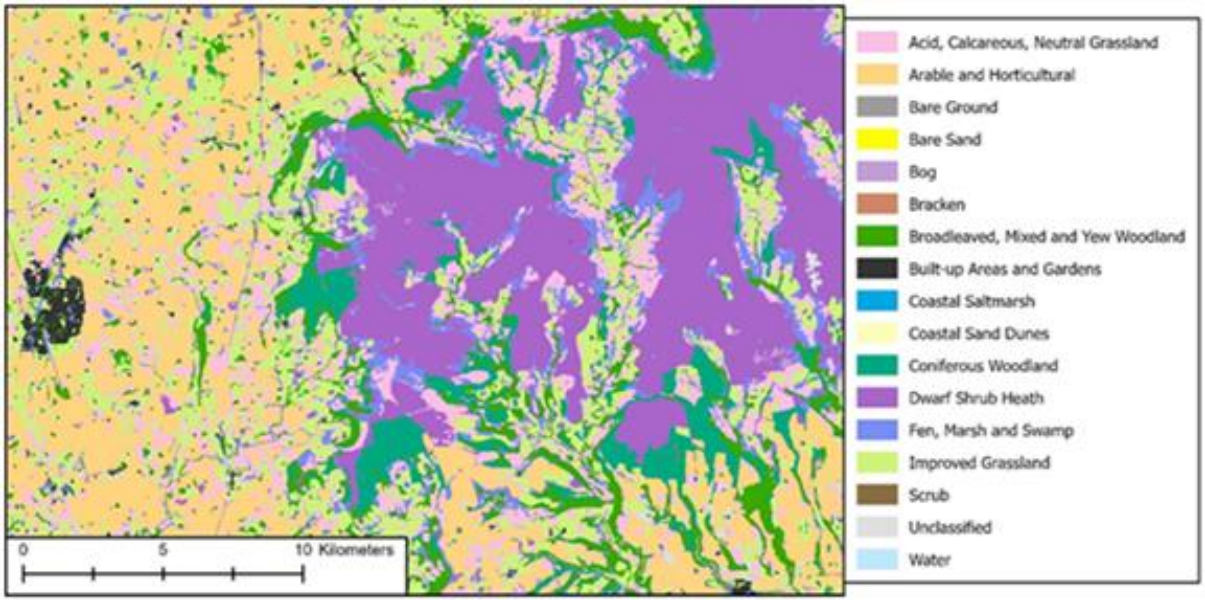


Figure 5 Example Living England Habitat Probability classification (Phase 4) and symbology, showing the North York Moors and Northallerton. © Natural England 2022.

8. England peat map

This protocol will only be used on sites that have been included in the England Peat Map survey scheme. Suitable sites will be flagged up in the surveyor information pack.

If your monad includes a suitable site, you will need to take five peat depth measurements within a 10x10m square centred on the 2x2m vegetation plot.

No samples are taken offsite, and it is not intended for repetition on the same site. The following method is adapted from the NCEA England Peat Map Field Protocol – Vegetation only: 2022, Version 1.9 (Natural England 2023). The entire protocol is in the surveyor library and should be checked for specific requirements associated with EPM surveys including

- health and safety requirements
- any avoidance measures or consent needed for work on designated sites additional to those outlined for the vegetation and landscape survey
- suitable equipment for measuring peat depth. The Hisco Utility Probe is the preferred tool, but the manual explores alternatives
- further guidance on using a peat probe.

On the rare occasion that the vegetation is dominated by Sphagnum, meaning a cover of 60% or over, you will need to complete a vegetation survey This is not tied to the vegetation plots; you can select the most appropriate location. Refer to the full EPM Field Protocol – Vegetation only: 2022, Version 1.9 in the surveyor library

8.1 Quadrat location and layout

The 2m x 2m vegetation plot should be at the centre of the 10m EPM square. The peat depth survey will be carried out in a 10m x 10m quadrat orientated along cardinal directions, that is north, south, east and west. Do not disturb the vegetation plot during this part of the survey.

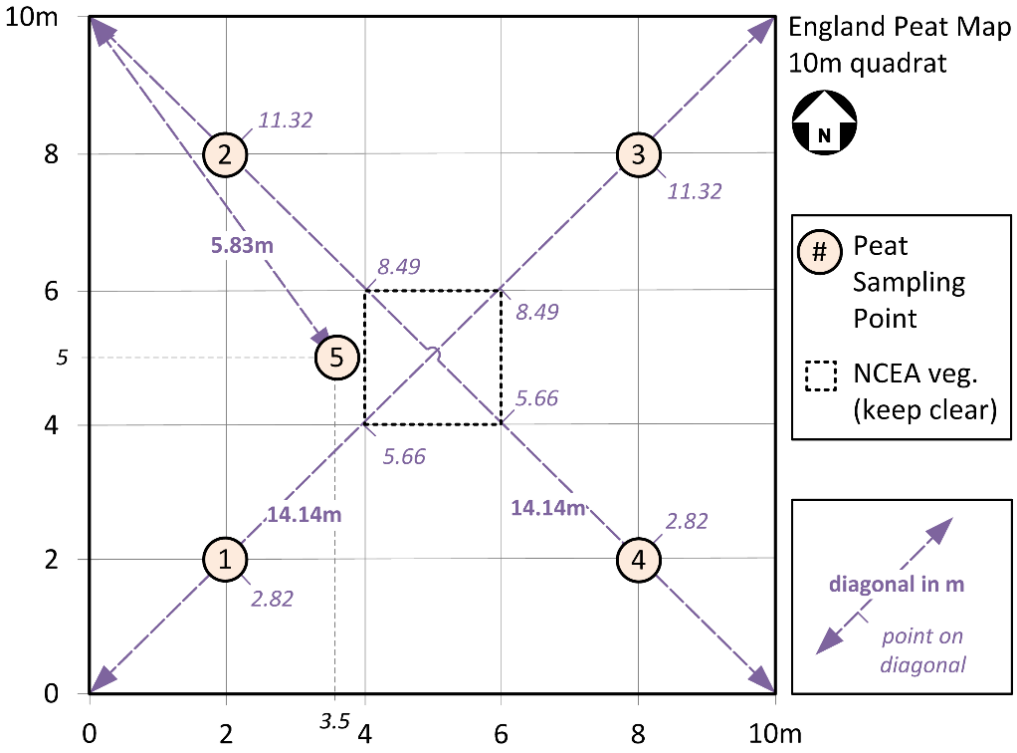


Figure 6 Quadrat layout

For this survey, the 2 metres by 2 metres vegetation plot will already have been marked out. This determines the location of the 10x10 metre quadrat. Use canes to mark out the corners of the 10 metre square

1. Starting at the NE corner of the 2x2 metre quadrat measure out 8.49 metres in a SW direction ensuring the tape passes through the SW corner of the 2x2 metres quadrat. This marks the SW corner of the 10x10 metre quadrat.
2. Start at the South-West corner of the quadrat. Mark the SW corner with a ranging pole and record the GPS co-ordinates.
3. Attach the end of both 20-metre tape measures to the SW corner ranging pole. One surveyor stays at this point, securing the ends of the tape measures and sighting using a compass* (how-to-use-a-lensatic-compass). NB Make sure the compass is kept clear of mobile phone/tablet/GPS as this can affect the bearing taken
4. Measure out 14.14 metres exactly NE (45 degrees N) and place a second ranging pole at the NE corner. Measure with one 20 metre tape measure but carry and pay out the other one at the same time.
5. Using the GPS sense check the placement of the NE ranging pole (due to errors in the GPS position it will not be 100% accurate).
6. At 2.82 metres and 11.32 metres along the tape place a marker flag to mark out soil depth sampling points 1 and 3 respectively (Figure 6).
7. Now pay out both tape measures to 20 metres and tie each of them to the NE pole at the 20-metre mark.
8. With a third ranging pole, stretch out one of the 20 metre tape measures due West to form a right angle at 10 metres, and place the pole. This is the NW corner. Sight with compass to confirm the orientation.

9. Repeat with the fourth ranging pole, going South. This is the SE corner. Sight with compass to confirm the orientation.
10. Using the two 5-metre-long tape measures together locate and mark out soil depth sampling points 2,4 and 5 (Figure 6). In relation to the South-West corner of the 10-metre square, these points are (coordinates in metres): point 1 (2m,2m), point 2 (2m,8m), point 3 (8m,8m), point 4 (8m,2m), and point 5 (3.5m, 5m).

Depth surveying is carried out at all five sampling points.

Having set up the quadrat, record the GPS position of the SW corner in Field Maps

Table 8 Position of quadrat	
Variable	Method and comments
GPS position SW corner	Record the SW corner of the 10x10m quadrat
GPS accuracy	Record the precision in metres of the GPS signal at the time of the reading
GPS Unit	Record the make and model of the GPS unit used

8.2 Photographs

Take four landscape orientated photographs of the quadrat using a good quality smartphone/tablet camera. Care should be taken to ensure that the photos are not out of focus or blurry and that no people are included in the photo. When using the EPM app in Field Maps the photos need to be labelled with the direction of view only, for example “N”.

• Looking North: stand in the middle of the Southern quadrat boundary and align the image so that the NW and NE corners of the quadrat are at the top left and top right corners of the image. If required place the A4 sheet with photo information in view.

• Looking South: stand in the middle of the Northern quadrat boundary and align the image so that the SE and SW corners of the quadrat are at the top left and top right corners of the image.

• Looking East: stand in the middle of the Western quadrat boundary and align the image so that the NE and SE corners of the quadrat are at the top left and top right corners of the image.

• Looking West: stand in the middle of the Eastern quadrat boundary and align the image so that the NW and SW corners of the quadrat are at the top left and top right corners of the image.

8.3 Peat Depth

Locate in turn each of the five peat sampling points; point 1 (2,2), point 2 (2,8), point 3 (8,8), point 4 (8,2) and point 5 (3.5, 5). To identify them, use:

- the retractable tape measures
- the tape measures already laid out
- Figure 6 (see section 8.1) which shows measurements along the diagonals

Use an object (ideally a flag) to mark the location before you start surveying.

At each of the points, undertake the survey activities described in Table 9 and record the variables in Field Maps.

Table 9: Variables to be recorded at each of the five peat sampling points

Variable	**Method and comments**
Peaty soil presence (whole quadrat only)	**Visually check the soil surface to confirm presence of peaty soil**
Organic soil depth in cm (at five locations per quadrat)	At each soil sampling point use the peat probe to measure the depth of the organic horizon. Push the tip of the probe into the soil, attaching further extensions as required, until you feel resistance increasing markedly over a short depth interval, which can be associated with texture change, for example • sand grains rubbing against the probe can be felt or heard • stoneless clay gives a much more gradual increase in resistance with no grinding and the probe can still be pushed into it • the probe stops abruptly (peat on rock). Note that completely resistant, hollow-sounding material may be woody material which can sometimes be penetrated with further pressure or by probing again close-by. Once you've reached the bottom of the organic layer 1. use a retractable tape measure to measure from the ground upwards to the nearest joint or to the end of the probe. This is the above ground value. 2. carefully remove the probe from the ground. Use known lengths of the probes or joints to calculate the length of the probe to the joint you measured the above ground value to. 3. Subtract the above ground value from that length to obtain the depth of the organic layer. 4. Record the depth at that point.
Bottom reached (at five locations per quadrat)	Was the peat probe long enough to reach the bottom?
Presence of drainage feature within 5m (at five locations per quadrat)	Observe whether there are any natural or artificial drainage features such as gullies, grips or drains within a 5 metre radius of each point.

9. Landscape assessments

You'll assess landscape features and their condition within the survey monad. This will provide a good representative record of the monad's landscape character.

To help Natural England's understanding where and how the character of the landscape is changing, you will do a rapid survey of the monad and:

- assess the condition and visual quality of natural and cultural landscape features
- capture perceptual and experiential aspects
- take fixed-point photography viewpoints

Changes have been made to the landscape survey protocol following pilot work in 2022. It now includes a glossary to further guide surveyors. This is in the surveyor library.

The advice and protocols apply only to the initial surveys. They will be revised for future re-surveys

9.1 Identifying locations for landscape assessments

You will record landscape assessment data and undertake fixed point photography at six locations in the monad. Usually, four of these will be associated with the random subsamples. Two more will be targeted. Locations for these may have been identified during the presurvey preparation.

The choice of survey points, in particular points 5 and 6, needs to ensure that the full landscape character of each monad is recorded once all six assessment points have been surveyed.

Where there is a public right of way (PRoW) running through or alongside the monad, it should be used for one or both of points 5 and 6. This is provided they add to the landscape character information gathered from the other points.

If the monad has a particularly complex landscape character (many different features and elements), you may need to move away from one or more of the random subsample points.

When there are significant views and landmarks visible beyond the boundary of the monad, include these in the recording. A section of the survey is available for this purpose.

The two additional points (points 5 and 6) should best reflect the landscape character of the monad as a whole. This can be looking inwards or along the boundaries and ideally from public vantage points or ProW as noted above (where available).

When selecting photo and survey points you should consider the following criteria as a guide for choice of points:

> The location of key landscape features and historic features that are considered representative of the monad or characteristic of the area. This should be based on the pre-survey review of the NCA profiles and relevant Landscape Character Assessments, and observations based on the aerial photograph and OS Map for the monad. To assist in identifying the relevant Landscape Character Assessment,

please see; The landscape character assessment database for the UK and Ireland is now available I Landscape Institute

Public vantage points, public rights of way or other points that are accessible to the public. Having points assessed from these will feed into any citizen science collection of landscape change data by the public in the future.

In order to gain a full assessment of the whole monad, you should aim in the first instance, and where it is possible, to capture a mix of scenes of landscape character and landscape features within and across the monad. Longer views beyond the monad that show the wider landscape context or influences on the landscape character of the monad, and which can be captured in the six panoramas, should be included. (This to some extent may depend on the topography of the monad or how enclosed or open the landscape is.)

Where survey points, as far as feasible, can be proportionally spread out over the monad, avoiding small clusters.

Where the edges of smaller settlements or edges of urban areas fall within monads, some points can be chosen that help to show how the built-up edge sits in the landscape.

Where it is possible to capture 180-degree panoramic photo sequences.

The landscape assessment points associated with the four vegetation plots and 1ha squares should be located within, or close to, the surveyed squares and meet some of the criteria listed above. The two additional points should be located to best meet one or more of the criteria listed above.

9.2 Survey protocols

At each landscape assessment point you should undertake a rapid landscape character assessment of landscape and historic environment features of the monad. Refer to OS Map and MAGIC to identify features of the monad which are not clear on the aerial photograph. For example, PRoW and identified heritage features such as tumuli.

Take fixed point photographs to create a panorama of the ‘in view’ assessment. The photo sequence should be taken from left to right, with the direction of view noted at the central point (such as North, Northeast). You must record the GPS location of the tripod at the survey point as accurately as possible.

The rapid landscape character assessment should record the key characteristics of the surrounding landscape, perceptual/experiential qualities, information on current landscape condition and visible forces for change (where apparent) on the survey form (Table 10).

Note the presence of particular landscape and historic environment features (adding any additional brief notes to describe it) within the monad and as represented in the photography. Significant views/landmarks beyond the monad should be used to record any significant features which are outside the monad, but which have an influence on its character, such as a large settlement or mobile phone mast in close range.

Table 10: Variables to be recorded at landscape assessment points	
Variable	**Method and comments**
GPS - landscape assessment location and elevation	Enter GPS pin label as recorded in mobile application and elevation (at tripod location)
Direction of assessment and panorama	Record as N/NE/E/SE/W/SW/W/NE at centre of panorama
Survey point on PRoW, Open Access Land, National Cycle Network	Record as Yes/No
Landscape assessment and photo number	Record all photo numbers from the camera taken in the panorama.
National Character Area(s) (NCA) No. and name	See link to NCA website in the surveyor library. List all, if more than one
Landscape features and characteristics (within the monad)	
Elevation	Record as either: • low lying (50m or under) • transitional (50-250m) • high ground (over 250m)
Scale	Record from survey point as either: • intimate - enclosed view • small-medium view – across monad • large, open view – beyond monad • expansive (vast) - panoramic views, extensive or distant views
Settlement and Development	Select from: • no development visible • sparse, such as occasional scattered farmsteads or dwellings • traditional buildings and barns • smaller settlements (hamlet or village) • urban edge (edge of town or city) • urban (larger settlements) • new housing • industrial development under construction or recently completed • Other (state) Record in notes any evidence of new housing or industrial development under construction.
Infrastructure and Renewable Energy	Record: • utilities • pylons • solar farms

Table 10: Variables to be recorded at landscape assessment points	
Variable	**Method and comments**
	• wind turbines • hydro-electric generation • roads • railway lines • airports • airfields • ports • other Record in notes anything under other
Landform	Record all visible landforms within the monad. Use the OS Map for the monad to aid understanding. • floodplain • plateau • hill • escarpment • broad valley • narrow valley • flat • terraces/shelving • gentle slopes • steep slopes • rolling/undulating • exposed rock • estuary • river terrace • cliff • mountain • other (state)
Land use	Record: • farmland – pastoral • farmland – arable • farmland – mixed • horticulture • orchards • permanent grass • woodland/Forestry - large • woodland /Forestry - small • copse • tree belt • scrub • heathland • equestrian/horse keeping • historic parkland • leisure/recreation • residential • military • industrial

Table 10: Variables to be recorded at landscape assessment points	
Variable	**Method and comments**
	• mineral working • commercial • other (state)
Field boundaries and trees	Record • hedgerows • hedgerow on earth bank • hedgerow on stone faced bank • hedgerow management (box trimmed, side trimmed, none) • stone faced bank • earth bank • boundary trees (predominate species if known and visible to record from survey point) • other trees (predominate species) • stone walls • ditches • post-and-wire fencing (stand-alone) • boundary protective fencing • timber post and rail fencing • wooden fencing • pony tape • grass/wildflower margin present • Other (e.g., electric fencing, significant barbed wire, record in notes)
Water	Record: • canals • reservoirs • rivers, streams • seas • tarns • water meadows • waterbody – small • waterbody - large
Historic features	For each of the following record if they are: • present and observed • recorded but not observed • none (not present) Record: • scheduled monument • listed building or structure • registered parks and gardens • registered battlefield • non-designated historic assets
Perceptual and experiential characteristics	

Table 10: Variables to be recorded at landscape assessment points	
Variable	**Method and comments**
Diversity	Record as either uniform, simple, diverse or complex
Enclosure	Record as either enclosed, open or exposed
Pattern	Record as either irregular, regular or formal
Sense of Remoteness	Record as either Yes/No
Movement	Record as Yes/No
Level of movement in the landscape (vehicles, wind turbines, aircraft)	Record as either still, some movement or busy
Level, location and rate of noise	Record as either loud, quiet or no noise Record as either distant or close Record as constant or intermittent
Presence of main roads/motorways	Record as present/ absent
Natural noise	Record birdsong, insect noise, water noise,
Significant views/landmarks beyond the monad (whole monad)	Yes/No If yes, list feature
NCA profile and/or Landscape Character Assessment (whole monad)	Is the whole monad representative of landscape character and features as described in National Character Area(s) and/or published Landscape Character Assessment(s)? Yes/Partially/No
Variable	**Method and comments**
Overall landscape condition of landscape character of monad	Record as either Good, Fair or Poor
Pressures of change on monad's landscape	Record any of the following: • development or infrastructure pressures • field boundary removal • habitat fragmentation • invasive species • plant diseases observed • recreational pressures • other

The condition of the landscape of the whole monad is assessed as either good, fair or poor overall. The judgement of landscape condition is on the basis of good management for landscape quality and character. It includes the condition of the natural features of the

monad, as well as the condition of the cultural and human features. To make an overall assessment of the landscape as a whole, it is defined as follows:

> *'Landscape condition is based on judgements about the physical state of the landscape, and about its intactness, from visual, functional, and ecological perspectives. It also reflects the state of repair of individual features and elements which make up the character in any one place.' (An Approach to Landscape Character Assessment, 2014, NE*).

You should refer to the glossary in the surveyor library for more detail on how to assess landscape condition. You should provide evidence or your observation to support your scoring in the final part of the survey.

Good - overall the landscape of the monad functions well (relative to the expected functions of its landscape features and their interactions). Characteristic physical features are visually intact, and the monad performs well ecologically.

Fair - overall the landscape functions adequately (relative to the expected functions of its landscape features and their interactions), but some elements do not function as well as they could; there are some visual detractors, characteristic physical features are mainly but not fully visually intact; and most but not all features perform well ecologically.

Poor – overall the landscape does not function well (relative to the expected functions of its landscape features and their interactions). There are significant visual detractors, characteristic physical features are not visually intact, and it does not perform well ecologically.

The fixed-point photography element will capture 'in view' characteristic landscape and historic environment features. It will also provide a record of visual condition and quality from different points across and into the monad. It is important that you take panoramic photos from survey points in a consistent and repeatable way, following the protocols for fixed-point photography. Appendix 6 has detailed guidance on taking fixed point photographs.

As you survey the monad, you can also record any additional observations you have including distinctive landscape features or perceptual and experiential factors. You can include a simple photograph if this would illustrate the observation.

9.3 Post survey

The panoramic photographs taken for each viewpoint will be stitched together using Adobe Photoshop software, following best practice in Landscape and Visual Impact Assessment (LVIA) photography. You will not need to do this. This will be done by NE.

The photos will be geo-referenced with location, date, survey points and directional data collected in the field survey and linked to the landscape condition survey data. The full set of panoramas for viewpoints should be made available in high resolution JPEG format as outlined in Appendix 6.

10. Point plots

10.1 Pond plots

This pond methodology incorporates the 'Habitat Suitability Index (HSI)' Oldham et al. (2000), which has been adopted by Natural England's District Level Licence surveys, and the 'Freshwater Habitats Trust PondNet Aquatic Vegetation Survey' methodology. This method incorporates a Predictive System for Multi-metrics (PSYM), whereby environmental variables are used to calculate pond quality.

A maximum of two ponds, wet or dry, each a maximum size of 2 ha. will be sampled within each monad where survey permission is granted. This may include ponds in woodlands where there is a lack of ponds elsewhere in the monad.

The 'Environment and Rural Affairs Monitoring & Modelling Programme' (ERAMMP) defines a pond as 'a body of standing water 25 m^2 to 2ha which usually holds water for at least 4 months of the year'. We are adopting this definition.

10.2 Survey protocols

The outer boundary of the pond is usually identified by the pond's highest annual water levels (usually in early spring). It may not be the current water level of the pond, but wetland vegetation such as rushes at the pond's outer edge, or water-line marks on tree trunks, stones and other solid features may be noted to delineate the pond boundary.

Map the pond within Sweet. A pond that falls only partly within the monad cannot be surveyed due to limitations in Sweet.

A dry pond can be identified from a range of attributes, including historical mapping data, local knowledge, landscape features and vegetative assemblage.

Survey from the dry edge of the pond, do not enter the water. Undertake all chemical and eDNA analysis before any vegetation survey in order to reduce the risk of sample contamination.

Figure 7 Illustration of a large pond with varying shelf depths (Swartz and Miller 2019)

Table 11 lists the variables to be recorded during pond surveys. The survey will include water sampling and vegetation recording.

Water sampling where there is standing water

Before surveying the vegetation, walk around the perimeter of the pond to identify safe, suitable areas where you can take water samples. Follow the instructions within the eDNA sample kit and supplementary guidance. Include separate samples for pesticide testing post-survey.

You must not enter the water to take samples as this will risk contaminating the sample. Strap the ladle or dipper on to a cane or similar extension to allow for a longer reach. A separate dipper must be used for each pond to avoid contamination and the cane disinfected between ponds. Collect enough water to enable eDNA and water quality testing. Complete all relevant eDNA documentation at a safe location and store the collected sample in line with the sampling kit instructions. A safe location might be a dry, flat area of firm ground away from the edge of the pond where you can safely complete the sampling procedures. Send samples to the laboratory in accordance with external contractor guidelines.

You should have enough water remaining to use for an onsite chemical analysis. This includes testing for phosphate, nitrate, alkalinity and pH. Details of how to undertake this analysis are found within the supplementary guidance in the surveyor library.

Vegetation survey

Identify the outer boundary of the pond (see above). Stay within the outer boundary and on the bankside.

You must not enter the water to try and gain a better view of vegetation.

Survey all safely accessible dry and shallow areas around the perimeter of the pond up to the outer pond boundary. Include terrestrial vegetation as the pond may be dry or those species may be present within the survey zone.

> Identify species in the field as far as possible. Adhere to biosecurity protocols if any vegetative matter is removed for further ID, this includes its disposal.

Photography

Where possible, take two photographs of the pond from north-south and east-west aspects of the pond. If this is not possible, or those bearings do not sufficiently represent the pond, take photographs from angles that best represent the pond. Record the direction from which they were taken, such as NW, SE.

Table 11: Variables to be recorded for pond surveys

Variable	**Method and comment**
Number of ponds within 1km of surveyed pond	During your pre-survey desktop study, use online mapping resources to estimate the number of ponds present within 1km of the surveyed pond (see section 4.4). Do not include the surveyed pond in the estimate.
Pond altitude	Record at most south-westerly (or nearest adjacent) point using a GPS held at ground level if not automatically recorded in Sweet
Geographical Zone – where; Zone A = optimal Zone B = marginal Zone C = unsuitable Where the location is on a boundary, select zone B (See HSI handbook in surveyor library for more information)	A, B, C 

Table 11: Variables to be recorded for pond surveys	
Variable	**Method and comment**
Pond status	Is the pond wet or dry?
Woodland pond	Record whether the pond is in woodland Yes/No
Island	Is there an island present Yes/No If yes, record the area of the pond occupied by the island to the nearest 10%
Undertake eDNA and water chemistry sampling if applicable	
eDNA Survey	Collect water sample and undertake eDNA collection as per supplementary guidance Record eDNA sample/kit ID
Water Chemistry	Use the excess water sample to record pH, Nitrate (NO3--N ppm), Phosphate (PO43-P ppm) and alkalinity
Continue with the remainder of the pond survey	
Pond Permanence	Record as either: • Never dries • Rarely dries - no more than two years in any ten-year period, or only in drought • Occasionally dries - dries between three years in ten to most years, • Annually dries • Permanently dry Pond permanence can often be deduced from local knowledge (such as from the landowner) and personal judgement such as water level at the time of the survey. Ponds that dry out annually usually have a hard base or have submerged terrestrial vegetation and may lack a range of aquatic vegetation.
Percentage of pond perimeter surveyed. (Survey all that is accessible and safe)	Estimate as a percentage (to nearest 10%) - including any areas that may be inaccessible but can still be adequately assessed by eye. Base your recorded metrics on accessible/visible area, do not make assumptions.

Table 11: Variables to be recorded for pond surveys	
Variable	**Method and comment**
Inflows	Record if present (artificial structures can include weirs, dams' sluices etc). • Nonapparent (for example, rain, groundwater, spring fed ponds or dew ponds • Ditch (with control structures) • Stream (with control structures) • Ditch (without control structures) • Stream (without control structures) • Pipe or culvert with no apparent associated ditch or stream (these may not be visible so check with landowner where possible).
Outflows	Record if present • Nonapparent (for example rain, groundwater, spring fed ponds or dew ponds) • Ditch (with control structures) • Stream (with control structures) • Ditch (without control structures) • Stream (without control structures) • Pipe or culvert with no apparent associated ditch or stream - these may not be visible so check with landowner where possible
Percentage of pond surface area shaded	Estimate how much of the total pond area, including any currently dry areas, is shaded from trees, scrub, or structures; the proportion of the pond that would be shaded when the sun is directly overhead Shading does not include that from emergent pond vegetation.
Percentage of pond margin shaded	Estimate how much of the pond margin (to 1m from the shore) is shaded from trees or structures. Shading does not include that from emergent pond vegetation.
Pond substrate the rock type underlying the pond (beneath the sediment).	Estimate the percentage composition of the pond substrate: • silt or clay • sand, gravel, cobbles • rock • peat • artificial such as plastic, concrete, other lined

Table 11: Variables to be recorded for pond surveys	
Variable	**Method and comment**
	• unknown (where it is not possible to determine the substrate) This is currently to the nearest 10% in Sweet, but it does not need to be that accurate. Recording will be changing to bands where 1= 0%-32%, 2=33%-66%, 3=67%-100%. A rough estimate will suffice Can often be assessed directly in the field or be determined using a geology map. In the field, push the handle of the pond net or cane through the sediment into the base.
Water quality (turbidity)	Estimate turbidity looking down into about 20cm depth of water in the pond (where it is safe to do so) • clear • moderately clear • moderately turbid • turbid (murky or green) • Peat stained or dystrophic (brown or tea stain colour)
Waterfowl impact	Record as either: • Major - severe impact of waterfowl, few or no submerged plants, water turbid, pond banks have patches where vegetation removed, feed put down • Minor - waterfowl present, but little impact on pond vegetation, pond still supports submerged plants and banks are not denuded of vegetation • None - no evidence of waterfowl impact (moorhens may be present).
Fish presence/ Indicators	Record as either: • Major - dense populations of fish known to be present • Minor - small numbers of stickleback or native species known to be present • Possible - no evidence of fish, but local conditions suggest that they may be present • Absent - no records of fish stocking and no fish revealed during survey • Indicative – evidence of angling (line, pegs).

Table 11: Variables to be recorded for pond surveys	
Variable	**Method and comment**
	Landowner, occupier and local knowledge may be helpful. If unsure make an assessment based on the water quality and other indirect evidence.
Pond management	Record any of the following if there is evidence of management within previous 12 months. Record: • Fully dredged • Partly dredged • Vegetation removed • Trees clear-felled • Trees cut back or coppiced • Planting - trees • Planting - other • Bank plants mown • Pond changed shape / size / reprofiled • Structural work such as a dam • Straw added • None
Disturbance by dogs	Record as either: • Major - dogs repeatedly use the pond, compacted edges with little vegetation, water very turbid • Minor - dogs use the pond, but little impact on pond vegetation, pond still supports submerged plants and banks are not denuded of vegetation • None - no evidence that dogs are using the pond. If unable to ascertain absence, select 'Minor'
Fencing	Record as: • No fencing • Partially fenced • Wholly fenced
Grazing	Record: • percentage of aquatic and emergent vegetation grazed. (Stock can often wade into shallow ponds to graze if there are no barriers to this.) • percentage of pond perimeter grazed In 10% increments

Table 11: Variables to be recorded for pond surveys	
Variable	**Method and comment**
	Grazing intensity. Record as either: • absent • slight - some signs of grazing and little if any poaching • moderate – short-grazed vegetation and/or some poaching but <20% exposed, trampled mud on the pond margins • major - heavily grazed and poached with between 20% and 90% of the pond banks and margins bare poached mud • heavily poached and almost bare
Distance to nearest land use	Distance in metres between outer boundary of the pond to the nearest land use. For example, there may be a fringe of vegetation or fenced off area between the outer boundary of the pond and a surrounding arable field or pasture.
Quality of adjacent terrestrial habitat for amphibians and reptiles (Within approximately 250m of the pond, but only on the near side of any major barriers to dispersal such as main roads or large expanses of bare habitat.)	Record as either: • none - no suitable habitat around pond (e.g., centre of arable field or large expanse of bare habitat). • poor - habitat with poor structure such as amenity grassland, improved pasture and arable, that offers limited opportunities (less than 25% of available area) for foraging and shelter • moderate - habitat offers opportunities for foraging and shelter but may not be extensive (25-75% of available area) • good - extensive habitat that offers good opportunities for foraging and shelter over more than 75% of available area. For example, rough grassland, scrub or woodland, also brownfield sites and low intensity farmland) Shelters can include: • established scrub patches • brash or log piles • stone walls • waste piles in urban areas (rubble, slabs) • embankments • unused burrows

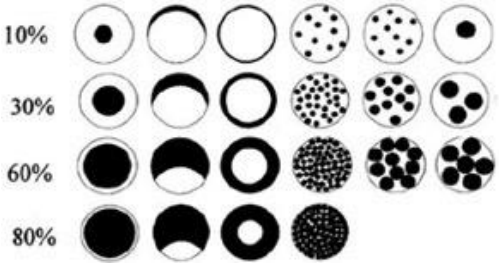
Table 11: Variables to be recorded for pond surveys	
Variable	**Method and comment**
	• exposed root systems or rotten stumps above water line.
Adjacent land use - Habitat	Record the dominant habitat occupying the dominant adjacent land use Use EES broad habitat and priority habitats or EES other detailed habitats if present (see Appendix 2).
Aquatic vegetation-floating and submerged macrophytes (species characteristic of standing water)	Record the percentage of the pond surface covered by floating plants and submerged plants reaching the surface, excluding duckweed, *Azolla* species and filamentous algae. Record in 10% increments. See diagram below as a guide. 
Aquatic vegetation – emergent macrophytes	Record the percentage of the pond covered by emergent macrophytes, that is the whole area within the outer edge of the pond even if this includes dry areas at the time of survey. Record in 10% increments
Invasive non-native species	Record presence in or adjacent to the pond of any invasive non-native species, for example: • New Zealand Pigmyweed *Crassula helmsii* • Floating Pennywort *Hydrocotyle ranunculoides* • Parrot's Feather *Myriophyllum aquaticum* • Water Fern *Azolla filiculoides* • Canadian Pondweed *Ellodea canadensis* • Nuttall's Pondweed *Elodea nutallii* • Curly Waterweed *Lagarosiphon major* • Japanese Knotweed *Fallopia japonica* • Himalayan balsam *Impatiens glandulifera* • American Mink *Neovison vison* • Goldfish *Carassius auratus* • Grass Carp *Ctenopharyngodon idella* • Other

Table 11: Variables to be recorded for pond surveys	
Variable	**Method and comment**
Vegetation - plants from within pond outer edge	Record species and tick type present • Submerged-leaved species • Floating-leaved species • Emergent species • Terrestrial species
Number of trees within pond	Record the number of trees over 2m tall whose roots are completely submerged by water Include those that stand within the outer edge of the pond even if the pond is dry. It should be evident as the roots will be exposed. Do not include trees on the banks whose roots are partially submerged Include both lone trees and trees with overlapping canopies in the number
Record any **lone** trees (canopies not overlapping) over 2m tall whose roots are completely submerged following the ToW protocol in the following section, 10.3. Record as a high resolution lone tree if it is amongst your subsample of 12 trees selected from across the monad (table 13). If not one of the twelve, then record as a 'tree in feature' (table 14).	
Species and relative abundance of trees within pond	If there is a mix of tree species with submerged roots, record the % of each making up the assemblage (% in terms of tree number not canopy cover) Include both lone trees and those with overlapping canopies
Age class of trees within pond	List the age classes of trees with submerged roots. Include all that apply. Options: young; semi-mature; early mature; mature; late mature; veteran; ancient (Guidance in section 10.3) Include both lone trees and those with overlapping canopies
Trees surrounding pond	Estimate the number of trees over 2m tall within 25m of the pond edge.

Table 11: Variables to be recorded for pond surveys	
Variable	**Method and comment**
	A line of trees or small wood should be mapped and recorded as for the ToW protocol Section 11.2
Species and relative abundance of trees within 25m of pond	For example: *Salix*, *Alnus*, mix. Record abundance (%) of each species that make up the tree assemblage within 25m of the pond edge (in terms of tree number not canopy cover)
Age class of trees surrounding the pond	List the age classes of trees within 25m of the pond edge Include all that apply. Options: young; semi-mature; early mature; mature; late mature; veteran; ancient (Guidance in section 10.3)

10.3 Trees outside of woodland (ToW)- lone trees

This survey protocol is designed to identify and capture high resolution data for a range of lone trees (individual trees) within the survey monad. The range should extend from young trees over 2m tall to mature and veteran trees (if applicable). This is to determine the continuity of 'trees outside of woodland' habitat within the landscape.

You should record a representative selection of up to 12 trees (if present), focusing on broad-leaved trees, Yew and Juniper. Do not sample other types of conifers.

All lone trees associated with the hedgerow, riparian or pond plots must be recorded. These 'trees in feature' can be amongst the 12 trees selected for a detailed or high resolution survey (table 13). If not selected, a summary of attributes and variables must be collected as set out in table 14.

Do not record any tree twice. If the 'tree in feature' is recorded in detail, there is no need to collect summary data as well.

10.3.1 Identifying trees outside of woodland

Trees outside of woodland refers to any tree outside of a woodland habitat. Woodlands are defined under the National Forest Inventory (NFI) as any wooded area covering at least 0.5 hectares, with a minimum width of 20m, and a minimum, or the potential to achieve, at least 20% tree canopy cover (Forestry Commission 2016).

ToW encompasses a wide variety of habitats; including trees found on farmland, along waterways, hedgerows, and in urban habitats such as parklands, road verges and street trees (Reid et al. 2021).

A lone tree is defined as a single tree over 3m tall in a hedgerow or 2m elsewhere where the canopy does not overlap with another tree. For the sake of the EES survey, this also includes trees in traditional orchards and wood pasture and parkland where the canopies do not overlap.

A tree is defined as a woody perennial of a species typically forming a single self-supporting main stem and having a definite crown.

A shrub is less than 5m tall with more than one stem, grows with a spreading habit and would form part of an understorey

A shrub is deemed to be acting as a tree when it has a single, self-supporting main stem with a diameter breast height (DBH) of ≥4 cm and a definite crown, with the potential to reach 5m.

10.3.2 Identifying a veteran tree

A veteran tree can be defined as a 'tree that is of interest biologically, culturally or aesthetically because of its age, size or condition' (English Nature 1999). A veteran tree can be any age, but it is a tree which shows ancient characteristics. These can be caused by many factors including management, natural damage, or the tree's environment.

Ancient trees are all veterans but not all veterans are old enough to be ancient. A veteran may be a young tree with a relatively small girth in contrast to an ancient tree, yet still bear the 'scars' of age such as decay in the trunk, branches or roots, fungal fruiting bodies, or dead wood. These veteran features will still provide wildlife habitat. (Woodland Trust 2008).

Characteristic features found on veteran trees include:

- an 'old' look
- bark loss
- crevices in the bark, under branches or on the root plate sheltered from direct rainfall
- decay holes
- epiphytic plants
- fungal fruiting bodies such as from heart rotting species
- girth large for the tree species concerned
- high aesthetic interest
- high number of interdependent wildlife species
- large quantity of dead wood in the canopy
- major trunk cavities or progressive hollowing
- naturally forming water pools
- physical damage to trunk
- sap runs

Many ancient trees have a large girth, but this is not the defining feature. Smaller trees such as hawthorn and apple, equally reach veteran status. Where the monad includes traditional orchards, include some traditional orchard trees of veteran status.

Some of the typical features of a veteran tree are shown in figure 8.

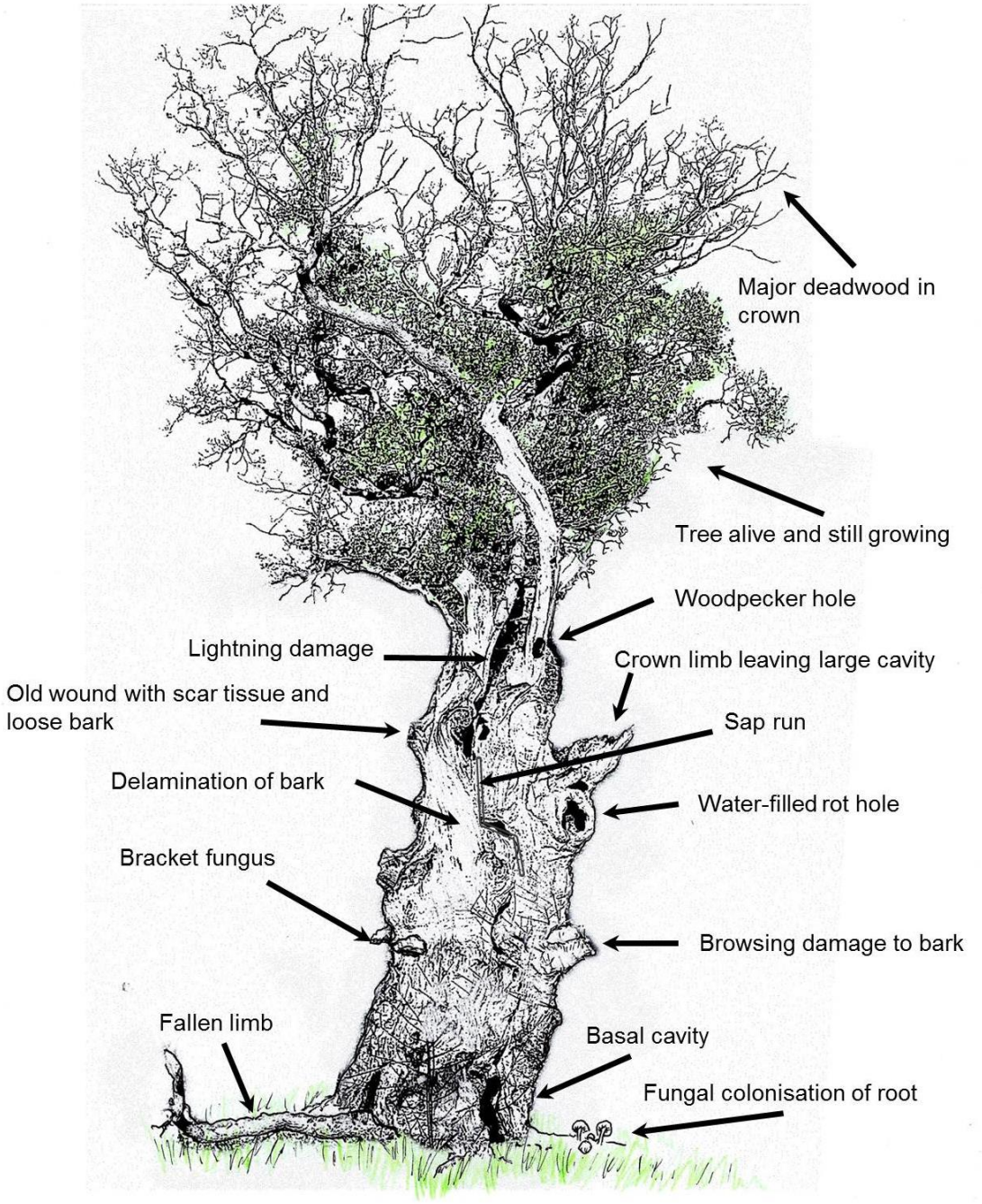


Figure 8: Example of a typical veteran tree

10.3.3 Surveying lone trees outside woodland

You should record up to 12 ToW in the monad, primarily based on surveying 3 trees closest to each of the 4 vegetation plots. This may not be possible in some monads because of a lack of trees.

Use the following protocol to select the trees for survey

The principal of the protocol is to capture a range of tree ages present with the monad. You must record at least one ancient or veteran tree (if present) within each selection of three trees, after which, trees within the next lowest age class are surveyed. Begin at V1 then sequentially moves down the tree age classes as they move on to V2, V3 and V4.

Beginning with vegetation plot 1 (V1), grade the target trees using the 7 age classes listed in Table 12.

Table 12: Age class for grading target trees	
Young	Equivalent to being obviously planted within the last three years.
Semi-mature	Still in formative period. Crown developing, foliage increasing, up to 25% of attainable age
Early mature	Almost full height, crown still developing and seed bearing; up to 50% of attainable age
Mature	Full height and crown spread, seed bearing; over 50% of attainable age
Late mature	Full size and may be showing signs of damage, senescence of dieback and reduced extension growth
Veteran (Not strictly an age-class but we want to identify them.)	Identified by a diameter breast height measurement (DBH) >75-150 cm (depending on the species – refer to table in appendix 10, Hedgerow Survey Handbook) or The tree has at least 3 of the veteran tree attributes or features that are deemed to make the tree of exceptional cultural, landscape or nature conservation value
Ancient	A tree that has reached a great age in comparison with others of the same species.

Worked Example

In the following example the surveyor captures a representative range of trees within the survey area, in this case one ancient, two veteran, four mature, two semi-mature, one early mature and two young trees.

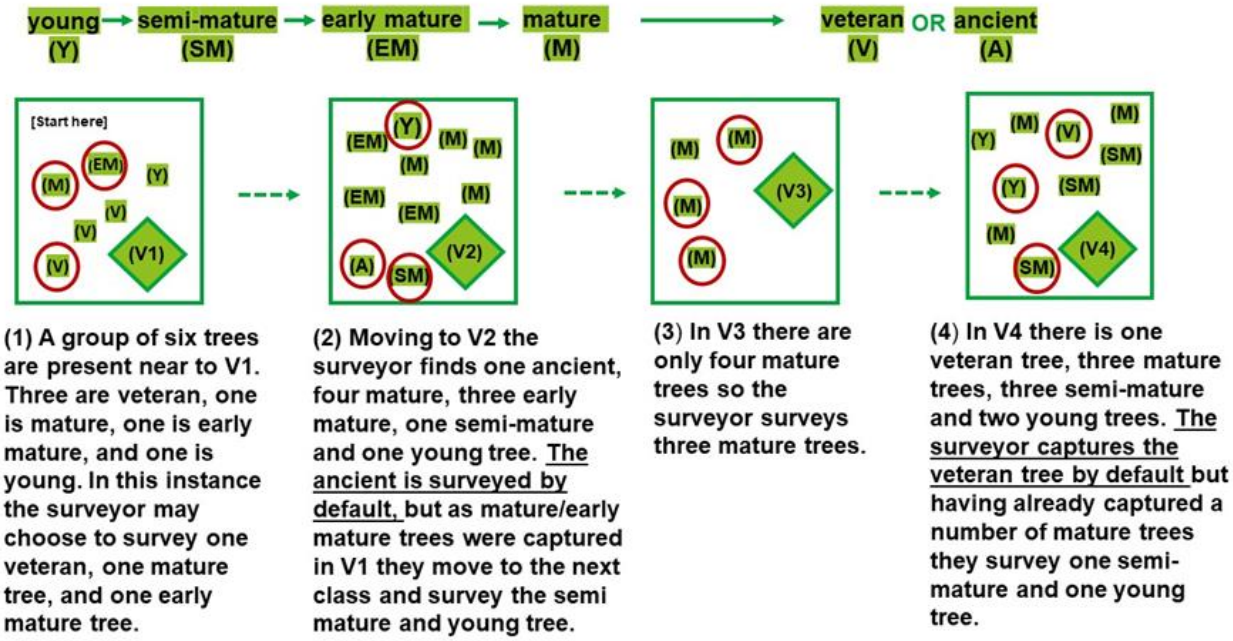


Figure 9 Worked example of tree selection protocol

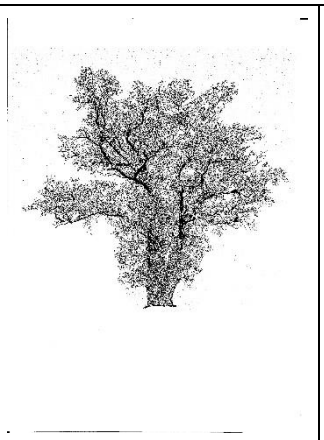
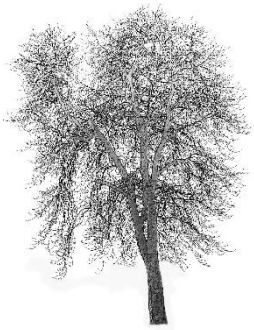
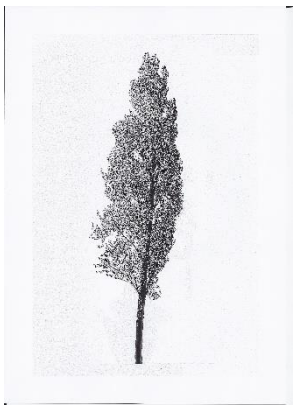
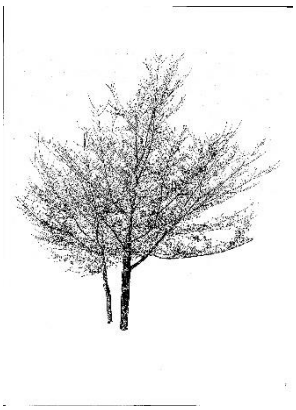
If the trees are not conveniently situated adjacent to V plots, then you may need to expand the search criteria to include:

- trees located within or on the edge of a surveyed square
- trees located within surveyed hedgerows or other linear features
- trees encountered when moving between plots and squares

To a certain extent, aerial photographs will aid in locating discreet or small groups of trees not within a woodland setting.

Table 13 Variables to be recorded for lone trees See the 'Veteran Tree Specialist Survey Method Handbook' in the surveyor library for more detailed guidance.	
Not all variables will be applicable to all surveys. Complete as fully as possible.	
Variable	**Method and comments**
Photographs	Photograph: • the whole tree from a direction that best illustrates the overall structure and landscape context • closeup photo of any key or ancient features • closeup photo of leaf, fruit or flowers if ID is not confirmed • evidence of any pests and diseases if present or suspected Avoid losing detail in sunny conditions because of overexposure and taking directly into sunlight. Manually expose for the tree over-exposing the sky if necessary.
Context	Record if • hedgerow tree • in-field tree • orchard • pondside • pond - within • riparian • woodland edge • wood pasture and parkland and/or associated with • ancient track • footpath or bridleway • common land, • parish boundary • old buildings, • recent development
Connectivity	Estimate distance to nearest other tree, woodland, or hedgerow to nearest metre. Measure using the ruler tool in the app.
Tree species	Record species
Age class	Young, semi-mature, early mature, mature, late mature, veteran, ancient
Form	Record as either: • maiden • multi-stemmed, • coppice • managed pollard • lapsed pollard • natural pollard • remnant dead tree (stump/standing deadwood) • phoenix regeneration • dead (See illustrations in handbook)

Tree status	Standing, leaning, fallen
Number of trunks	If multi-stemmed, record the number of stems over 0.3m diameter and arising from below 1.3m height.
Shade	Record the extent to which the tree is shaded Record as either: • heavy or extensive shade • moderate shade (and close shade - shade on the side but not overtopping tree) • light shade • unshaded
Adjacent habitat	Record the dominant adjacent habitat using EES broad habitat, and priority or EES other detailed habitat if present (see Appendix 2). In orchard and wood pasture and parkland record adjacent habitat as such. Individual trees in these habitats can be recorded where the canopies do not overlap.
Buffer zone	Record the presence of a buffer zone kept free from cultivation, crop growing, mechanical compaction, supplementary feeding, ditching, the application of pesticides, or other damaging activities. Yes/No - if yes, assess and record • the average width of buffer measured from the bole of the tree to the nearest metre • the vegetation height in the buffer zone beneath the canopy (cm) Using a ruler record modal sward height. This is the height at which most of the vegetation sits, so ignoring tall stalks, place a hand or card lightly on the vegetation at a level below which about 80% of it is estimated, by eye, to be growing, and read this value off a ruler.
Girth (**DBH)**	Record girth at 1.3m height in centimetres (DBH will be calculated from this)
Height of girth measurement if taken below 1.3m	If there are swellings, burrs, branches or other irregular features which occur at 1.3m height, then measure at the nearest point below, where the trunk is more regular. Record in centimetres If the tree is multi-stemmed and the multi- stem formation occurs below 1.3m then measure the largest stem at 1.3m in centimetres. Record if measuring at non-standard height or largest stem in multi-stemmed tree or both.
Proportion of canopy alive and intact	Visually assess and record to the nearest 5%
Height to the crown base	Estimated height to nearest 0.1m to where the crown base begins - the height of the lowest level of foliage that is connected to the crown

<table>
<tr><td rowspan="4">Crown shape</td><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Spreading</td><td>Oval</td><td>Fan</td></tr>
<tr><td>  </td><td>  </td><td>Select from
column
cone
fan
oval
spreading</td></tr>
<tr><td>Column</td><td>Cone</td><td></td></tr>
<tr><td>Epicormic growth</td><td colspan="3">Record if present and use following:
Base
Trunk
Crown
Base and trunk
Base and crown
Trunk and crown
Base, trunk, and crown
None present</td></tr>
<tr><td>Dead wood attached to the tree</td><td colspan="3">Record if there are any dead branches or trunk sections attached to the tree over 15cm wide (thickness of a leg) and 1m in length - equating to 1 unit of deadwood.
Count the units and note where they are found using following
Base
Trunk
Crown
Base and trunk
Base and crown
Trunk and crown</td></tr>
</table>

	• Base, trunk, and crown • None present
Fallen deadwood	Record number of deadwood units around the tree that have originated from this individual. One unit is 1m in length and over 15cm in diameter. Multiple units can be counted along a single length, for example, a 5m x15cm piece of deadwood would count as 5 units. (The units need to be above a certain size to be of true ecological value.)
Loose bark	Record if there are large areas greater than 30cm x 30cm of dead, loosely attached, missing or flaking bark about the tree and where these are found. Use following: • Base • Trunk • Crown • Base and trunk • Base and crown • Trunk and crown • Base, trunk, and crown • None present
Bark sap runs	Record type of bark sap runs present from dry, wet, sticky, bubbly, other or none.
Wound Count Tears, splits, and scars	Record number of tears, splits, scars, lightning strikes more than 30cm long.
Hollow trunks	Record trees as either: 1. Apparently solid trunk with minor cavities (less than 15cm) 2. Hollow trunk entire circumference. Minor holes may be present on one or more sides. 3. Partially solid trunk, partial circumference with major cavities, large openings >15cm) or merging apertures 4. Remnant trunk with incomplete shell up to 30% of outer circumference missing. 5. Remnant trunk with more than 30% of outer circumference missing. Record as either 1, 2, 3, 4, or 5
Rot holes	Record the number of rot holes of at least 5cm in diameter.
Major rot sites more than 15cm across	Record the number of major rot sites of at least 15cm in diameter.
Naturally forming water pockets	Record as Yes/No

Lichen Bioindicators: See full Opal sheet in surveyor library	Record % cover of the following bioindicator lichens if present. • Nitrogen-sensitive; *Usnea, Evernia, Hypogymnia* • Intermediate; *Melanelixia, Flavoparmelia, Parmelia* • Nitrogen-loving; Leafy *Xanthoria*, Cushion *Xanthoria*, *Physcia* Choose the side of the trunk with the most lichens. Focus just on the lichens between 50 to150cm above ground level. Only record from the list of nine indicator lichens and record % cover across the observed area Less than 1% record as 1% 1-10% in increments of 1% 10-100% in increments of 5%
Epiphytes and Hemiparasites	Note the presence and type of epiphytes and hemiparasites upon the tree. Type: Lichens Moss Fern Ivy Mistletoe Other - trees / shrubs / climber None present
Fungi	Record presence of: • bracket fungi • slime • skin-like covering • cap and stalk • other
Evidence of saproxylic invertebrate activity - without removing bark	Identified by the presence of burrows or exit holes and frass about the wood, bark and sites of decay. Frass is a dry powdery residue from tunnelling. Record as: • None: no obvious signs • Minor: localised evidence; most of the of the tree appears free of activity. • Major: significant evidence of activity throughout the tree.

Evidence of other fauna	Evidence of species other than invertebrates inhabiting tree structure. Record presence of • bat roosts • bird nests • woodpecker holes • other activity Use notes to detail other, such as badger setts, pine marten activity
Evidence of access limitations	Record any features that limit access: • controlled public access • private land • protective fencing • signage • other feature(s) limiting accessibility
Evidence of management	Record any evidence of recent tree management (roughly in the past ten years). This includes: • management of competitive tree growth • other arboricultural work • planting • pollarding or coppicing • weed control (within crown spread) • none known
Evidence of damage from herbivores (including root zone compaction)	Record as: • none • minor • major • severe
Tree Health	Record any of: • bacterial seep • chemical toxicity: herbicide or fertilizer application or identifiable pollution. • compaction • excessive browsing or damage from pests • excessive leaf loss • fire damage (human derived) • fire damage (natural derived, such as lightning) • inappropriate tree surgery • mechanical damage (impact and abrasion from plant or machinery) • ploughing, ditching, or trenching

	• storm or snow damage • vandalism • wire attached to trunk Examples of inappropriate surgery include: • removal of limbs or deadwood to create a tidy appearance or facilitate vehicular access • careless attempts at coppicing or pollarding resulting in no regrowth • surgery that leaves a tree unbalanced and susceptible to high winds Appropriate surgery will prolong a tree's life or be undertaken for valid health and safety reasons.
Evidence of suspected tree pests and diseases	List any present. Refer to Observatree (2018b) field identification guide and OPAL (2015a) field identification guide. Pests or diseases to record: • Ash bud moth • Ash Decline • Ash key gall • Asian Longhorn Beetle • Bleeding canker of Horse Chestnut • Chalara ash dieback • Citrus longhorn beetle • Emerald Ash Borer • Horse Chestnut Bleeding Canker • Horse Chestnut leaf blotch • Horse chestnut leaf miner • Horse chestnut scale • Knopper Gall • Nectria canker • Oak decline • Oak mildew • Oak Processionary Moth • Pine processionary Moth • Tortrix roller moth

Recording lone 'trees in feature'

Trees associated with vegetation plots and ponds can be recorded as part of the above protocol (10.3.3 table 13) if you are including them in the subsample of 12 trees to be recorded at high resolution. If not recorded at high resolution, you must record the variables listed in the table below (table 14) for:

- hedgerow plots - all trees > 3m along the 30m length of hedgerow

- riparian plots – all trees > 2m rooted in the plot or in-channel trees where they occur in the 10m length of watercourse immediately adjacent to the plot
- ponds – all trees > 2m where the roots are completely submerged

If already recorded at high resolution do not repeat.

Table 14: Variables to be recorded, as a minimum, for any lone 'within feature' tree	
Feature type	Record feature type • Hedgerow • Riparian • Pond
Tree species	Record tree species
Age class of tree	For each tree record as either: • young • semi-mature • early mature • mature • late mature • veteran • ancient
Tree Form	For each tree record as either • maiden • multi-stemmed • coppice • managed pollard • lapsed pollard • natural pollard • remnant dead tree • phoenix regeneration • dead
Crown shape	Record crown of each tree as either • column • cone • fan • oval • spreading
Evidence of saproxylic invertebrate activity - without removing any bark	Identified by the presence of burrows/exit holes and frass about the wood, bark and sites of decay. Frass is a dry powdery residue from tunnelling. Record as: • None: no obvious signs • Minor: localised evidence; most of the tree appears absent of activity • Major: significant evidence of activity throughout the tree
Evidence of other fauna	Record evidence of species other than invertebrates inhabiting the tree structure.

	Record presence of • bat roosts • bird nests • woodpecker holes • other activity Use notes to detail other activity, such as badger setts, pine marten activity.

11. Low resolution features to be recorded across monad

11.1 Low resolution hedgerow survey

This survey protocol is to provide an overview of linear habitat and connectivity within the monad. The objective is to collect low-resolution data of all hedgerows within the monad. This is in areas where permission is granted and there are clear views to the hedgerows. It includes hedgerows where high resolution data was collected from the linear hedgerow plot.

The definition of a hedgerow, for the purposes of EES, is described within the hedgerow survey chapter (see 6.4.1). As the purpose of this survey protocol is primarily to map habitat continuity, it incorporates a lower resolution definition, whereby hedges can be considered continuous if they:

- have 90 degree or greater bends
- continue beyond features such as walls or gates or narrow lanes

A linear habitat become discontinuous when:

- there are gaps of 20m or more
- where a hedgerow meets woodland or another habitat

Other habitat types will be recorded separately.

Pre-survey

As part of pre-survey monad preparation, you will need to study satellite imagery and cross reference it with the survey planning map to gain baseline information of onsite hedgerows and their locations. At this stage routes around the monad for other EES work can be planned. Optimise the route to incorporate observation of any potential hedgerows identified at the desktop study stage.

Methodology

Drawn linear features may or may not correspond with the satellite imagery base-map as the imagery will not be as current as on-the-ground observation. Draw what is observed at the time of the survey. This may require walking up to some hedgerows to verify GPS locations on the application map.

The protocol involves a walkover and mapping survey, so you can undertake it at the same time as other elements of the field survey.

You should:

- only survey and map areas within the monad where access permission is granted
- draw linear hedgerow features onto the hedgerow or linear habitat features layer
- not draw continuous lines where there is a gap of 20m or more, instead, draw a new line from where the hedge continues, if applicable.
- fill out the low-resolution hedgerows survey form (see table 15) once you have completed the mapping across the whole monad

Table 15: Low-resolution hedgerows survey form	
Variable	**Method and Comments**
Does the mapped hedgerow(s) continue beyond the surveyable area?	Yes/No
Estimate the level of hedgerow fragmentation within the surveyed area.	Estimate number of gaps of 20m or more
Is/are the surveyed hedgerow(s) representative of hedgerows within the visual local/wider area in terms of continuity?	Yes - similar No – more gappy than in the wider landscape No – less gappy than in the wider landscape Undetermined
Abundance of native hedgerows	Estimate the % of hedgerows in the monad that are predominantly native, that is they have >80% cover of native woody species

11.2 Trees outside of woodland: surveying small woods and groups of trees

'Trees outside of woodland' refers to any trees outside of a woodland habitat, which is defined by the Forestry Commission (2016) as:

- a wooded area covering at least 0.5 hectares
- having a minimum width of 20m
- having a minimum, or the potential to achieve, at least 20% tree canopy cover

See figure 10 for ToW categories.

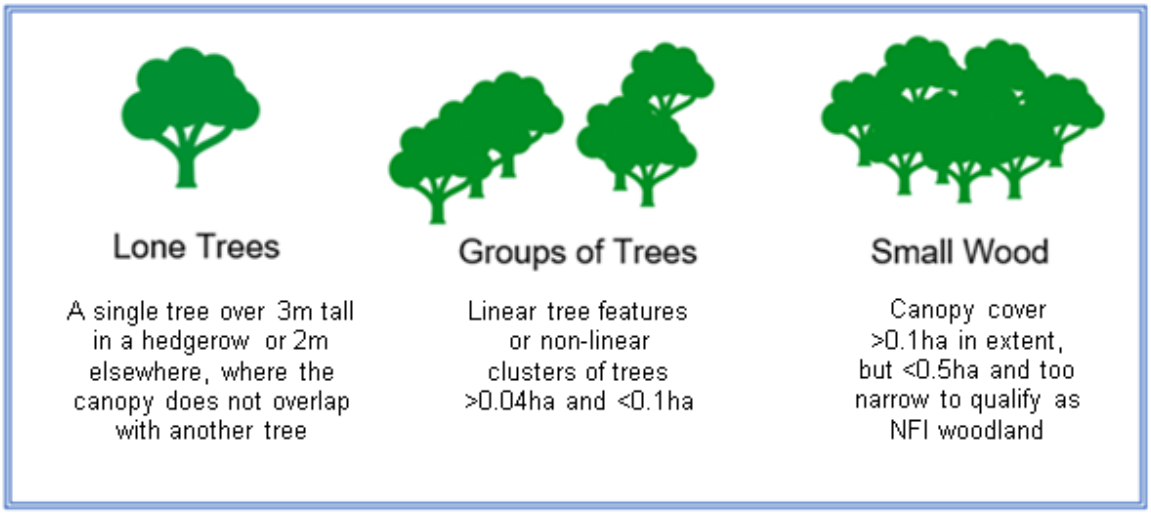


Figure 10 Trees outside of woodlands category definitions for EES (adapted from Forestry Commission, 2017)

Defining small woods and groups of trees

Small woods

A small wood as defined by the Forestry Commission (2017) is an area of canopy cover greater than 0.1ha but smaller than 0.5ha and is too narrow (<20m) to qualify as NFI woodland.

Groups of trees – clusters

Non-linear clusters are defined by the Forestry Commission (2017) as two or more trees with an extent of <0.1ha. For EES purposes, you should only map small stands or clusters of trees greater than the MMA of 0.04ha.

Groups of trees – linear

Linear tree features of at least 20m in length with a length to width ratio of roughly 4 to1. Includes lines of trees derived from hedgerows, lines of planted or managed trees, avenues and narrow windbreaks. The gap between the canopies must be less than 20m.

To differentiate a line of trees derived from a hedgerow from a hedgerow, look for:

- a natural shape resulting from a lack of management
- the base of the canopy being greater than 2m from the ground
- the width and cover of an associated shrub layer. If over 5m wide or has less than 20m of continuous canopy cover it can no longer be considered part of a hedge

Refer to the hedgerow guidance and protocol if there in some ambiguity differentiating between a line of trees and a hedgerow (section 6.4.1).

Pre-survey

You can identify small woods and groups of trees, including lines of trees, using aerial photographs and OS maps as part of your pre-survey preparation. At this stage you can also select the optimal route to record these alongside other features.

Survey Methodology

Within the areas with permitted access survey

- any small woods that fall entirely within the monad.
- any clusters of trees over the minimum mappable area of 0.04ha that occur in the squares.
- clusters of trees elsewhere in the monad if time allows. This is more likely in monads with few trees
- linear groups of trees anywhere in the monad

Map the feature in Sweet using the extent of the canopy to create a polygon and record the attributes and variables in Table 16.

Table 16: Variables to be recorded for small woods and groups of trees	
Variable	**Method and comments**
Aspect	Measure using a compass, from the highest point facing towards the lowest point or record as flat if there is no discernible slope.
Major canopy species	Record any species achieving over 25% canopy cover and record the % canopy cover.
Connectivity: Small Woodland	Record the distance in any direction to the nearest adjacent tree, predominantly broadleaved woodland, or hedgerow. Record in whole metres even if this extends outside the monad. Use the ruler tool and aerials as an aid. You may need to estimate, but you do not need to walk outside the monad.
Connectivity: Line of Trees Point A	From end closest to centre of monad in any direction, record the distance to the nearest adjacent tree, predominantly broadleaved woodland, or hedgerow. Record in whole metres even if this extends outside the monad. Use the ruler tool and aerials as an aid. You may need to estimate, but you do not need to walk outside the monad.
Connectivity: Line of Trees Point B	From end furthest away from centre of monad in any direction, record the distance to the nearest adjacent tree, predominantly broadleaved woodland, or hedgerow. Record in whole metres even if this extends outside the monad. Use the ruler tool and aerials as an aid. You may need to estimate. but you do not need to walk outside the monad.

11.3 Low resolution recording of watercourses

In addition to information collected in the vegetation plots, collect low-resolution data along the length of at least one watercourse in your monad. The more watercourses that can be surveyed the better and you can include those that pass through woodland This data will provide additional useful information on naturalness of hydrology, and habitat connectivity in your monad.

On land in the monad where you have access permission, you should:

- choose a watercourse or watercourses representative of your monad in terms of the degree of modification and habitat features along its length.
- map the watercourse(s) with the aid of the aerial photograph, as a line feature
- Walk the entire length and record the attributes and variables in table 17 across both banks.
- record the percentage of the watercourse that you were able to visually assess, if you could not access the whole length.

- take a photograph at the beginning and end of the stretch looking along the length surveyed.

If representative of the monad, you should use the stretch of river where you surveyed your riparian plot. This will compliment that data even though it will result in some duplication. If this is not representative choose one that is. Do not record along ditches.

You do not need to walk along both banks to complete the recording, choose the most accessible route and look across to the opposite bank.

If the watercourse divides, treat the minor tributary as a separate watercourse.

Do not attempt to record width and modification features if the river is in flood.

Table 17: Variables to be recorded along watercourses

Variable	**Method and comments**
Direction of flow	Record predominant direction of flow through the monad using one of the 8 compass points – N, NE, NW, S, SE, SW, E, W
Watercourse type	Record as either river (where river is >2.5m) or stream. Do not record ditches.
Headwater	Yes/No That is, within 2.5km of its furthest source. Identifiable on the OS 1:50000 maps as the start point of the blue line depicting a watercourse course.
Watercourse condition	Record as either dry, wet, in flood
Watercourse width	Estimate average bankfull width in metres (to the nearest 0.5 metres). Measure at one location on a straight reach with uniform banks if possible. Figure 4, section 6.5 Bankfull width - the horizontal distance across the channel at the level where the river first spills out of the channel. Where no distinct breaks in slope occur, estimate using clues to the winter flood level.
Bankfull height	Record in m to the nearest half metre Bankfull height is the vertical distance from water level on the day, to the point where the river first spills out of its channel on to the floodplain.

Riparian zone vegetation	Record habitat types along the length of the watercourse within 5m of both bank tops Record broad habitat Record priority habitat or EES other detailed habitat if present Record any habitats over 33% cover as extensive otherwise simply record presence
Extent of trees and associated features	Along both bank tops record as • none, • isolated/scattered. • Regularly spaced, • single, • occasional clumps, • semi-continuous, • continuous. and, associated with the trees • Shading of channel • *Overhanging boughs • *Exposed bankside roots • *Underwater tree roots • Fallen trees Record as None, present (if >1%), >33% *record if under 1%
Level of modification	Record as either 1. Natural/near natural (including channels engineered for natural habitat restoration) 2. Modified (for over 5% of surveyed length – artificial impounding structures may be present but rare and with limited impact) 3. Extensively modified (for over 33% of its length) and/or artificial impoundments have considerable impact Where the cross sectional and longitudinal profile of the channel has been modified through re-alignment, deepening, widening; bank reprofiling or reinforcement/protection; impounding structures such as weirs and dams; and other engineering works affecting the banks and channel.
Evidence of modification and management	Record the presence of indicators of modification from the following: • bank erosion • bank mowing • bank reinforcement, for example with woodpiling, gabion, stone

	• bank re-sectioned or reprofiled • bank undercutting • bridges affecting banks and channels, that is within channel supports or bank abutments occupying more than 10m of bank • dredging - recent or historically over deepened channel • fenced river/stream side • flood embankments • in channel structures, such as weirs, dams, sluices, deflectors, culverts and fords, where fords are permanent artificial fording places • large woody debris left • live trees in channel • poached bank (significant trampling by livestock or people) • realignment (if known) – can sometimes be seen in aerial photographs • river habitat restoration structures • scrub encroachment • structures on bank including boat moorings, jetties, boardwalks, fishing platforms • weed cutting
Presence of invasive non-native species	Record any INNS from the water channel, margins, bank face, bank top and the riparian zone 5m from the bank top. Record as Yes/No and species – refer to INNS list
Fauna	Record any sightings or signs of • dipper • dragonflies and damselflies • grey wagtail • heron • kingfisher • otter • sand martin • water vole
Percentage of watercourse surveyed	Percentage of bank habitat surveyed. (Survey all that is accessible/safe). Estimate as a percentage (to nearest 10%) - including any areas that may be inaccessible but can still be adequately assessed by eye from one bank or the other

Further guidance on recognising artificial features or modifications can be found in the surveyor library. List extracted from the 'River Habitat Survey in Britain and Ireland - Field Survey Guidance Manual (Environment Agency 2003)

11.4 Ponds – low resolution survey

The objective of this survey protocol is to obtain low resolution data for all ponds within the monad where access permission is granted. It is in addition to the full pond survey protocol in which a maximum of two ponds per monad are surveyed in detail.

As for the high-resolution recording, we are employing the definition of a pond as body of standing water 25 m^2 to 2ha which usually holds water for at least 4 months of the year. There may or may not be natural or artificial inlets and outlets. Ponds that are dry at the time of the survey are also included within this protocol, as are ponds within woodland provided access permission is granted.

Should you feel that this size limit does not reflect the character of your monad, and that there may be smaller bodies of water for which it would be useful to capture information, please use the notes section pertaining to the whole monad to record this.

Pre-survey

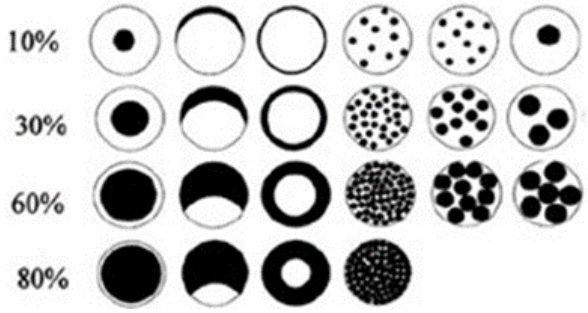
As part of pre-survey monad preparation, you will have studied satellite imagery and cross-referenced this with the monad access permission survey areas. This is to gain baseline information of potential onsite ponds and their locations. It is also good practice whilst organising survey dates and times to ask the owner/occupier(s) if they have knowledge of ponds in the monad area. At the pre-survey stage, routes within the monad can be planned and optimised to incorporate all aspects of EES survey.

Methodology

- The protocol can be carried out at any time whilst onsite as it is primarily a walkover mapping survey.
- Approach any ponds identified either during pre-survey or whilst onsite and determine their overall status. **Do not enter the water.**
- Using the drawing tool within Sweet, draw the area where the historical high-water level would be. (Refer to the full pond survey protocol (Section 10.1) for further guidance on determining the pond edge.)
- Drawn polygon features may or may not correspond with the satellite imagery base-map as the imagery will not be as current as on-the-ground observation. Draw what is observed at the time of the survey.
- Only map ponds within areas where survey permission is granted.
- Record the low-resolution pond features in table 18 for each pond.

Table 18: Low resolution Pond features	
Variable	**Method and Comments**
Is the pond present on the OS map	Y/N
Connectivity	Record if • there are waterbodies (including rivers, streams and ditches) or wetlands within 100m of the pond, • the pond is immediately surrounded by extensive waterbodies or wetland areas such as an extensive peat bog, many ponds or lakes, Y/N
Pond Status	Is the pond wet or dry at the time of the survey Wet/Dry
Perimeter accessible/surveyed (%)	Identify potential for accessibility only, you do not need to attempt to access any shoreline. Complete this metric for both wet and dry ponds. Record % of shoreline that is accessible, where zero % means shoreline is inaccessible.
Pond shading	Record % of pond that is shaded, where zero % means no shading This is an estimate of how much of the whole pond area (not the current water area) is directly overhung by structures, trees and shrubs including bramble; the proportion of the pond that would be shaded if the sun was directly overhead. Do not include shade from emergent pond plants
Inflows (natural or artificial)	Examples of artificial structures include weirs, dams' sluices. Record if present: • Nonapparent, for example, rain, groundwater, spring fed ponds, or dew ponds • Ditch (with control structures) • Stream (with control structures) • Ditch (without control structures) • Stream (without control structures) • Pipe or culvert with no apparent associated ditch or stream (these may not be visible, check with landowner where possible)

Outflows (natural or artificial)	Examples of artificial structures include weirs, dams' sluices. Record if present • Nonapparent, for example rain, groundwater, spring fed ponds or dew ponds • Ditch (with control structures) • Stream (with control structures) • Ditch (without control structures) • Stream (without control structures) • Pipe or culvert with no apparent associated ditch or stream (these may not be visible, check with landowner where possible)
Grazing intensity	Record the following • Percentage of aquatic and emergent vegetation grazed. (Stock often wade into shallow ponds to graze if there are no barriers.) • Percentage of pond perimeter grazed In 10% increments Grazing intensity. Record as either • absent • slight - some signs of grazing and little if any poaching • moderate - short-grazed vegetation and/or some poaching but <20% exposed, trampled mud on the margins • Major - heavily grazed and poached with between 20% and 90% of the pond banks and margins bare poached mud • heavily poached and almost bare
Emergent vegetation	Present/Absent
Floating/submerged vegetation	Present/Absent
Cover of aquatic vegetation	Record the percentage of the pond area, including any currently dry areas, covered by submerged, floating and emergent pond vegetation (excluding duckweed, *Azolla* species and filamentous algae). Record in 10% increments See diagram below as a guide

	
Invasive non-native species	Record presence in or adjacent to the pond of any invasive non-native species, for example: • American Mink *Neovison vison* • Canadian Pondweed *Ellodea canadensis* • Curly Waterweed *Lagarosiphon major* • Fish (Goldfish, Grass carp) • Floating Pennywort *Hydrocotyle ranunculoides* • Himalayan balsam *Impatiens glandulifera* • Japanese Knotweed *Fallopia japonica* • New Zealand Pigmyweed *Crassula helmsii* • Nuttall's Pondweed *Elodea nutallii* • Parrot's Feather *Myriophyllum aquaticum* • Water Fern *Azolla filiculoides* • 'other'.
Surrounding land use	Record the dominant land use within 100m of the pond

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Appendix 1: Living England ground data

Living England (LE) is a satellite-derived national habitat map that has been designed by Natural England. It was funded through the Environmental Land Management System and NCEA. It uses satellite imagery, habitat records and machine learning to classify England into different habitat and landcover classes. The Living England project produces a map which looks like Figure 11, where each coloured segment represents a different habitat class.

In order to accommodate the phenological and habitat variation across England within a single classification, and to facilitate the acquisition of cloud-free image mosaics, England has been divided into 14 biogeographic zones.

Figure 11 Living England Biogeographic Zones

To improve the accuracy of the satellite-derived map, regular provision of field survey data is required to train the model and carry out model validation. This consists of a surveyor visiting individual Living England segments. They will use the ArcGIS Field Maps app to classify what the habitat class actually is (as opposed to what Living England predicts it is). This way the Living England model 'learns' where it has correctly or incorrectly classified segments, and accuracy will be improved

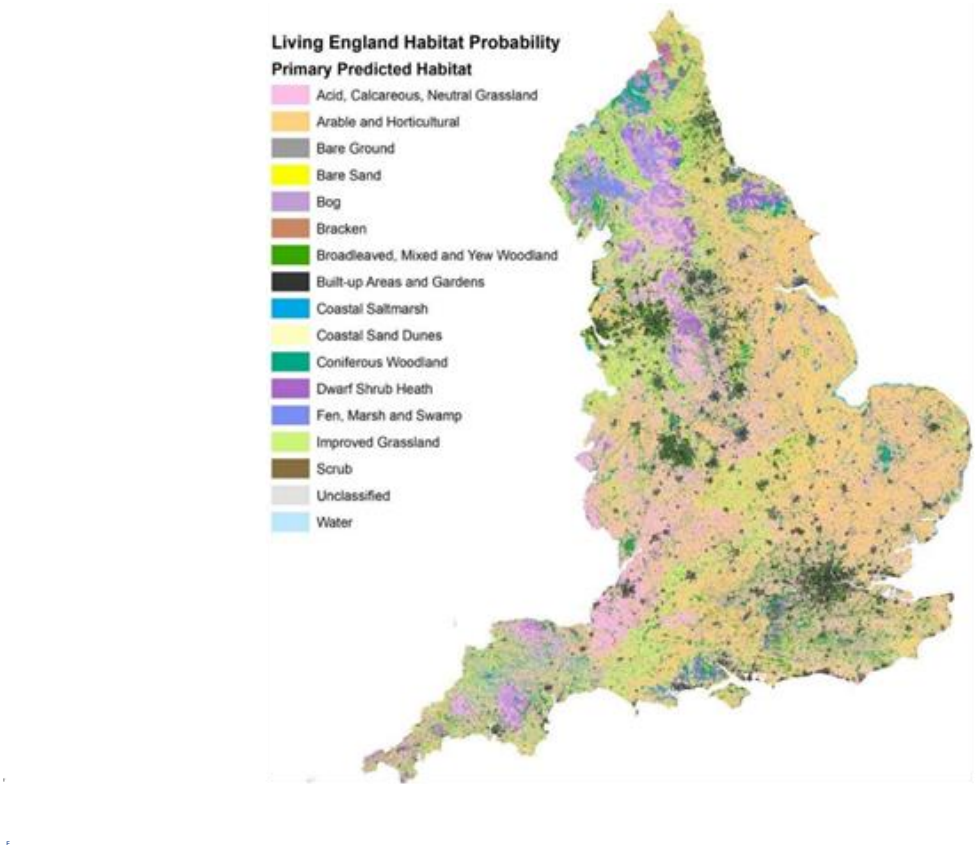


Figure 12 Living England Phase IV habitat probability map. © Copyright Natural England 2022.

Living England Habitat Classification

Living England follows the UK Biodiversity Action Plan (UKBAP) classification framework with some adjustments, as shown in Table 19 (JNCC, 2011).

The LE UKBAP Classification Framework sets out the relationship between ecosystems, broad and priority UKBAP habitats, and the

"Broad" and "Detailed" LE Classification.

In most cases, 'Detailed' LE habitats equate to the broad UKBAP level. Exceptions are introduced where classes can or cannot be confidently mapped in relation to the resolution of Sentinel-1 and Sentinel-2 satellite imagery. These include:

- acid, calcareous, neutral grassland - which is combined with semi-natural grasslands at the ecosystem level
- coastal sand dunes and coastal saltmarsh are mapped at the higher resolution priority habitat level
- segments labelled as ‘Unclassified’ typically indicate locations where cloud-free satellite imagery was not available or where urban areas are misclassified as cloud
- for Phase IV Inland rock and bare soil or peat were combined into bare ground

Table 19 Living England Phase IV UKBAP habitat classification framework

Detailed Habitat	**UKBAP Level**	**Broad Habitat**
Acid, calcareous, neutral grassland	Semi-natural grasslands	Grassland
Arable and horticultural	Broad	Cropland
Bare ground	EO Resolution	Bare ground
Bare sand	EO Resolution	Bare ground
Bog	Broad	Wetland
Bracken	EO Resolution	Grassland
Broadleaved, mixed and yew woodland	Broad	Woodland
Built-up areas and gardens	Broad	Urban
Coastal saltmarsh	Priority	Coastal
Coastal sand dunes	Priority	Coastal
Coniferous woodland	Broad	Woodland
Dwarf shrub heath	Broad	Heath
Fen, marsh and swamp	Broad	Wetland
Improved grassland	Broad	Grassland
Scrub	EO Resolution	Woodland
Water	EO Resolution	Freshwater
Unclassified		Unclassified

To improve the transferability of ground data collected for LE, an additional level of habitat detail beyond UKBAP priority habitat level is taken from the European Union (EU) Habitats Directive. Refer to Annex 1 of the Directive, the habitat classification framework (EU, 2013).

Collecting Living England Ground Data

LE ground data is to be collected at all survey locations in the monad. And, if time permitting, at as many points as possible between the survey locations, particularly where there is an under-represented habitat or an area where priority habitat needs to be corrected.

LE has been designed as a quick and easy method to use. Once you have identified the correct habitat levels from the indicator species present, it only takes 5 mins to capture the data and take photographs. You should take two photographs, one looking down at the vegetation near your feet and one of the surrounding habitat within the segment.

You can find full details of the survey method in the 'Living England Specification for Ground Data Collection' document (see surveyor library). This document provides information on:

- how to plan LE surveys
- how to identify under-recorded habitats
- a step-by-step guide to the field method
- collecting ground data points in the field using the ArcGIS Field Maps app

Planning your route

You should record the 'under-recorded habitat classes' for the Biogeographic Zone you are in. LE data collection should focus on these under-recorded classes as there is currently insufficient data in these habitats to create a reliable classification. LE requires at least 50 data points per year in each habitat class in every Biogeographic Zone.

Up-to-date, under-recorded habitat classes for each Biogeographic Zone can be found on the AGOL LE Ground Data Dashboard

The Living England Quick Start Guide to ground data collection (see surveyor library) provides a guide to using these tools. It also provides information on obtaining access permissions for Living England surveys if collecting data outside of the monad.

Where to collect ground data

LE ground data collection is designed to be quick and simple. It is ideal to do alongside the other survey protocols that you undertake in your monad.

To use your time efficiently, undertake ground data collection as you move around the monad when completing other parts of the survey. For example, as you walk to a plot, you should do LE ground data collection in the LE segments you happen to be walking through. Then from the segment containing your plot and the segments in the surrounding hectare square. See Figure 13 for an example of how LE ground data collection was incorporated into a route around a monad in the North Yorkshire Moors.

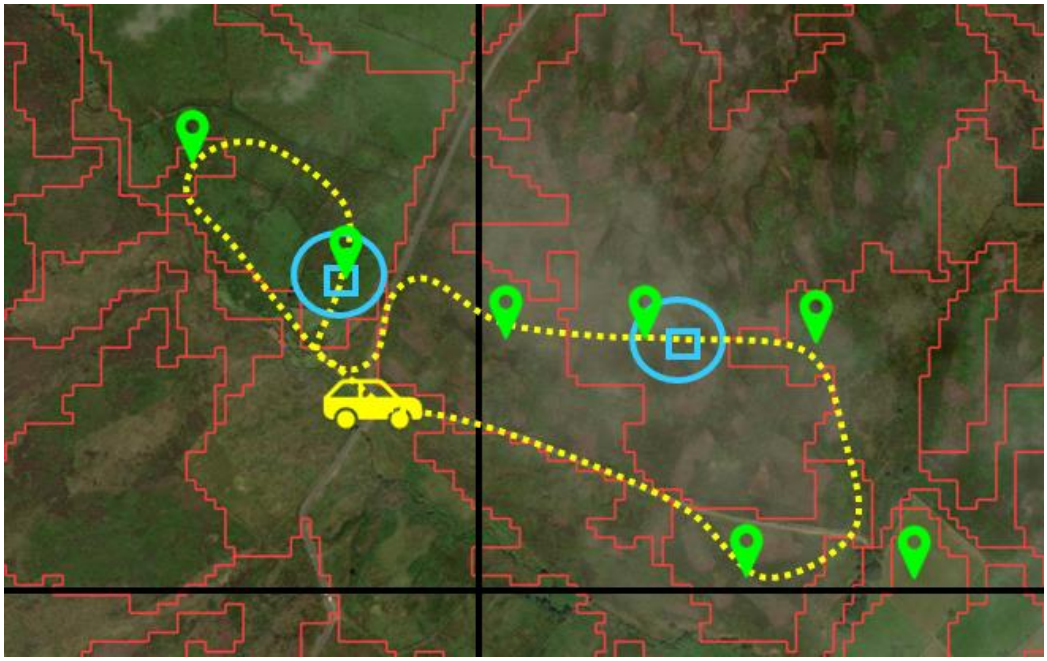


Figure 13 an example day route (yellow dash) between two of the vegetation squares and plots (blue) collecting Living England ground data points (green) within nearby Living England segments (red). Background shows ESRI world imagery for context. The car symbolises direction of movement, you will be on foot

The surveyor library has links to:

- all the Living England Survey Method Guidance including the Living England Classification Framework
- habitat descriptions to help you capture the correct habitat types when using the Field Maps app

Appendix 2: EES broad habitats, priority habitats and stand mapping

Key to Table 20

Shaded cells mean habitats which will be mapped only. Stand variables will not be collected. Hedgerows, ponds and riparian habitat have their own separate protocols.

Habitat mosaics – Record as a mosaic and record the habitats that make up the mosaic, referring to the list in Table 20

Transitional habitat – Choose habitats that the vegetation sits between.

Habitats or feature-types marked with an asterisk (*) can be recorded as components of the larger surrounding habitat if they fall below the minimum mappable area of 0.04ha. Record the indicator species for these habitats.

Table 20 Habitat Classification

UK BAP Broad Habitats	**Priority habitats (in bold)** and other detailed habitats	**Priority habitat feature types**	**Notes**
Calcareous grassland (CG)	**Lowland calcareous grassland**		Unimproved
	Upland calcareous grassland		Unimproved
	Good quality semi-improved calcareous grassland		Not unimproved/priority habitat but retaining interest - record against CG indicator lists
Acid grassland (AG)	**Lowland dry acid grassland**		Unimproved
	Upland acid grassland, moorland and rough grazing		Record negative indicators only (positive indicators TBC)
	Good quality semi-improved lowland acid grassland		Not unimproved but retaining interest – record against

			lowland AG indicators
Neutral grassland (NG)	**Lowland meadows**		Unimproved (MG4,5 and 8)
	Upland hay meadows		Unimproved (including MG3)
	Good quality semi-improved neutral grassland		Not unimproved meadows but retaining interest – record against NG indicators
	Other neutral grassland		Can be unimproved but does not qualify as priority habitat as comprises common, intrinsically species-poor communities. Record against NG indicator species
Improved grassland	**Coastal and floodplain grazing marsh (CFGM)**		For improved and semi-improved grassland types where they occur on CFGM, map type and select option for CFGM
	Improved grassland		No indicators to record but record other stand variables
	Poor quality semi-improved grassland		
Coniferous woodland			
Broadleaved, mixed and yew woodland	**Wood pasture and parkland**		Record component habitats beneath the trees. Individual trees

	Traditional orchard		can be picked up under ToW protocols Orchard that is no longer managed as such but retains old fruit trees record as defunct
	All other types of broadleaved, mixed and yew woodland.		
Dense scrub	Predominantly native		>90% cover shrubs usually <5m tall but can include scattered trees Not including dwarf/western gorse, which are part of the heathland habitat, nor creeping willow
	Predominantly non-native		
Arable and Horticultural	**Arable field margins ***		Not mapping arable field margins unless above MMA but include as component of arable field and record indicator species
	Arable		Veg plots to be carried out but **not** collection of stand variables.
	Temporary grassland or ley		Grassland occupying the ground for 1 to 5 crop years. Veg plots, but no stand recording, required. Record as crop type under arable

	Horticultural		Including commercial or intensively managed orchards
Boundary and linear	**Hedgerows (native)** i.e, >80% cover of native species Hedgerows non-native		Record and map as per hedgerow protocols
Rivers and streams	**Rivers (which includes small streams and headwaters)**		Record and map as per riparian protocols
Standing open waters	**Ponds** Lakes Canals Ditches		Ponds (25 m^2– 2ha in area) to be mapped and recorded as per pond protocols.
Dwarf shrub heath	**Lowland wet heath** **Lowland dry heath** **Upland wet heath** **Upland dry heath** Fragmented heath		Fragmented heath = dwarf shrubs frequent but less than 25% cover
Bog	**Blanket bog** **Lowland raised bog (which can occur to moderate altitudes)**		Degraded bog (little or no *Sphagnum* and dominated by grasses or dwarf shrubs also recorded here
Fen, marsh and swamp	**Lowland fens** **Reedbeds**		
	Upland fens, flushes and swamps	**Short-sedge* acidic fen (upland)**	Map and record the component habitat/feature types Soakway and sump – record positive indicators only
		Soakway and* sump (upland)	
		Upland alkaline* fen	

		(excluding alpine flush)	Alkaline fen – record positive indicators only
		Spring-head, rill and flush (upland)*	
		Alpine flush*	
		Transition mire, ladder fen and quaking bog (upland)*	
	Purple moor-grass and rush pastures		
Tall herbs	Tall herbs ruderal Tall herbs non-ruderal		
Bracken	Dense Bracken		Canopy cover >95% at height of growing season
Inland rock	**Lowland calaminarian* grassland**		Vegetation on metalliferous substrates. Not restricted to rock; can include e.g. small spoil heaps
	Upland calaminarian grassland and serpentine heath *		
	Inland rock outcrops and scree habitats	**Calcareous rocky slope (upland)** **Calcareous scree (upland)** **Tall herbs* (upland)**	Map and record against the relevant feature-type On ungrazed, species-rich ledges – record positive indicators only

	Limestone pavements		
	Open mosaic habitats on previously developed land		Revegetating areas on quarries, mines, disturbed ground etc
Montane	**Mountain heath and willow scrub**	**Alpine dwarf shrub heath**	Map and record against component habitat/feature types
		Alpine summit communities of moss, sedge and three-leaved rush	
		Juniper heath and scrub (upland)	
		Montane willow scrub	Montane willow scrub – positive indicators only
		Moss, dwarf-herb, and grass-dominated snow-bed	Snow-bed– positive indicators only
		Yellow saxifrage bank (upland)*	Yellow saxifrage bank indicators – positives only
Built-up and gardens	Built up areas and gardens		To include curtilage, transport routes, hard-surfacing working quarries, unvegetated ground/spoil, mines, allotments, private gardens etc

Littoral sediment	**Coastal saltmarsh**		
Supralittoral sediment	**Coastal sand dunes**	**Dunes with Salix repens**	Combined list for sand dunes available if recording an intimate mosaic or record against the four component habitat/feature types
		Fixed dune grassland	
		Humid dune slacks	
		Strandline, embryonic dunes and mobile dunes	
	Coastal vegetated shingle		
Supralittoral rock	**Maritime cliff and slopes**		

Appendix 3: Recording bryophytes and lichens

You must focus on recording vascular plants, especially sedges and grasses. Record them accurately and completely, instead of spending effort on identifying bryophytes. Even if you record those listed below, this will often only represent part of the total, which is why there is a higher priority to recording total bryophyte cover and the cover of coarse *Sphagnum* categories.

Table 21 Bryophyte species to record (if possible)

Species
Atrichum undulatum
Aulacomnium palustre
Brachythecium albicans
Brachythecium rivulare
Bracyhthecium rutabulum
Breutelia chryoscoma
Bryum pseudotriquetrum
Calliergonella cuspidata (Calliergon cuspidatum)
Calliergon giganteum
Campylium stellatum
Campylopus introflexus
Campylopus sp.
Climacium dendroides
Cratoneuron (Palustriella) commutatum
Ctenidium molluscum
Dicranella heteromalla
Dicranum majus
Dicranum scoparium
Drepanocladus aduncus Only in swamps, not flushes
Eurhynchium sp/Oxyrrhynchium/Kindbergia.
Fissidens sp.
Fontinalis antipyretica
Hedwigia stellata
Homalothecium lutescens
Homalothecium sericeum
Hookeria lucens
Hylocomium splendens

Table 21 Bryophyte species to record (if possible)
Species
Hypnum cupressiforme
Hypnum jutlandicum
Leucobryum glaucum
Mnium hornum
Neckera crispa
Pellia spp.
Philonotis fontana
Plagiothecium sp.
Plagiothecium undulatum
Pleurozium schreberi
Polytrichum commune
Polytrichum juniperinum
Pseudoscleropodium (Scleropodium) purum
Ptilidium ciliare
Racomitrium lanuginosum
Rhizomnium punctatum/pseudopunctatum
Rhytidiadelphus loreus
Rhytidiadelphus squarrosus
Rhytidiadelphus (Hylocomiadelphus) triquetrus
Scorpidium scorpioides
Sphagnum green/fat
Sphagnum green/thin
Sphagnum red/fat
Sphagnum red/thin
Thamnobryum alopecurum
Thuidium tamariscinum

Sphagna groups

- *Sphagnum* (green and fat)
- *Sphagnum* (green and thin)
- *Sphagnum* (red and fat)
- *Sphagnum*(red and thin)

The simple classification above includes the Sphagna species identified in table 22 (following AJE Smith, *The moss flora of Britain and Ireland* (1978).

Table 22 Key species of Sphagna within each group	
Green and fat	**Green and thin**
S. compactum	sect. Cuspidata*
S. molle	*S. fimbriatum*
S. palustre	*S. fuscum*
S. papillosum	*S. girgensohnii*
S. squarrosum	*S. recurvum* (note this species is now part of *S.fallax)*
S. strictum	*S. russowii* (green form)
S. subsecundum (Sect.)	*S. quinquefarium*
S. teres	(* includes *S. tennellum* and *S. cuspidatum*)
Red and fat	**Red and thin**
S. medium	*S. subnitens*
	S. russowii (red form)
	S. warnstorfii

Table 23 Lichen species to record (if possible)
Species
Cetraria aculeata
Cetraria islandica
Cetraria sp.
Cladonia arbuscula
Cladonia cervicornis
Cladonia chlorophaea
Cladonia ciliata
Cladonia coccifera
Cladonia coniocraea
Cladonia crispata
Cladonia fimbriata
Cladonia floerkeana
Cladonia furcata
Cladonia glauca
Cladonia gracilis
Cladonia macilenta

Table 23 Lichen species to record (if possible)
Species
Cladonia ochrochlora
Cladonia polydactyla
Cladonia portentosa
Cladonia pyxidata/coccifera
Cladonia ramulosa
Cladonia rangiferina
Cladonia rangiformis
Cladonia sp.
Cladonia squamosa
Cladonia subcervicornis
Cladonia subulata
Cladonia uncialis
Cladonia verticillata
Hypogymnia farinacea
Hypogymnia physodes
Hypogymnia sp.
Hypogymnia tubulosa
Parmelia sp.
Peltigera canina
Peltigera sp.
Placynthiella icmalea
Placynthiella oligotropha
Placynthiella uliginosa
Ramalina sp.
Trapeliopsis granulosa
Usnea sp.
Xanthoria parietina

Appendix 4: Recording vegetation structure using roundrats

The following is adapted from Natural England's guidance on techniques, principles, and methods for monitoring both invertebrates and their habitats.

A pragmatic approach to capturing a unit's structural complexity is to look at the diversity and range of 'functional ecological surfaces' (FES). That is, habitat surfaces present within a habitat or vegetation type.

Within each stand, the vegetation and other surfaces (such as exposed sediment or water) are imagined as a series of three-dimensional 'blocks' with an average 'surface' height.

Individual plants or clumps or areas of vegetation might be seen to exist within the bounds of an imaginary box, or 'block'. A habitat can be seen as a series of 3-D blocks with a, but differing, surface topography.

The technique is then to count the obvious surfaces, reducing the complexity of the heterogeneity to a manageable scale and relying on those surfaces as a proxy for all that lies beneath and between.

Important considerations in what constitutes a surface:

- Surfaces are independent of species composition – the same species or plant community can form different surfaces and a single surface can be composed of several species.
- As a working rule, a surface should be large enough in area such that, if it was on the ground, you could stand in it.
- A water surface *always* constitutes a separate surface, though the water body needs to be a 'reasonable size' i.e., bigger than a dinner plate.
- If you cannot easily see a surface, it is probably not really there.
- Wet mud, peat, sand, or shingle adjacent to water always form a surface, albeit a wet one.
- Individual shrubs/small trees within an otherwise uniform sward form a surface.
- Where a fairly uniform vegetation surface is punctuated by higher, sparser pieces of vegetation, there is only one surface to consider.
- Early successional surfaces need to have more bare / thin / lower plant cover than successional higher plant cover (for example, ground-hugging composites) for them to count.

To provide a framework within which to capture a unit's structural complexity, use Structural Recording Surveys (SRS) to look at the diversity and range of 'functional ecological surfaces' (FES) present within each area.

The technique is to survey several points or stops within the stand. Make assessments of the heterogeneity at each of the stops using Structural Recording Samples (SRS). SRS are circular (of 6m radius - area 113m^2) and can be described colloquially as 'roundrats'. Figure 14 shows a stand of vegetation with five different surfaces and an imaginary 6m radius roundrat.

Figure 14 Functional ecological surfaces and roundrat (Heaver et al 2008)

With a standard SRS, go to the point to be assessed. Define a 6m radius out from it, either by:

- pacing
- marking the edges with rucksacks or something similar
- eye

and stand in the middle

From within the 'Roundrats', the FESs present are identified and recorded. It is important to note that the underlying topography of the substrate is not what is being assessed here, so that a uniform grass sward over ridge and furrow would still only express a single surface and not take account of the undulations. However, if the vegetation responded differently to these changes in microtopography, for example having a lush and taller growth, then this would be recorded as a change in surface.

The different FESs recorded in the EES are:

- Open water
- Bare ground, ESS (Early Successional Surfaces) -useable
- Bare ground - unusable
- Low bryophytes, lichen
- Very short grass, herbs, and heather

- Medium grass, herbs, building heather
- Tall grass, herbs, hay meadows (added for EES)
- Low scrub, tussocks, mature heather
- Young scrub < 2.5m
- Mature scrub, trees > 2.5m
- Tree canopy

Note the presence of these FESs at each stop. This data will be recorded in 2 ways:

1. Frequency of occurrence of each FES across the stand, that is, if found in 1 out of 10 stops then this would have a 10% frequency of occurrence.
2. Average (modal) number of surfaces present at each stop.

There is a range of ways that an SRS might be located within the general habitat, including:

- standard distance pacing, for example, walk 60 paces, stop, undertake SRS assessment, walk, repeat
- a standard W-walk

A standard assessment should use 10 SRS. This gives a ground coverage of 1130 m^2 and is comparable to the quadrats used in botanical assessment. In large stands, more assessment points may be needed to achieve representative coverage within the unit. However, in large stands with little structural diversity 10 SRS may be adequate. These should be in the W walk across the Square.

Appendix 5: Protocol for assessing and relocating soil plots

Adapted from the EES Soil Survey Manual – refer to that manual for further information

8.1 Summary of soil survey process

Within the 16mx16m soil plot there are four sampling points placed 2m apart. These are distributed around the 2x2m vegetation plot and comprise 1m^2 areas of disturbance where different soil samples are taken. These samples will undergo laboratory analysis of physical, chemical, and biological soil properties.

The vegetation plot and 1.5m buffer zone are to remain undisturbed during the survey. The co-location of soil sampling points and vegetation plot provides valuable information about the relationship between the plants and the soil.

A Natural England pre-survey desk study to identify suitable 16mx16m soil plot locations will not include an assessment of suitability for the vegetation surveys. If the vegetation and landscape survey precedes the soil survey, you will need to assess this in the field using the protocol in 8.2.2 below

8.2 Assessing suitability of the plots

8.2.1 Desk study completed by Natural England

The NE presurvey desk study to identify suitable 16x16m soil plot locations looked at the following:

- land where soil cannot be sampled due to designations, such as scheduled Ancient Monuments.
- land where sampling would be unsafe, such as landfills, quarries.
- presence of known underground and overhead utilities.
- unexploded ordnance hazard level (UXO).
- presence of significant non-uniformities within the plot, such as trees, tracks, paths, different habitats, different soil types (see criteria for assessment of plot suitability in the field, section 8.2.2).

The desk study did not include assessment of suitability for the vegetation surveys and does not guarantee that the default plot is safe and suitable for the survey. The suitability of the plot must be confirmed before the soil survey can begin.

The map in the field data collection app, Survey 123, shows grids of alternative plot locations within a monad. There will be between two and six grids in each monad. Each grid is centred on a default plot location. Each plot is numbered (1-169) and has a suffix indicating results of the desk study assessment carried out by Natural England, for example 61_SX. The central plot of the grid, no. 85, is the default plot location (Figure 15).

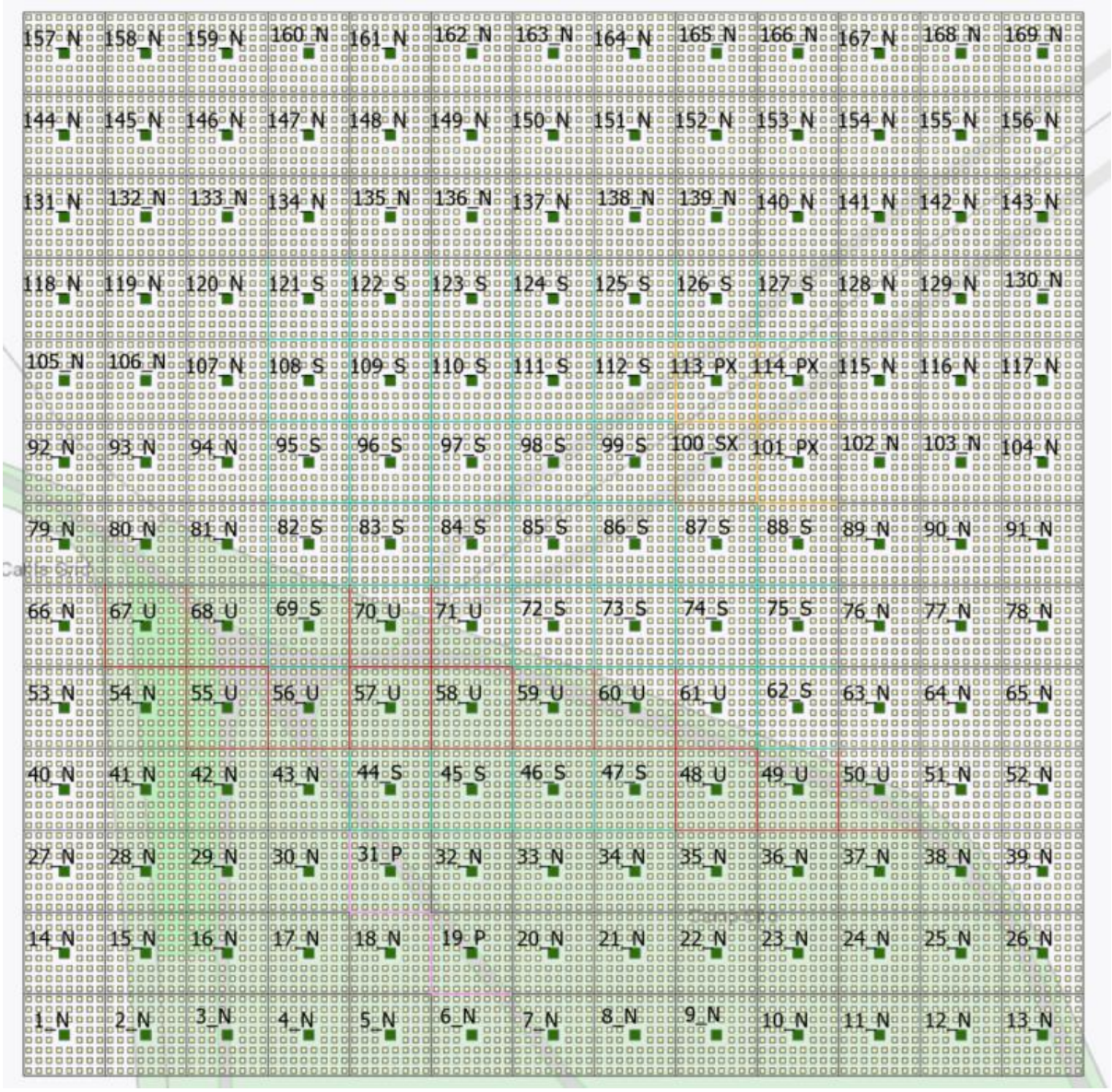


Figure 15: Example of grid of alternative plot locations numbered from 1-169.

The suffixes used in Figure 15 to denote suitability of plots for the soil survey are defined as:

S – plot deemed as suitable for the soil survey, carry out field checks on field identifiable features to verify.

P – plot deemed potentially suitable for the soil survey. Carry out field checks on field-identifiable features to verify.

U – plot deemed unsuitable for the soil survey, either due to hard constraints or non-homogeneity. Must not be surveyed.

N – suitability for the soil survey not assessed. Carry out field checks on field-identifiable features to verify.

X – additional suffix indicating UXO risk higher than low. Soil surveys must not be carried out without nonintrusive UXO survey and explosive ordnance clearance, but field checks can still be carried out

8.2.2 Assessing suitability of survey plots on site

Every soil survey plot must have a suitable vegetation plot at its centre. The soil plot is not surveyed if the vegetation plot is unsuitable (see section 3.3 for suitability criteria for the vegetation plot)

If the randomly selected 2mx2m vegetation plot is suitable this must be surveyed following the protocol in section 6.2. If the associated soil plot is unsuitable, an alternative soil plot will need to be identified and an additional 2mx2m vegetation plot recorded at its centre.

If you are on site before the soil surveyors, you must

1. Locate and survey the randomly selected 2x2m vegetation plot either at its default position or, if unsuitable, relocated 16m to the W, N, E or S. See section 3.3 Moving or abandoning a subsample. If none of these locations are suitable abandon the plot and move to step 4
2. Assess the suitability of the associated soil plot by looking around and applying the criteria given below (8.2.3). If the soil plot appears suitable after this quick check, walk outside it along its perimeter, keep assessing its suitability, and mark the corners with flags or canes.
3. Check the suitability of the soil plot again, now looking at the marked extent of the soil plot.
4. If the vegetation plot is suitable but the surrounding soil plot is not, or if the vegetation plot was abandoned, using the soils alternative grid in Sweet:
    - select a suitable soil plot with a suitable vegetation plot at its centre. Assess the closest in-between options in this order: SW, NW, NE, SE (plots no. 71, 97, 99, 73 in figure 15 above, 85 being the default position of the randomly selected 2x2m vegetation plot). If none of the above are suitable, continue assessment of further alternative plot options one grid segment further from the default plot in clockwise order starting from plot no. 59, 58, 57, 70 and so on, even if that takes it out of the 1ha square
    - In Sweet, create the soil vegetation plot (choose V7 to V12) at the centre of the suitable soil plot and survey it as you would the randomly selected vegetation plot. You do not need to record any further information about the soil plot.

8.2.3 Criteria for suitability of a soil plot

A soil plot is unsuitable if:

- the vegetation plot in its centre is unsuitable. If the vegetation plot is moved or abandoned the soil plot must be moved
- (the plot is crossed by underground utilities or overhead power lines. – only applicable to the soil surveyors, you will not need to check this)
- there is no or very limited soil present on a large part of the plot making soil sampling very difficult. For example, exposed rock or scree slopes
- a significant part of the plot has got a different macro or microtopography such as vertical exposures, half ridge and furrow and half not
- there are significant differences in slope or aspect in parts of the plot giving rise to differing soil characteristics, for example part of the plot is on a slope and part is level
    - except where there is spatial variation at a plot scale characteristic of the surrounding area such as eroded revegetated blanket bog

- there is significantly different land use or land management in parts of the plot such as grassland and arable
- crossed by a field boundary, even if management on both sides of the boundary appears to be the same
- the plot is an unusual landform otherwise not present in the surrounding area, such as a single mound or hollow
- part of the plot is subject to localised erosion, compaction or superficial damage, where this is not a regular, unavoidable feature of a larger area, such as erosion rills, vehicle tracking, scrapes, gullies
- part of the plot is noticeably wetter or drier
- there are man-made structures in the plot, such as
  - a path
  - track
  - materials storage (manure, soil, hay)
  - soil stripping
  - electricity pylon
  - drainage ditch (except frequent moorland grips)
  - animal path crossing through the field
  - feeding stations where animals gather.
- part of the plot appears to be influenced by localised pollution or nutrient enrichment
- the plot includes two different habitats, stands etc, unless it is a typical feature of the surrounding area, a pattern occurring at a plot scale which would be impractical to avoid.

The soil plot is also unsuitable if large shrubs are present in the plot. Small shrubs, such as heather that are in keeping with the surrounding habitats and would not interfere with sampling are permitted.

It is also unsuitable if large animal burrows are present (rabbit warrens, badger setts etc.) but sampling point suitable if only the occasional burrows such as, mole hills, are present. Look around the plot and nearby for signs of badger activity. Follow guidance given in Appendix 4 of the EES Soil Survey manual for signs of badgers. Choose a plot buffered by at least one more plot from a plot where a badger sett is suspected.

A soil plot that is currently unsuitable may become suitable later in the same survey campaign if:

- plot is flooded.
- potentially dangerous animals, such as bulls, cows with young calves, are present within the plot (enquire with farmer/landowner).
- fertilisers, manures, waste materials or pesticides have been applied within last month

8.2.4 Vegetation survey following soil survey

The soil surveyors will have assessed the randomly selected 2mx2m vegetation plots and associated soil plots for their suitability. If found to be unsuitable they will have chosen an alternative soil plot from which to collect soil data. They will not have collected any vegetation data; you must do this. Referring to the dashboard in Survey 123 you must

1. Check the location of the randomly selected 2x2m vegetation plot and associated soil plot as selected by the soil surveyors, and survey the vegetation plot at this location

This may be at the default location or, if that was judged unsuitable, moved 16m to the W, N, E or S. Navigate to the selected location using the soil plot grid in Sweet and record the plot variables and attributes. Use the options in Sweet to note if it is at the default position or has been moved.

If the soil surveyors deemed all five possible locations unsuitable for a soil survey, they will have chosen an alternative plot, in which case continue to Step 2

2. Assess the suitability of the randomly selected 2x2m plot for a vegetation survey following the protocol in 3.3. It must still be recorded as a standalone plot in the absence of an associated soil plot, unless it has to be abandoned altogether

3. Having surveyed the randomly selected 2mx2m plot as a standalone plot, navigate to the alternative soil plot chosen by the soil surveyors. Use the freely placed soil vegetation plots V7-V12 in Sweet to plot and record an additional 2mx2m plot at its centre following the protocol in section 6.2

Appendix 6: Fixed point photography for landscape assessments

This appendix sets out the technical set up and guidance for taking the landscape fixed point photography using an iPad, tablet mount and tripod. At each landscape survey point (LD1 – LD6) the following photography will be undertaken to accompany the landscape assessment:

- **4 x Single Frame Images taken at 45 degree intervals**

  These images will be taken from and stored within the Sweet App

- **1 x Panorama taken with the default iOS camera app using auto-panorama mode**

  Panoramas will be taken using the iPad camera app and then named and stored in Quatrix (following secure file transfer protocol [SFTP]). SFTP including Quatrix account registration, file naming, iPad file storage and transfer of images can be found in the surveyor library.

Equipment required:

- iPad 9th Generation
- Tripod in carry case
- iPad mount for tripod
- Tape measure (or piece of cord/string cut to 140 cm)

iPad camera settings

Ensure these settings are established on iPad device before taking any landscape photographs. Applying settings within Sweet isn't required and step 3 isn't relevant for single frame images in Sweet.

1. Ensure location service for camera app is switched on
2. In the iPad camera app settings, ensure the Format is set to 'Most Compatible'
3. Ensure the 'Grid' is turned on under Composition
4. Ensure Keep Normal Photo is 'on'
5. When the iPad camera app is used for photography ensure that the Live photo mode is set to 'off' and that the HDR mode is set to 'off'. You can preserve the Live photo mode setting in the main camera app settings.

Live photo mode off

Setting up the tripod and mounting the iPad

1. Fully extend the tripod legs and lock them in position. Use the spirit level bubble on the tripod to adjust the legs as necessary to obtain a level setting.

2. Remove the sliding camera plate from the tripod head clamp and attach to the bottom of the iPad mount with the ¼ inch thread screw – making sure it is tightened up.

3. Attach the iPad mount on the plate back onto the tripod head clamp and tighten up.

4. **Note** – for the Single Frame Images the iPad must be mounted in landscape position, for the Auto Panorama mode the iPad must be mounted in portrait position

Single Frame Images (landscape)

Auto Panorama (portrait)

5. Adjust the tripod central column so that the iPad camera lens is at a height of 140 cm (measure or use pre-cut cord/string to height)

6. Make any adjustments to the tripod ball head, so that the iPad sits both vertically and horizontally level (see images above). You can use a Spirit Bubble App on the iPad to ensure a good horizontal level. It is important that the iPad camera is set up level.

Taking the Single Frame Images (iPad in landscape position, using Sweet App)

1. Set up so that iPad camera is aimed at the left side of your landscape scene. Make sure that the camera is not zoomed in (it should say x1)

2. Identify a suitable point in the scene to focus the lens (try a tree, building or other landscape feature in the middle distance). Hold your finger on the iPad screen on this point until the auto focus locked symbol appears as “AE/AF Lock” in a yellow box.

3. Take the first image, then rotate the tripod head by 45 degrees to the right and take the second image. Repeat these steps until you have taken the 4 Single Frame Images. Be careful to rotate with the tripod head and not the ball joint.

Rotate with tripod head

Taking the Auto Panorama (iPad set in portrait position, using camera App)

1. Set up so that iPad camera is aimed at the left-hand side of your landscape scene. Make sure that the camera is set to ‘PANO’.

2. Identify a suitable point in the scene to focus the lens (try a tree, building or other landscape feature in the middle distance). Hold your finger on the iPad screen on this point until the auto focus locked symbol appears as “AE/AF Lock” in a yellow box.

Note: you will need to focus on a point that is just outside the greyed-out panorama window

3. Loosen the tripod head (not the ball joint) so that it easily rotates. Press the camera shutter button and slowly and steadily rotate the iPad on the head until you reach the right-hand side of your landscape scene. Press the shutter button again at the end to complete the panorama. Check the results of your panoramic image.

Your panorama images will be stored within the iPad Photos App and will require re-naming and storing in file folders for each Monad ready for transfer onto Quatrix. Further guidance on the protocols for file naming, iPad file storage and transfer of images can be found in the surveyor library

Appendix 7: Recording plot locations to aid re-survey of plots

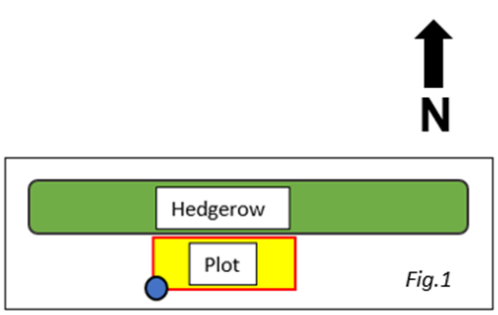
While plot location will be marked by GPS, it is important to supplement this with other methods. This will ensure that surveyors returning to the same plot in future years can be confident they are in the same location.

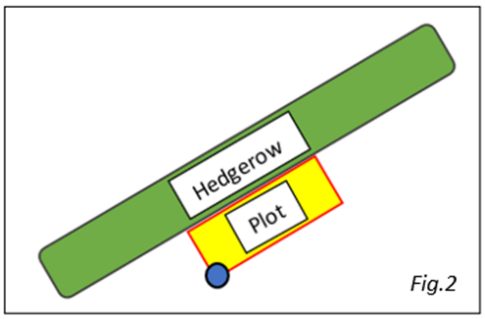
Below is a summary of methods available to mark plot locations. This only applies to hedgerow linear, riparian and stand vegetation (2m x 2m) plots.

Permanent markers

In some locations permission may have been granted by the landowner to install permanent markers (such as pegs or plates) Follow the steps below when installing permanent markers.

1. Choose which corner of the plot to install the marker. Where possible this should be the south-west corner. Make it clear in the sketch map which corner is chosen
2. To aid relocation with a metal detector, drive the metal marker into the ground at an angle <45 degrees with the ground surface until the top edge is just below ground level.
3. Make sure the plate is **not** within the plot itself and is sloping away from the plot.
4. Be sure to note in the sketch map at which corner the marker has been buried.





In Fig.1, the permanent marker (marked by the blue dot) would be recorded as being in the SW corner. In Fig.2, the marker would be recorded as being in the S corner.

Do not use metal plates in unstable substrates or cultivated ground. In some instances, it may be possible to install them nearby, for example on the boundary of an arable field. Record measurements and directions from the marker to the plot.

Plot photographs

To make the plot stand out in photographs, the south-west corner, or the corner with the permanent marker, should be marked with a cane highlighted with a fluorescent flag, tape or similar. Leave the tape measure or cord marking the plot when taking the photographs. Make it clear in the sketch map in which corner the cane and permanent marker have been placed.

Photographs to show plot location should be taken and saved in Sweet. Photographs can either be taken directly in Sweet, or outside and then attached.

You must take:

- a close-up photo of the plot, showing detail of the vegetation

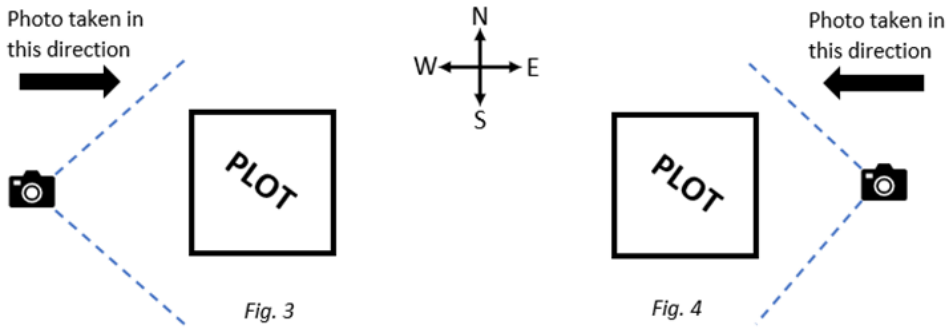
- a ‘whole plot’ photo of the plot, showing the plot in context of its surroundings (if this is not an option in Sweet, use one of the ‘directional photographs’)
- a sketch map photo (see the section below on sketch maps)

When adding these photos, the appropriate option should be selected from the ‘Type’ drop-down menu in Sweet.

Take up to four additional ‘directional’ photographs to help future surveyors re-find the plot, although you are unlikely to need that many. These should include photographs that show the corner of the plot and the features or landmarks that have been used as reference points. It can be useful to leave the measuring tape in place. This will show from where on the feature, such as a coppiced tree or large rock, the measurement has been taken.

When taking these photos, you should select a direction from the ‘Aspect’ drop-down menu. The ‘Aspect’ selected should be the direction in which you are facing, not the side of the plot you are standing on. The diagram at the end of this section illustrates this. The position from which the photographs are taken, and the direction of the shots, should also be shown on the sketch map.

All the types of photographs described above may be taken directly in Sweet, or taken on your device, annotated, and then attached. You must make sure all annotations are clear and legible (typed text is preferable to handwriting).



The aspect selected for Fig. 3 should be ‘E’; the aspect selected for Fig.4 should be ‘W’.

Sketch maps

Sketch maps show the location of the plot in relation to other features in the surrounding areas. The most useful sketch maps indicate the distances and compass bearings between a corner of the plot (or preferably the marker plate) and two nearby landmarks. Choose landmarks that are likely to still be present when the plot is re-surveyed (most likely in five years’ time).

Examples of landmarks are:

- distinctive rocks or trees
- fenceposts, gates or benches
- monuments or buildings

If it is not possible to take measurements from two landmarks, you should show a measurement from one landmark and a compass bearing.

On the sketch map, you must show:

- precisely where measurements have been taken from on the landmarks
- in which the corner the marker is buried (if used)

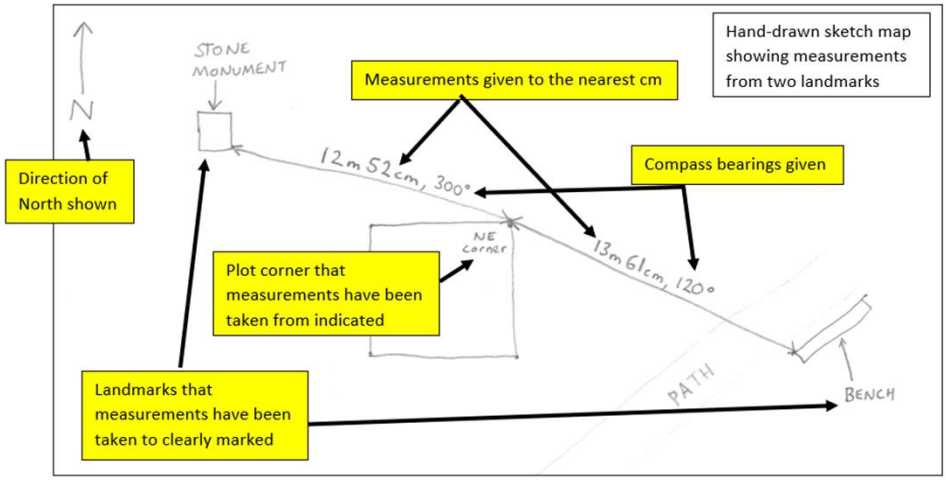
Sketch maps can be either hand-drawn maps or photographs annotated in your device, examples of both are shown at the end of this section.

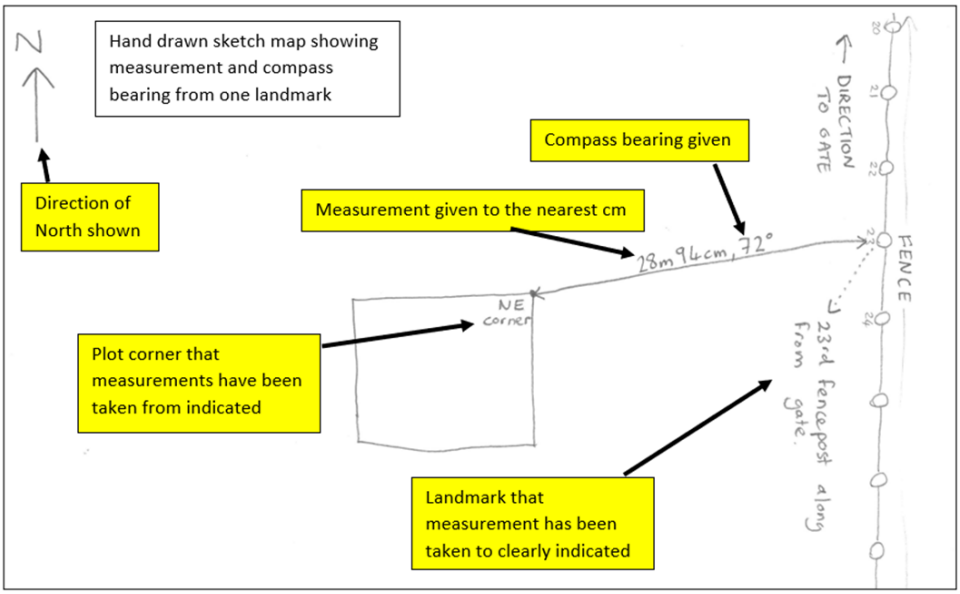
Sketch maps need to be attached to Sweet by going to the ‘Photos’ section in the ‘Related’ tab for that particular plot type. Then select ‘sketch map’ from the ‘Type’ drop-down menu. If you have made a hand-drawn sketch map, take a photo of it. You can also attach a sketch map made by annotating photographs.

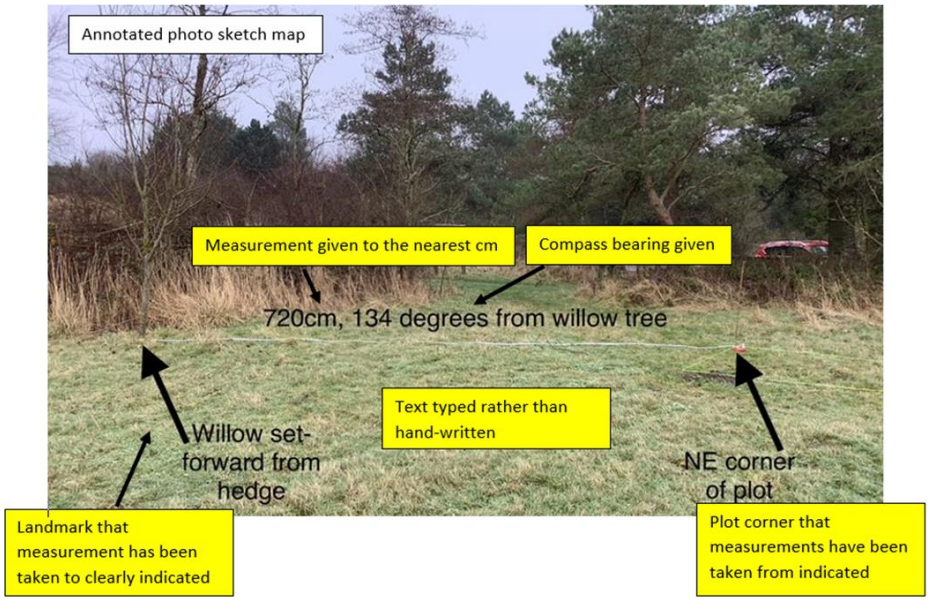
Things to remember when making a sketch map:

- Show clearly in which corner the permanent marker has been placed if used
- Show in which corner the visible cane has been placed, particularly important if it is not the southwest corner
- Sketch maps can be either hand-drawn sketches or annotated photographs.
- The most useful sketch maps have measurements and compass bearings from the same plot corner or marker plate to at least **two** nearby landmarks.
- If there are not two landmarks that can be measured to; a measurement and compass bearing to one landmark is acceptable.
- Choose, if possible, landmarks that are most likely to be there in five years’ time when the plot is due to be re-surveyed. Remember that features such as fenceposts may be replaced or moved and trees may be cut-down.
- Make sure on the sketch-map that you show precisely where on the landmark you have measured to and from
- Always indicate which corner of the plot measurements have been taken from.
- Write down measurements to the nearest centimetre.
- Write down compass bearings to the nearest degree.
- Show from where the supporting photographs have been taken and the direction of the shots
- Always show the direction of north on hand-drawn maps.
- If hand-drawn, sketch maps do not have to be to scale.
- Make sure writing is legible and clear – if annotating photographs use type rather than handwriting if possible.
- It is much quicker taking the measurements for a sketch map in a pair than on your own.
- Double-check your sketch map for mistakes before submitting it!

Examples of sketch maps






Annotated photo sketch map
Measurement given to the nearest cm
Compass bearing given
720cm, 134 degrees from willow tree
Text typed rather than hand-written
Willow set-forward from hedge
NE corner of plot
Landmark that measurement has been taken to clearly indicated
Plot corner that measurements have been taken from indicated