Forestry Commission

National Forest Inventory of Great Britain Survey Manual: 4th cycle

National Forest Inventory

(Version 1.5.1)

Issued by: National Forest Inventory, Forestry Commission,
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Date: January 2026

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Forestry Commission

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List of Abbreviations

AP	Aerial Photography
BA	Basal Area
CG	Component Group
CWD	Coarse Woody Debris
EU	European Union
FC	Forestry Commission
FLS	Forestry and Land Scotland
FR	Forest Research
GB	Great Britain
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectare
IFT	Interpreted Forest Type
NFI	National Forest Inventory
NRW	Natural Resources Wales
NVC	National Vegetation Classification
RAS	Relevant Adjacent Stands
SE	Standard Error
SNH	Scottish Natural Heritage
UK	United Kingdom
UK BAP	UK Biodiversity Action Plan
UKFS	UK Forestry Standard

1 Introduction

The National Forest Inventory (NFI) provides a record of the size and distribution of forests and woodlands in Great Britain and information on key forest attributes. Woodland surveys and compiled forest inventories have been collected in Great Britain at 10–15 year intervals since 1924. The National Forest Inventory, which started in 2009, is the latest of these periodic surveys to gather information and keep it current across Great Britain in accordance with responsibilities under the Forestry Act (1967) and international commitments.

NFI data and reports are used by many people and organisations involved in forestry and land management and there is growing requirement across government, non-governmental organisations and the private sector to quantitatively describe our woodlands. Data from the NFI survey has fed into numerous key publications that have directly impacted in areas such as policy, guidance for protecting and increasing the value of Britain's woodlands, plans for future developments, forest management, investment and research. A full listing of NFI objectives and outputs can be found in the Forest Research website.

All information gathered in the NFI survey is held in the strictest confidence and will not be used to police, regulate or directly affect management of individual woodlands. Information will only be published in a summary form that does reveal information about individual woodland holdings.

1.1 Aim

This document is designed to provide information and detail about the methodology and field techniques required for the fourth cycle of the NFI field survey. It is a reference document for;

- surveyors planning to tender for a contract in the fourth cycle of the NFI field survey and;
- Surveyors that are successful in gaining a contract and carry out the fourth cycle survey.
- Those interested in how the NFI data is derived, such as data analysts and end users of the data

Specialist software is used to record data and observations in the field. Details and instruction about how to input data into the software can be found in a series of videos that are available upon request. Email nfi@forestresearch.gov.uk.

This chapter provides an introductory overview and background information relating to the survey. Please refer to the Glossary for definitions of the terminology used to describe features of the NFI survey. There is also an Index and an Annex containing

supporting documents. In addition to these supporting documents, there is a library of videos relating to specific chapters of the field manual. The videos relate to the chapter topics and explain how data is recorded through the dedicated software.

1.2 The National Forest Inventory

National forest inventories are carried out by the Forestry Commission (FC) to provide accurate, up-to-date information about the size, distribution, composition and condition of the forests and woodlands in Great Britain (GB). These data are essential for developing and monitoring policies and guidance to support sustainable forest management. The current National Forest Inventory (NFI), which began in 2009, is a multi-purpose operation that has involved the production of a forest and woodland map for GB (1), and a continuing programme of field surveys of the mapped forest and woodland areas (2):

1. An earth observation-based programme monitors and maps the extent and location of woodlands across GB on an annual basis. The **NFI woodland map** covers all forests and woodlands over 0.5 ha with a minimum of 20% canopy cover (or the potential to achieve it), including new planting, clear-felled sites and restocked sites. The NFI map was established in 2010 and was based upon 25 cm resolution colour aerial photography for England and Scotland, and 40 cm resolution aerial photography for Wales. It was originally validated and updated using satellite imagery (available up to 2009), which gave an independent crosscheck of woodland present. Since 2010 the map has been updated annually using 25 cm resolution colour aerial photography and satellite imagery to identify areas of recently felled forests and newly established trees. The map is stratified into Interpreted Forest Types (IFT's), including coniferous, broadleaved, mixed, and clear-fell (see the Interpreted Forest Types section of the NFI Survey Manual for more details).

2. The **NFI field survey** assesses a large, stratified-random sample of woodlands across GB on a 5-year rolling cycle using a standardised protocol. Detailed data on various attributes are collected from approximately 15,100 one-hectare sample squares that are partially or entirely covered by forest, including clear-felled areas, according to the woodland map. The first cycle ran from 2010 to 2015 inclusive, and the second cycle ran 2015 to 2020 inclusive, the third cycle ran from 2020 to 2025 inclusive, and the fourth cycle is due to start in 2025 with completion in 2030. The survey provides an extensive, in-depth and spatially explicit record of our forests and woodlands.

Further details of the survey, mapping work and the derivation of forested areas can be found at www.forestresearch.gov.uk/nfi.

1.3 Survey design

1.3.1 Lots

To manage the framework contracts, Britain has been split into 108 hexagon shaped Lots (approximately 36 miles across at the widest point) (see annex A). Surveyors are invited to bid for the Lot/s and the sample squares within each Lot will be allocated to one contract.

1.3.2 The survey schedule

NFI field survey data are collected by a team of contract surveyors from one-hectare sample squares located across Great Britain. The sample squares are selected using a stratified-random sample methodology and the sampling schedule for the five year cycle is produced by the NFI to ensure the survey objectives are met. Each contractor will be provided with a bespoke schedule based on their Lots and the statistical survey design. The contractor will have the opportunity to examine the proposed schedule and give feedback (for example, the contractor may want to adjust the schedule to accommodate commitments, personal or otherwise, outside the contract). The final schedule will then be agreed and set. The schedule can be reviewed at the beginning of each financial year. While there is some flexibility within the design of the survey in terms of the schedule, there are specific timeframes within which sample squares must be assessed. Therefore, while feedback from the surveyor will be considered, the NFI reserve the right to decline any adjustment in surveying schedule that may materially affect the delivery of the survey objectives.

1.3.3 Assignment of work

The sample squares will be assigned to the contract surveyor by the NFI scheduling team based on the agreed sampling schedule and have to be assessed within an agreed period of time (±3 weeks of the scheduled assessment date).

It is paramount that the contractor adheres to the agreed work schedule, failure to do so can materially affect the delivery of the survey objectives. The scheduling team will provide regular updates to the contractor about their progress and timeliness in terms of the work schedule. Regular communication is expected between the NFI team and the contractors to ensure both parties are up to date with anything that may impact the contractors ability to adhere to the agreed work schedule.

1.3.4 Remeasure squares and New squares

During the fourth cycle of the field survey the NFI surveyors will collectively be required to visit approximately 11,000 one-hectare (~2.5-acre) sample squares over the 5 year cycle. The fourth cycle survey will predominantly involve the re-measurement of sample squares that have been assessed in one or more of the previous survey cycles (remeasure squares) and a small amount of new sample squares that have not been

previously assessed (new squares). The purpose of remeasure squares is to build a series of surveys at the same site to build a detailed picture of change in woodlands over time. The purpose of new squares is to enable the NFI monitor new woodlands (established since the previous survey either by planting or regeneration) and monitor established woodland that has not been previously surveyed. The latter can also be used as independent check on the remeasure squares, to test if they are becoming different to the wider population. Maintaining continuity between survey cycles is important. For example, the current surveyor will be required to locate the sample square and identify, on the ground, the mapping and observations recorded by the previous surveyor. In general, assessment of a remeasure square generally involves checking and confirming and/ or updating observations from the previous square assessment. Assessment of a new square will require the surveyor to record observations and take measurements in a sample square for the first time using the protocol and methodology described in this document. There is a great deal of cross over in the assessment protocol between remeasure and new squares but where there are differences this will be highlighted.

1.4 Sample square evaluation

1.4.1 Categorising woodland area

The NFI defines a woodland as an area of land meeting these criteria:

1. Any area of land with an established tree canopy where the tree cover extends to at least 20% of the land and the whole area of land is greater than 0.5 ha in extent and over 20 m in width.
2. Open spaces of less than 0.5 ha or less than 20 m in width within the woodland (e.g. rides, glades, ponds).
3. Areas of clear-felled or windblown woodland for up to 10 years after the clear-fell or windblow event, if a change of land use has not been established.
4. Areas covered by young trees that are a minimum of 0.5 ha in extent, or that are adjacent to established woodland, forming a total area of at least 0.5 ha. This may have resulted from planting, natural regeneration or colonisation that has not yet established a continuous canopy.

1.4.2 Stratification of the sample square

The surveyors are required to map individual woodland 'parcels' or polygons within each one-hectare sample square. These areas of woodland are then further stratified into smaller sections, of homogeneous canopy type based on differences in features such as woodland habitat and tree species, or more subtle factors such as condition and thinning history. Within each section containing trees two or three circular mensuration plots are randomly located and trees, seedling, sapling, stumps and deadwood are assessed.

1.4.2.1 NFI sample square data structure

Data collected from the sample square are mapped and recorded at several levels (see Figure 1.2 and Figure 1.2):

Square: A one-hectare (100 m by 100 m) square, which may be entirely within woodland or may overlap the woodland edge. A stratified-random site selection design was used to provide a representative sample of all types of woodland in GB, including conifer plantations and ancient semi-natural, urban, rural and upland woodlands.

Section: Within each sample square, the forest is stratified into different woodland 'sections'. Sections are defined by individual strata (homogeneous areas) at least 0.05 ha in size that are differentiated on basis of habitat or land use (e.g. forest type, priority type, silviculture system, tree and shrub composition, age and structure, open space, built environment). These features can be natural or anthropogenic. A section is mapped as a discrete polygon. Typically, sample squares covered parts of two or more sections (minimum number per square is one).

Component group: Homogeneous areas that are too small (<0.05 ha) to practically map as a discrete section, but with most of the same defining characteristics as a section. They can represent features of the natural or built environment. Every section contains at least one component group. Component groups have no minimum size, to include very small features - those important enough to record, but too small to map (such as one-metre of railway line intruding into a sample square, a pond or small area of woodland habitat). Component groups can be subdivided into components (see below).

Component or sub-component: Individual elements (components) of the component group. For example, each tree species will be recorded under a separate component, as will each habitat type if two habitats are intimately mixed (such as upland birchwood and wet woodland). Different ground vegetation and NVC types are also recorded as sub-components below the relevant components.

Circular plots: Within each section, field-based computer systems is used to locate two or three randomly located 0.01 ha circular plots within which all trees of ≥4 cm diameter at breast height (DBH) are mapped, species and age identified, stocking rates assessed, tree heights and diameters measured. Three plots are generated for sections over 0.6 ha and two plots if section is less than 0.6 ha.

Relevant adjacent stand (RAS) is an area outside the Sample Square boundary that is mapped to show the continued extent of a section across the square boundary where specific circumstances are encountered (e.g. to reflect areas of native woodland extent) the RAS is used to define areas of native woodland (Native RAS).

A flow chart demonstrating the sample square data hierarchy and showing the links between each of the chapters is in Figure 1.3.

Figure 1.1 An example of a completed sample square

An example of a completed NFI sample square. The image was created in Forester, an integrated spatial platform for forest and land management and used by the NFI to record field data and information. [Black square]: sample square boundary, [Blue lines]: section boundaries, [Large circles]: randomly located circular plots within each NFI section with trees, [Small coloured circles]: individual trees ≥4 cm diameter at breast height (DBH) that have been assessed and mapped. For definitions of 'open space' and 'woodland' refer to the Glossary.

Figure 1.2 A schematic illustration of the key elements included in the sample square assessment

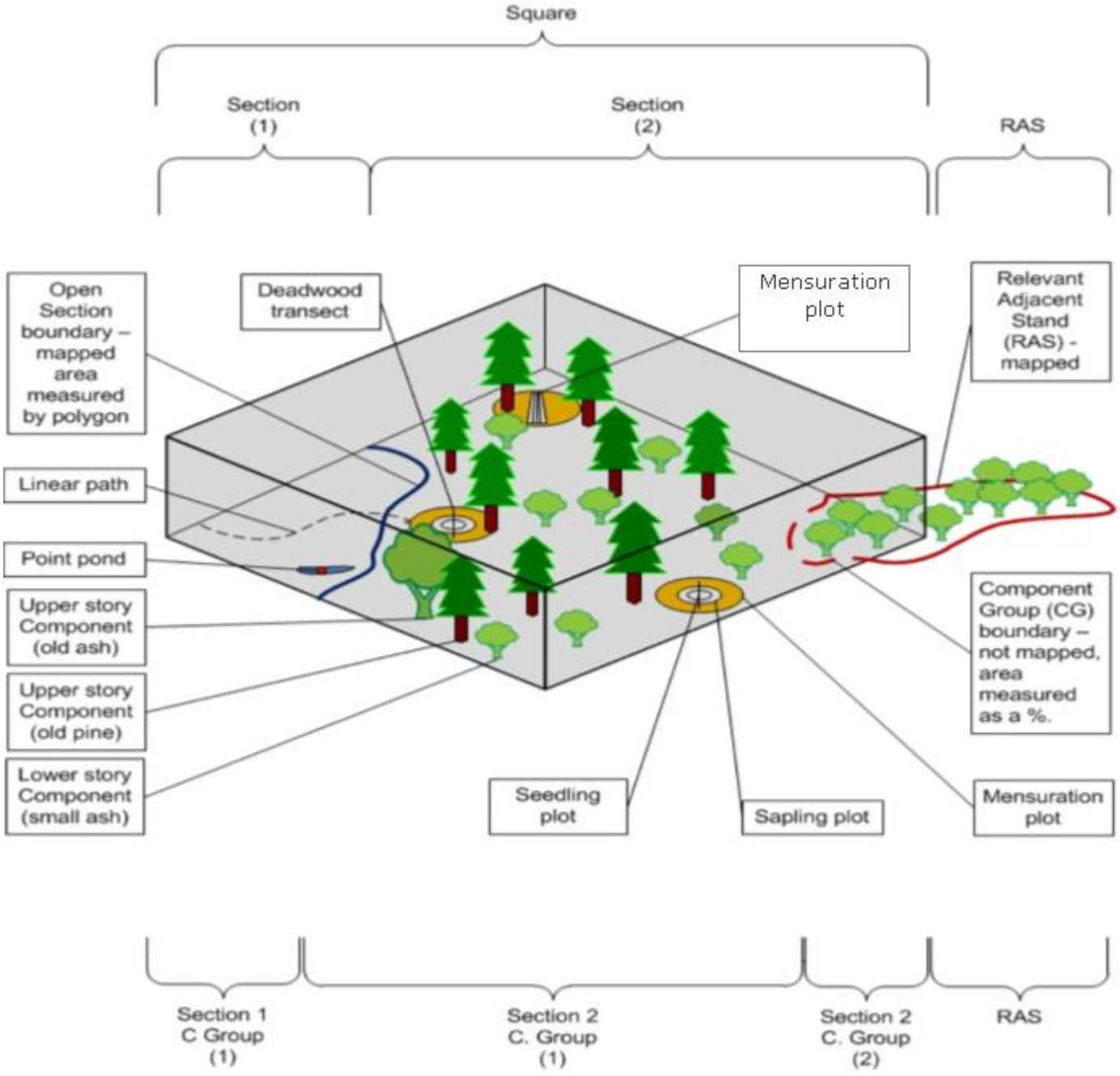
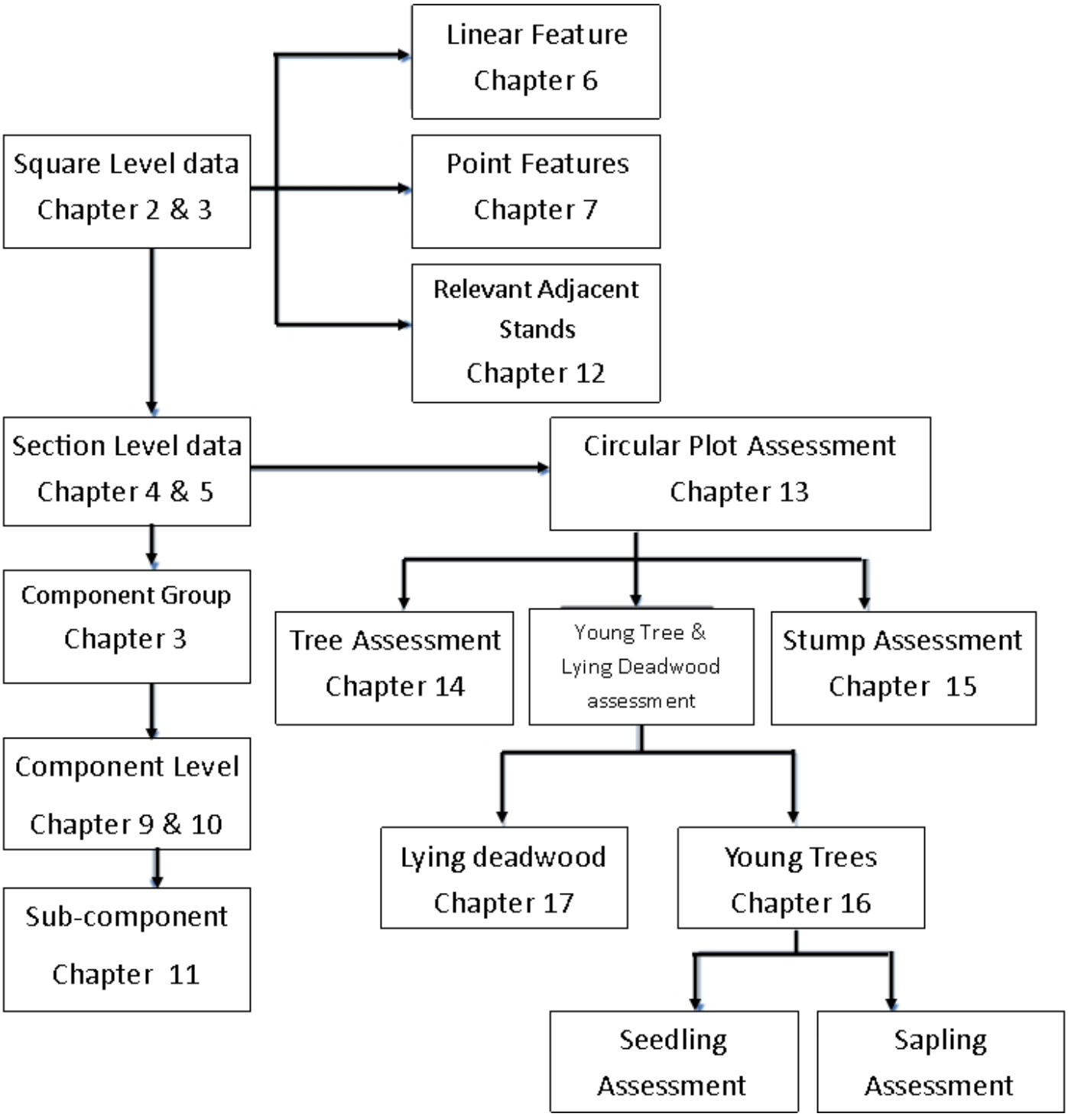


Figure 1.3 Field data hierarchy and the links between each chapter



1.4.3 Data recording using Forester

Forester is an integrated spatial platform for forest and land management. It is the platform used by the NFI contract surveyors to record the field data on the ground. More information about Forester can be found online. ArcMap is used as part of the Forester software and allows the user to explore data within a data set, symbolise features accordingly, and create maps. Details of how to use the software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Once collected data is submitted via the specialist software, it is subject to quality assurance checks, office and field based.

1.5 Quality assurance

The Forestry Commission applies rigorous and strict quality assurance processes to ensure that the field surveys capture a representative and unbiased representation of each square and woodland in turn. All measurements are subject to office-based checks and 3-5% are re-measured in the field by an independent quality assurance team to ensure consistency and high standards. It is the responsibility of the contractor to have in place quality assurance procedures.

1.6 Extrapolating NFI field survey statistics to a reporting area

Evaluation of the data collected in the field is done by the NFI statistics team. The sample squares evaluated so far in cycles one and two of the field survey represent approximately a 0.6% sample of all GB woodlands and this level of sample of woodland has been calculated to be representative of the wider woodland through analysing the variance within the woodland population. Therefore, it important that the surveyors capture a representative and unbiased picture of each square as any error will be amplified when the data is extrapolated.

Reports published by the NFI using the field survey data can be found on the NFI website

2 Editing the NFI Sample Squares in Forester

2.1 Introduction

Forester is an integrated spatial platform for forest and land management. It is the platform used by the NFI contract surveyors to record the field data on the ground. More information about Forester can be found online. ArcMap is used as part of the Forester software and allows the user to explore data within a data set, symbolise features accordingly, and create maps.

2.2 Aim

This chapter is designed to demonstrate the basics of the software and how to access it correctly in order to begin recording and/ or editing data. The entire content of this chapter is presented as videos.

3 Square level assessment

3.1 Introduction

Stratified random sampling is used to select one-hectare sample squares across Britain. The square level assessment records data that gives and overview of the whole sample square. Square level data can be used to assess trends across large geographical areas (e.g. regional or country) and identify issues with things like accessibility and ownership.

3.2 Aim

This chapter describes the protocol used to carry out the square level assessment. As part of the square level assessment the following attributes are assessed;

- Square GPS location referenced by the SW corner or most easily accessible corner
- Square accessibility
- Distance of square to road
- Potential for mechanical harvesting
- Extent to which weather impacted on the survey

Details of how to use the software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software.

3.3 Locating the square and square navigation

The sample square must be located before the assessment can be carried out. It is important that the same area is assessed during the previous survey cycles is assessed again during the current cycle.

3.3.1 Locating the square

The Geo-dataBase (GDB) supplied for each square will automatically load the Aerial Photos (AP) and Ordnance Survey (OS) files for the area around the square. These images and the grid references supplied by the GIS software should be used to navigate to the sample squares approximate location. Traditional paper maps, such as atlases and OS land ranger maps can also be used. Furthermore, the E1.0 Multi-Square Tool is an application in Forester that allows visualisation of multiple squares and their geographical location in relation to each other to help with planning work.

Once the surveyor is in the broad location of the square the GPS, tough book (with specialist software installed) and traditional survey techniques (i.e. map and compass) can be used in combination to find the exact location of the sample square.

3.3.2 Locating the square: remeasure square

As preparation for surveying a remeasure square it is recommended that the current surveyor examine sample square information collected during the previous assessment. Looking at the previously collected information the surveyor can ascertain the number of sections, storeys, components, and plots. There may also be notes on access to the sample square and the distance the surveyor may be required to walk to the square and a GPS trace from the previous surveyor.

Each remeasure sample square is marked at the south-west corner (or most easily accessible corner) with a metal peg and a wand. The metal peg is close to the ground and may not be immediately visible. The plastic, brightly coloured wand is placed with a large section above ground and should be more visible. For a remeasure square you will be supplied with the GPS reading for the location of the peg taken by the previous surveyor. There may also be field notes detailing any features that may help to locate the corner peg.

3.3.2.1 Searching for the peg/ wand

The surveyor should spend a maximum of 20 minutes searching from when they arrive at the assumed location of the corner peg.

If after 45 minutes the surveyors is unable to locate the corner peg then place a new peg and wand in the location of where they have assessed that the peg and wand should be.

Placing out a replacement peg and wand should be a last resort and all efforts to locate the original peg and wand should have been made. Ensure that you have double checked all location information and field comments from the previous surveyor.

Pegs, wands and disks are provided to you by the NFI. The surveyor will need to ensure they have a supply of replacement pegs and wands for going out in the field.

3.3.3 Locating the square: new square

The surveyor will be provided with the GPS location of the new sample square and expected to accurately navigate to this location. Accuracy is important to enable the sample square to be remeasured in the future.

The surveyor is required to locate the most easily accessible corner of the new sample square. This will be key reference point for the whole survey as all other measurements will be located in relation to this point. The surveyor is required to mark the most easily accessible/ identifiable corner with a metal peg and wand.

3.3.3.1 Marking the corner of the sample square

The peg should be sunk vertically into the ground, through the metal disc, until only 1 inch is visible above the ground. The wand should be sunk vertically next to the peg with the majority of it proud of the ground so it is visible. The objective is to make the wand visible from a distance to help easily locate the sample square corner. However, if the wand is removed the peg, being less visible, will remain as a back-up. A metal detector can be used to help locate the metallic peg.

Pegs, wands and disks are provided to you by the NFI. You will need to ensure you have a supply of replacement pegs and wands for going out in the field.

3.4 Sample square accessibility

The first stage in the sample square assessment is to assess accessibility. This is important because the level of access will determine what is required in terms of input into the software and the protocol that is carried out. There are two options:

1. Complete access to the sample square and with the ability to undertake the full survey – this will cover most instances.
2. Access of the sample square is limited or completely restricted. In this instance a restricted variant of the survey protocol is applied to assess the sample square (see Annex B for the square accessibility flow chart and Annex C for a table detailing the inaccessible square data fields where a visual assessment is possible).

3.4.1 New square & remeasure square: accessible

If the sample square is accessible, then the surveyor is expected to undertake the full new or remeasure square assessment as described in this document. Refer to the video library at the beginning of this chapter for details on how record visit and access status. The accessible square data fields (new square/ remeasure) are detailed in Annex D.

3.4.2 New square & remeasure square: inaccessible square & visual assessment possible

If the entire square is inaccessible but it can be visually assessed then an abbreviated assessment is conducted. The inaccessible square data fields (new square/ remeasure) are detailed in Annex E.

3.4.3 New square and remeasure square: inaccessible square & visual assessment not possible

If the entire square is inaccessible and no part can be assessed, only the 'inaccessible reason' data field should be completed in the software. The reason for the inaccessibility should be stated on the inaccessible invoice.

4 Section Stratification

4.1 Introduction

The surveyors are required to stratify habitats and map individual woodland 'parcels' or polygons and open space within each one-hectare sample square. Areas of woodland are then further stratified into smaller sections of homogeneous canopy type based on differences in features such as woodland habitat and tree species, or more subtle factors such as condition and thinning history.

Sections are homogeneous areas ≥5 m wide and ≥0.05 Ha in size that are differentiated on the basis of forest type, habitat, land use, silviculture system, tree and shrub composition, age and structure. They can represent features of the natural or built environment.

Examples of how sections may be differentiated include; landuse, habitat type, tree/shrub species composition, tree age (distinct differences), tree height (distinct differences), tree storey structure (distinct differences), tree regeneration, silvicultural system, woodland origin (e.g. Ancient Woodland, Plantation etc.), management (e.g. thinning, livestock grazing etc.), accessibility.

4.2 Aim

This chapter describes the protocol and rules used to correctly identify and map different types of section in the field.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

4.3 Section stratification: new square

The surveyors are required stratify the sample square into sections, mapping woodland and open sections for both NFI and non-NFI land. The surveyors are also required to check the accuracy of the NFI woodland map within each sample square.

4.4 Remeasure square: section stratification

The section mapping of the sample square from the previous survey visit will be provided to the surveyor. The surveyor is required to verify the section mapping recorded from the previous sample square assessment. The surveyor is required to amend the section mapping where it is found to be incorrect or outwith defined

tolerances. The surveyors are also required to check the accuracy of the NFI woodland map within each sample square.

Important Note: The following rules for correctly identifying woodland and non-woodland sections (NFI and non-NFI) in the field should be applied. However, it is important to be aware that there may be differences between the 2014 NFI Woodland Map and what you observe in the field when applying the following rules for section stratification.

4.5 Distinguishing between different types of sections

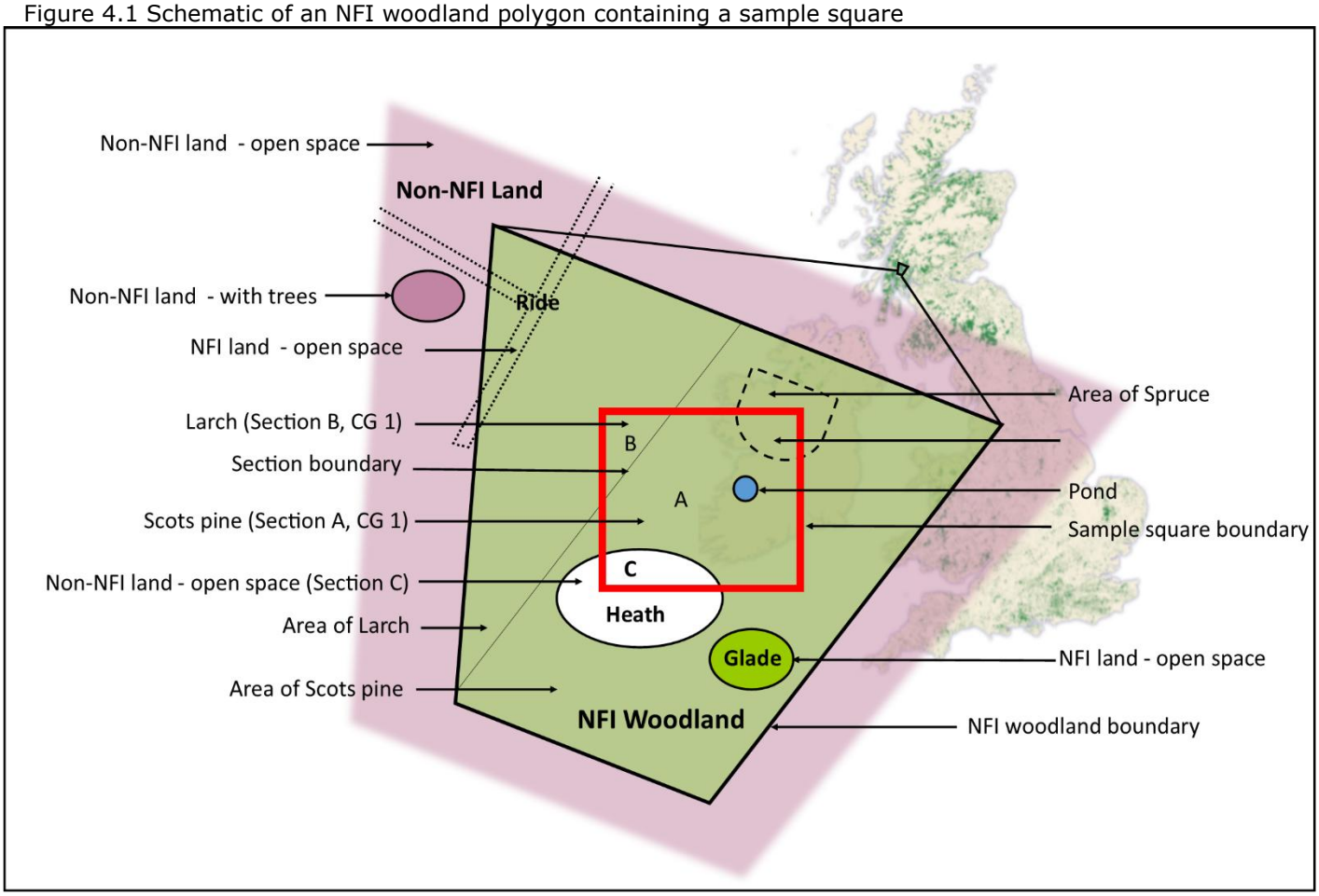
All areas of woodland in GB, ≥0.5 Ha in extent, ≥20 m wide and have ≥20% combined canopy cover, are included in the NFI woodland map. These areas, or polygons, of GB woodland are defined as NFI Woodland. In respect of gardens, parks, churchyards, and cemeteries, please note, these four land uses do not preclude woodland associated with them from qualifying as NFI woodland. If the NFI thresholds for area, width and canopy cover are met, then the woodland constitutes NFI woodland. The sample squares may be entirely within the NFI woodland polygon or the square may overlap the woodland edge (see Figure 4.1).

An early stage in sample square evaluation is section stratification. Initially the surveyor must identify the NFI woodland and areas of non NFI-land, considering the entire woodland polygon and land within which the sample square is located (see Figure 4.1). NFI land and non-NFI land may contain trees or open space meaning there are four overarching types of section within the sample square and each section type requires a different level of assessment in the field:

- **NFI Land sections:**
    1. **NFI land - containing trees (treed)**: a full component and sub-component assessment, plus a mensuration assessment, is required.
    2. **NFI Land - open area:** a full component and sub-component assessment is required.

- **Non-NFI Land sections:**
    3. **Non-NFI Land - containing trees (treed):** a full component and sub-component assessment is required.
    4. **Non-NFI Land - open area:** an abbreviated component and sub-component assessment are required.

Figure 4.1 Schematic of an NFI woodland polygon containing a sample square



All areas of woodland in GB, ≥0.5 Ha in extent, ≥20 m wide and have ≥20% combined canopy cover (see definition below), are included in the NFI woodland map (pictured in the background above). These areas, or polygons, of GB woodland are defined as NFI Woodland. The sample square (red bold square) may be entirely within the NFI woodland polygon (as above) or the square may overlap the woodland edge. The diagram above shows how the square would be sectioned given the features that are present in this example. Within the sample square there are three sections (A, B & C). Section A is NFI land with trees and has two component groups (CG); scots pine and spruce. Section B is NFI land with trees and has one CG; larch. Section C is classified as non-NFI open space. Within the NFI woodland polygon there is also a ride and a glade that are both classified as NFI land open space and a pond which, in this example, is a point feature, if it was ≥5 m wide and ≥0.05 Ha in size it would be another section. In general, whether a section is classified as NFI or non-NFI land is based on the size of the area, however, please refer to the definitions below for detailed definitions to accompany this diagram.

4.5.1 Key definitions

Below are some key definitions that accompany Figure 4.1 (above) and other definitions that relate to this chapter (see also the Glossary for definitions).

Key to understanding is the distinction between the definitions for NFI woodland and sections of NFI land with trees. They are distinguished by scale; NFI woodland describes woodland at the GB level, where areas of NFI land with trees which are a part of the

greater NFI woodland area and describe sections of NFI woodland within the sample square (see Figure 4.1).

NFI woodland is any area, or polygon, of GB woodland ≥0.5 Ha in extent and ≥20 m wide, which has ≥20% combined canopy cover of tree species and shrubs acting as trees, or the potential to achieve this through maturation of the existing crop of trees (saplings and seedlings included) and shrubs acting as trees (see Figure 4.2).

- **NFI land with trees section** are areas within the sample square classified as part of the NFI woodland polygon (≥0.5 Ha in extent and ≥20 m wide) containing trees which have ≥20% combined canopy cover of tree species and shrubs acting as trees, or the potential to achieve this through maturation of the existing crop of trees (saplings and seedlings included) and shrubs acting as trees (see Figure 4.2). There are some exceptions that relate to the mapping of sections of NFI land with trees.
- **NFI land open space section** are areas of open space (<20% canopy cover) that are classified as NFI land if:
    - the area of open space is <0.5 Ha or <20 m wide in extent and surrounded completely by NFI woodland, it is classified as NFI land open space (see Figure 4.3).
    - the open land creates a gap of any size in an NFI woodland edge and the gap contains the presence of trees (saplings and seedlings included) this is classified as NFI woodland if the trees are <20 m from the adjacent NFI woodland.
    - the open land creates a gap <20 m in an NFI woodland edge and the gap contains no trees, this is classified as NFI woodland if the open space can sensibly be regarded as a continuation of the adjacent NFI woodland in terms of ground flora or land use (i.e. woodland glade or deer lawn).

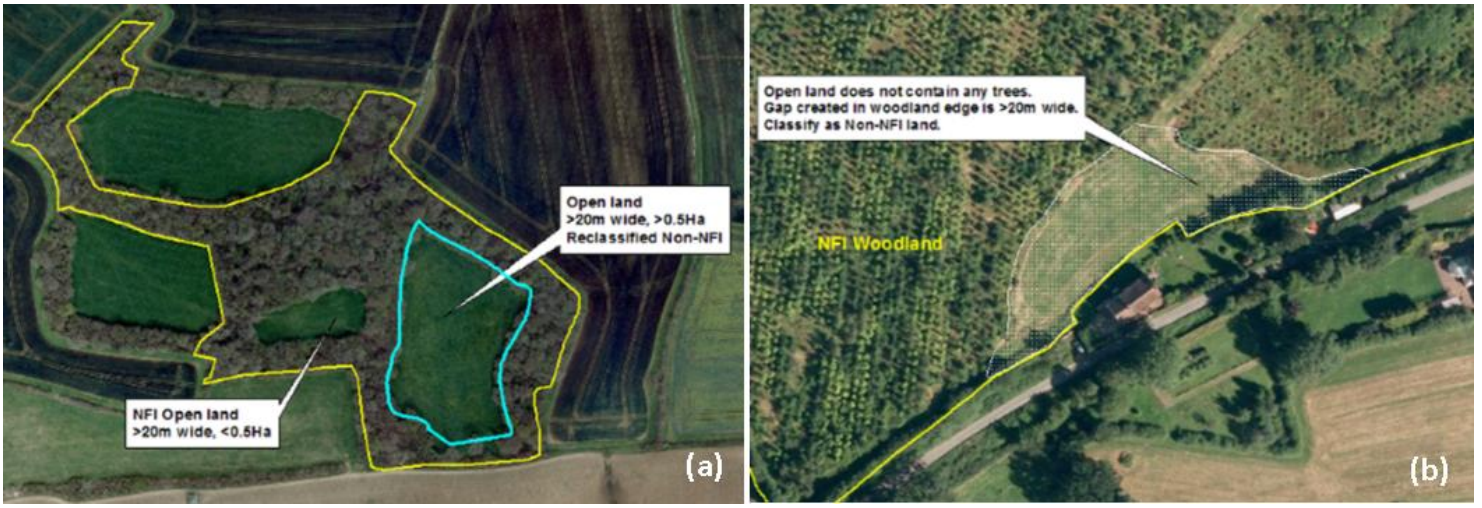
Non-NFI land is any area that does not conform to the definition for NFI woodland.

- **Non-NFI land with trees section** is any area of GB woodland <0.5 Ha in extent and <20 m wide which has ≥20% combined canopy cover of tree species and shrubs acting as trees, or the potential to achieve this through maturation of the existing crop of trees (saplings and seedlings included) and shrubs acting as trees.
- **Non-NFI land open space section** open space is any area with <20% canopy cover and is always classified as non-NFI land with three exceptions detailed above under NFI land open space.

Figure 4.2 Woodland split into NFI and Non-NFI parts

The smaller area of trees with a white outline has been classified as non-NFI because the woodland is < 20 m wide in this area, where the woodland is ≥20 m wide and ≥0.5 Ha in extent it is classified as NFI woodland. The outlines represent the external boundaries of the woodland.

Figure 4.3 Examples of open space



(a) The larger of the two open spaces located within an NFI woodland is classified as non-NFI land because it is ≥20 m wide and ≥0.5 Ha. The smaller open space section is ≥20 m wide but <0.5 Ha and because it is surrounded completely by NFI woodland it is classified as NFI land. The areas where the woodland is <20 m wide and the adjacent open spaces are classified as non-NFI land (woodland and open spaces outwith the yellow outline). (b) The Open space is ≥20 m wide and ≥0.5 Ha, does not contain trees and is not a continuation of the adjacent woodland in terms of ground flora or land use, therefore it is classified as non-NFI land.

Permanent open space or open land is defined as land that will not, under existing circumstances, become woodland. Land beneath linear features can fall into this category.

Temporary open space is defined as land that is currently open but will probably come under canopy cover either through colonisation or canopy spread. This can include tree

canopy gaps that will come under canopy once the existing trees have grown to maturity or unmaintained unsealed routes and streams that >50% obscured by the overhead canopy in adjacent trees.

A tree is defined as a woody perennial of a species typically forming a single self-supporting main stem and having a definite crown. NFI tree species are listed in Annex GG. Note that hawthorn, blackthorn and Juniper are always regarded as trees in the NFI regardless of their form.

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

NFI Woodland boundary is the boundary between NFI land and Non NFI land, i.e. the woodland edge.

Section boundary is the boundary between one type of woodland and another type of woodland. After the square has been sectioned into NFI land and non-NFI land, the NFI land is further sectioned to distinguish different types of NFI land, for example and change in tree species.

Square boundary is an artificial boundary imposed by the sampling methodology and does not take into account any land features, only geographical location. In nearly all Sample Squares the Square boundary will divide Sections arbitrarily. When carrying out Mensuration plot work within a Section and a circular plot crosses the Square boundary line, all the area of the plot that would have been in the Section had the Square boundary not existed is assessed.

4.5.2 NFI Woodland Map

The NFI woodland map is a digital map showing the location and extent of NFI Woodland across Britain and this should be used, in the first instance, to distinguish between NFI and non-NFI land. The map is supplied as a GIS layer which automatically loads into the field software when the sample square geodatabase and default map schema are opened.

The digital woodland map is updated annually using more recent aerial photography, interpretation of satellite imagery and administrative records of newly planted areas covered by government grant schemes. As the update is annual in some instances there may be a difference between what the map shows and what is on the ground at the sample square at the time of the field survey.

Surveyors must routinely check the accuracy of the NFI Woodland Map within every sample square during their visit. Surveyors are expected to check:

- The NFI Woodland is correctly identified as such.
- The NFI Woodland boundaries are correctly mapped. This includes identifying instances where the boundaries need to be updated to reflect areas of new planting or permanent woodland loss (e.g. to housing development).

4.5.3 Interpreted forest types and interpreted open areas

The NFI Woodland Map is broadly differentiated into Interpreted Forest Type (IFT) and Interpreted Open Areas (IOA) categories, each ≥0.5 Ha in extent and ≥20 m wide.

Interpreted Forest Types are assigned to parcels of land with ≥20% tree canopy cover or the potential to achieve this through maturation of any existing trees (saplings and seedlings included). The minimum size of an IFT is 0.5 Ha.

Interpreted Open Areas are assigned to parcels of land with <20% tree canopy cover and no potential to achieve this through maturation of any existing trees (saplings and seedlings). Open areas less than 0.5 Ha are not mapped out and are included in the surrounding IFTs.

An NFI woodland may be comprised of a single IFT, or multiple IFT and IOA categories displayed as a patchwork of internal polygons.

A listing and description of the various IFT and IOA categories are detailed in Annex FFF and GGG, respectively.

Surveyors are required to view the IFT/IOA categories for specific polygons when carrying out a Native Relevant Adjacent Stand Assessment and this can also be useful when checking the accuracy of the NFI woodland Map as part of the sectioning procedure.

4.5.4 Identifying NFI woodland on the ground

All woodland that meets the above definition should be classified as NFI woodland, however, there may be circumstances where this is less clear on the ground. Therefore, the following rules are given to help correctly identify NFI woodland on the ground.

Table 4.1 Rules for identifying NFI woodland on the ground for use in conjunction with the NFI woodland definition

Land with trees	**Rule**
Other land uses within a woodland	Land beneath a tree canopy may be a residential garden, amenity grassland, urban parkland, grazing pasture, a cemetery or something else. Provided the area, width and tree canopy cover thresholds conform to the definition then the land is classed as NFI Woodland. As such it is subject to all the standard mapping and assessment regimes including mensuration assessments. Surveyors should avoid surveying in churchyards or cemeteries during religious services, funerals, memorials, and commemorations or when it is evident that undertaking such survey work would disturb the solace of any persons present
Orchards	NFI woodland does include traditional orchards where they conform to the definition of NFI woodland.
	NFI woodland does not include commercial orchards (intensively managed for fruit production). They are always classed as Non-NFI land
Nurseries and short rotation coppice	NFI Woodland does not include nursery crops. These are always classed as Non-NFI land.
	NFI woodland does not include short rotation coppice (SRC) crops. These are always classed as Non-NFI land.
Christmas trees	NFI woodland does include areas where Christmas trees are planted in a mixture with timber species or broadleaves provided the woodland conforms to the NFI woodland definition.
	NFI woodland does not include crops grown specifically and purely as Christmas trees. These areas are always classed as Non-NFI land.
Temporarily unstocked woodland	NFI woodland does include areas that are unstocked as a result of human intervention or natural causes, but only when this is temporary and are expected to revert to woodland within 10 years (i.e. through restocking) and conforms to the definition for NFI woodland. Examples include, clearfell sites, windblown crops, failed crops, burnt crops, recently-cut coppice crops.
	NFI woodland does also include areas where the ground has been prepared for new planting (e.g. ploughed, mounded, scarified etc.) within the last 10 years and conform to the definition of NFI woodland.
Shrub Land	NFI Woodland does include shrubby areas that conform to the definition of NFI woodland.
	NFI Woodland does not include shrubby areas that conform to the definition of open land, unless the shrubby area is totally enclosed by NFI woodland and is <0.5Ha in extent or <20m wide.

Thin bands of trees	Thin bands of trees >1 tree wide does not conform to the NFI woodland definition, however, they are recorded as a component group if they are too narrow to qualify as a Section (i.e. <5m wide)
Single lines of tree and hedgerows	Hedgerows and single lines of trees do not conform to the definition of NFI woodland. These are recorded and mapped as Linear Features in the NFI.

4.5.5 Classification of land beneath linear features

Linear Features are any linear landscape elements that occur within the sample square. Surveyors are required to map these linear features as lines using the software. Examples of linear features include transport routes (such as roads, tracks and rides), recreational routes (such as cycle ways, disabled access routes and footpaths), water courses (canals, rivers and streams), railway tracks and overhead powerlines.

Where a linear feature passes through land with trees in the sample square the surveyor needs to consider, in order of priority, the following things:

1. Is the land permanent open space? If not, then there is no need to record anything other than the presence of the linear feature.
2. If the open space is permanent then, is the land NFI or Non-NFI?
3. Finally, if the land is permanent open space then the surveyor needs to decide whether the linear feature should be mapped as a section or should it be recorded as a component group. The decision to map the linear feature as a section or a component group is dependent on the size of the area it covers.

The following rules (Table 4.2) are given, and in conjunction with the above definitions, will help correctly classify linear features on the ground.

Definitions for the different types of linear feature are given in the glossary

Table 4.2 Rules for identifying permanent open space on the ground for use in conjunction with the permanent open space definition

Linear feature	Rules
Sealed routes	Sealed roads and driveways, cycle ways, disabled access routes, walkways of any width are always classified as permanent open space.
Unsealed routes	Distinction is made between **maintained** and **unmaintained** unsealed routes. Maintained roads are the better quality roads maintained for use by vehicles. Unmaintained roads are the minor roads that are little-used and left to nature. They are typically heavily-vegetated, but there will be evidence that the road was surfaced at one time.
	Maintained unsealed roads and driveways are always classed as permanent open space. This rule also applies to maintained unsealed cycle ways, disabled access routes and walkways ≥3m wide. If the maintained unsealed route is <3m wide then it is classified as temporary open space and recorded as a linear feature only.

	Unmaintained unsealed roads and driveways are classed as permanent open space if ≥50% of the area is "open to the sky" i.e. **unobscured** by the canopy of trees when viewed from above. Routes that are **obscured** by tree canopy (>50%) are classified as temporary open space and recorded as a linear feature only. This rule also applies to maintained unsealed cycle ways, disabled access routes and walkways ≥3m wide.
Unsurfaced routes	Unsurfaced routes of any description are classed as permanent open space if ≥50% of the area is "open to the sky" i.e. **unobscured** by the canopy of trees when viewed from above. Unsurfaced routes that are **obscured** by tree canopy (>50%) are classified as temporary open space and recorded as a linear feature only.
Operational railway tracks and sidings	Operational railway tracks and sidings of any gauge are always classed as permanent open space.
	Railway embankments may be classed as woodland or permanent open space depending to which definition it conforms.
Disused railway tracks and sidings	Disused railway tracks and sidings are classed as permanent open space if ≥50% of the area is "open to the sky" i.e. unobscured by the canopy of trees when viewed from above (see Figure 4.6)
	Disused tracks and sidings that are obscured by tree canopy (>50%) are absorbed into the adjacent woodland (see Figure 4.6)
Canal, rivers and streams	Rivers and canals are always classed as permanent open space because they are effectively unable to grow trees
	Streams lined with concrete are classed as permanent open space.
	Streams lined with natural materials are classed as permanent open space if ≥50% of the area is "open to the sky" i.e. unobscured by the canopy of trees when viewed from above. Streams that are obscured by tree canopy (>50%) are classified as temporary open space and recorded as a linear feature only.
Overhead powerlines	Powerline corridors are classed as permanent open space where there are no trees beneath, or where the trees beneath are managed to remain clear of the powerline.
	Powerline corridors are **not** classed as permanent open space where the trees beneath do **not** require management to remain clear of the powerline. For example, Christmas tree crops planted beneath high voltage powerlines, or where a powerline crosses a wooded gorge. In this case woodland present is defined depending on woodland definition (either NFI or non-NFI).

Table 4.3 Rules for identifying NFI land on the ground for use in conjunction with the NFI land definition

Linear feature	**Rule**
Sealed routes (including roads, operational railway tracks and sidings, driveways, cycle	Sealed routes are classed as NFI land where the gap created through NFI woodland is <0.5 Ha (including any part of the sealed route outside the square). Sealed routes are classed as non-NFI land where the gap created through NFI woodland is ≥0.5 Ha (including any part of the sealed route outside

ways, disabled access routes, walkways)	the square). This rule also applies to sealed cycle ways, disabled access routes and walkways ≥3 m wide (of an equivalent width to a road/driveway).
	Sealed routes ≥3 m wide are always mapped as a section and can be used to divide up areas of woodland.
	Sealed route <3 m wide are recorded as a component group and are not used to divide up areas of woodland.
Operational railway tracks and sidings	NFI land includes railway embankments where they conform to the definition of NFI woodland.
	The rules apply to operational railway tracks located on the ground or in viaducts above woodland. Operational railway tracks in tunnels beneath woodland go unrecorded.
Unsealed and unsurfaced routes	If the unsealed route and any parallel open land creates a gap <20 m wide and the woodland on either side is classified as NFI woodland then it is classified as NFI land.
	If the unsealed route and any parallel open land creates a gap ≥20 m wide and ≥0.5 Ha then it is classified as non-NFI land.
Streams	Streams by definition are <5 m wide, therefore they are always recorded as a component group and not a section.
Disused railway tracks	The rules apply to disused railway tracks located on the ground or in viaducts above woodland. Disused railway tracks in tunnels beneath woodland go unrecorded.
Health and Safety Note: Overhead powerline corridors	Where the land conforms to the definition of NFI woodland NO plots are generated because of health and safety considerations (i.e. plot type = not applicable).
	Where trees establish beneath powerlines, including the wayleaves, and are not maintained, then the land use can be a tree based land use – e.g. High Forest or Worked Coppice, Christmas trees.
	Where the trees beneath the powerline/within the wayleaves 'area' are indistinguishable to those in the adjacent Sections the wayleave/corridor width should be no greater than twice the height of the powerline.
Operational railway tracks and sidings	Those ≥3 m wide are always mapped as a section and those <3 m wide are always recorded as a component group
	Railway embankments are classed as woodland (either NFI or non NFI) or open space depending on which definition it conforms to.
Disused railway tracks and sidings	Disused railway tracks and sidings are classed as permanent open space if ≥50% of the area is "open to the sky" i.e. unobscured by the canopy of trees when viewed from above.
	Disused tracks and sidings that are >50% obscured by tree canopy do not qualify as open space. They are absorbed into the adjacent woodland (either NFI or non-NFI,

Canal, rivers and streams	Rivers and canals are always classed as permanent open space because they are effectively unable to grow trees
	Streams lined with concrete are classed as permanent open space.
	Streams lined with natural materials are classed as permanent open space if ≥50% of the area is "open to the sky" i.e. unobscured by the canopy of trees when viewed from above. Streams that are >50% obscured by tree canopy do not qualify as open space, they are absorbed into the adjacent woodland (either NFI or non-NFI).
Overhead powerlines	Powerline corridors are classed as permanent open space where there are no trees beneath, or where the trees beneath are managed to remain clear of the powerline.
	Powerline corridors are **not** classed as permanent open space where the trees beneath do **not** require management to remain clear of the powerline. For example, Christmas tree crops planted beneath high voltage powerlines, or where a powerline crosses a wooded gorge. In this case woodland present is defined depending on woodland definition (either NFI or non-NFI).

4.5.6 Examples of the application of the rules and definitions

Below are some examples of the rules that have been described above.

Figure 4.4 Example of a sealed route passing through a woodland

(a) A tarmacked sealed route <3 m in width and <0.5 Ha passing through NFIwoodland, in this instance the linear feature would be classified as NFI land. (b) If the sealed route was ≥3 m wide and <0.5 Ha passing through NFI woodland the linear feature is classified as NFI land. (c) If the sealed route was ≥3 m wide and ≥0.5 Ha passing through NFI woodland then this would divide the woodland meaning that the lower part of the woodland no longer conforms to the definition NFI woodland (i.e. <0.5 Ha) and would therefore be classified as non-NFI, The sealed route would be classified as non-NFI land open space. If any of the sealed route fell within the sample square it should be mapped as a non-NFI open section and linear feature. (d) This example is the same as (c) but in this instance the lower part of the woodland is ≥0.5 Ha and therefore is classified as NFI woodland.

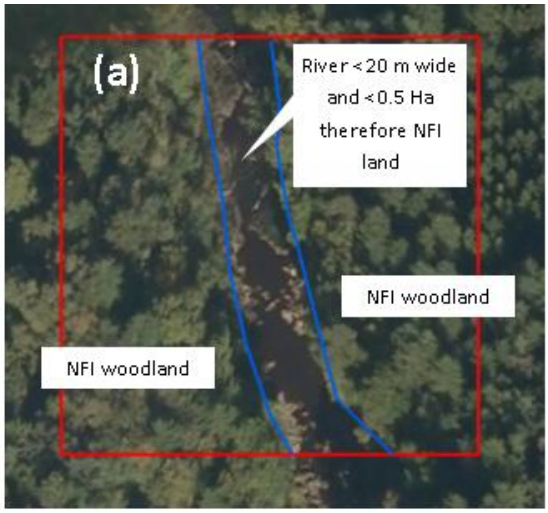
Figure 4.5 Example of an unsealed route passing through a woodland

(a) NFI Woodland does not include unsealed routes of any description that create, or form part of, an Open land "hole" ≥20 m wide and ≥0.5 Ha in extent. In such cases, the Open land "hole" containing the unsealed route is classed as Non-NFI land. (b) Open land surrounded by woodland with a maintained unsealed road that is >20 m wide and >0.5 Ha, therefore classified as non-NFI land.

Figure 4.6 Examples of disused railway tracks; open land and woodland

(a) Disused railway tracks (open land) (b and C) Disused railway tracks that may be in either NFI or non-NFI woodland.

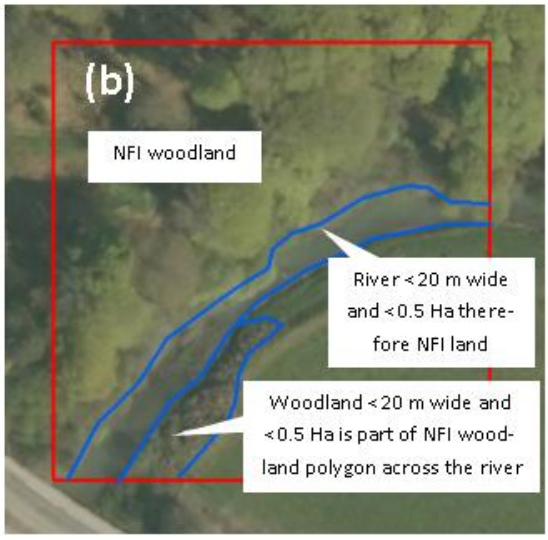
Figure 4.7 Examples of a river flowing through an NFI woodland polygon where the edges of the woodland gap containing the river run parallel



In all examples the river is <20m wide or <0.5Ha.

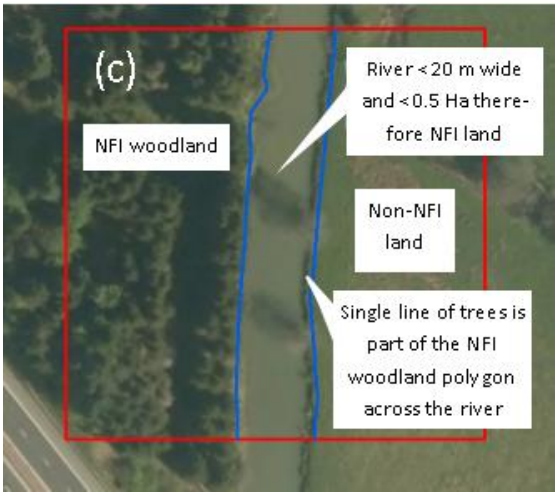
(a) The river is bounded by woodland ≥0.5Ha and ≥20m wide on one side, and by woodland ≥0.5Ha and ≥20m wide on the other.

Therefore: The river is NFI land. The river and the woodland on either side remain part of the same NFI woodland polygon.



(b) The river is bounded by woodland ≥0.5Ha and ≥20m wide on one side, and by woodland <20m wide or 0.5Ha on the other.

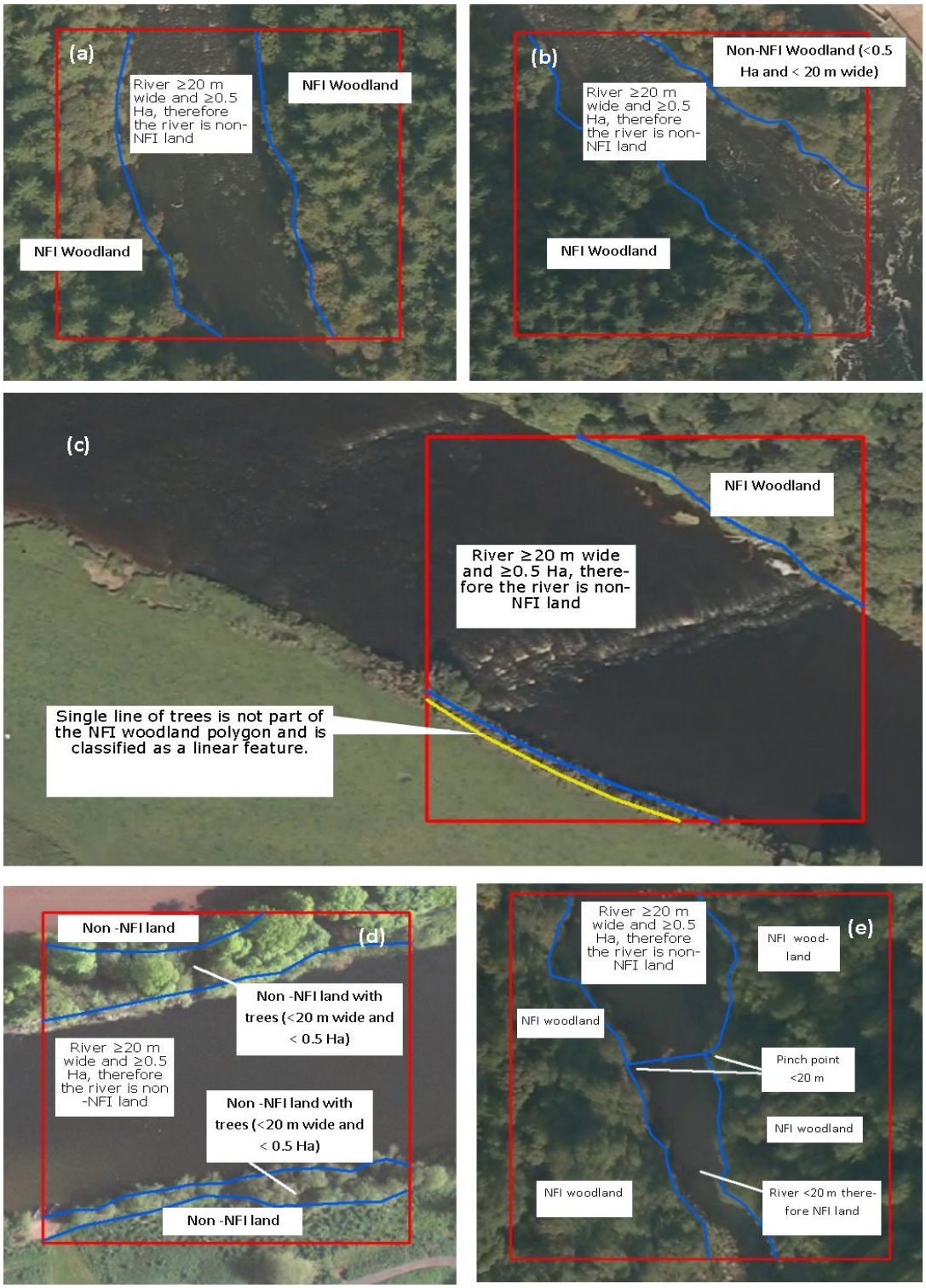
Therefore: The river is NFI land. The river and the woodland on either side remain part of the same NFI woodland polygon.



(c) The river is bounded by woodland on one side and by a single line of riverbank trees on the other.

Therefore: The river is NFI land. The river, the woodland on one side and the single line of riverbank trees on the other side remain part of the same NFI woodland polygon.

Figure 4.8 Examples of rivers classified as non-NFI land



(a) The river is bounded by woodland ≥0.5Ha and ≥20m wide on one side, and by woodland ≥0.5Ha and ≥20m wide on the other. Therefore: The river splits the original NFI woodland polygon into two separate NFI woodland polygons. Cont. overleaf.

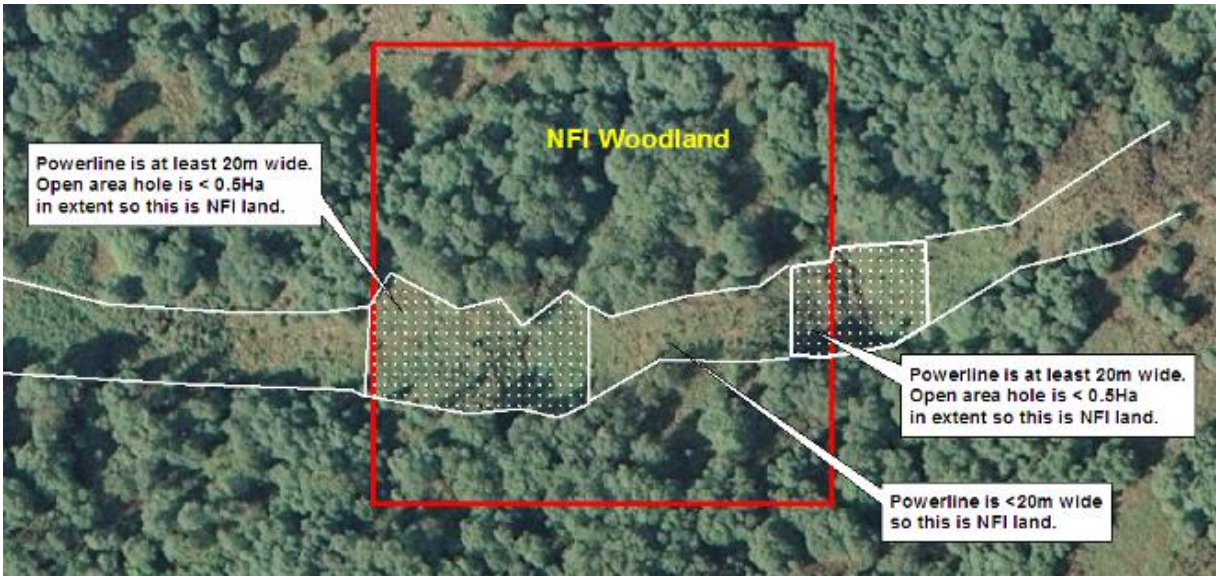
(b) The river is bounded by woodland ≥0.5Ha and ≥20m wide on one side, and by woodland <20m wide or 0.5Ha on the other. Therefore: The woodland ≥0.5Ha and ≥20m wide on one side remains an NFI woodland polygon. The woodland <20m wide or 0.5Ha on the other side becomes Non-NFI woodland.

(c) The river is bounded by woodland ≥0.5Ha and ≥20m wide on one side, and by a single line of riverbank trees on the other.
Therefore: The woodland ≥0.5Ha and ≥20m wide on one side remains an NFI woodland polygon. The single line of riverbank trees on the other side becomes a Linear Feature.

(d) The river is bounded by woodland <20m wide or 0.5Ha on one side, and by woodland <20m wide or 0.5Ha on the other (but logically taken together the river and woodland on either side is ≥0.5Ha and ≥20m wide, thereby qualifying as an NFI woodland polygon). Therefore: The woodland on either side of the river becomes Non-NFI woodland.

(e) River (always POS) flowing through an NFI woodland polygon. Woodland gap containing the river narrows to <20m wide in places, creating pinch points. Where the gap is <20m wide, it is NFI land. Where the gap is ≥20m wide and ≥0.5Ha it is Non-NFI land.

Figure 4.9 An example of an overhead power line corridor



The powerline corridor varies in width as it passes through the NFI Woodland, narrowing to <20 m in places and expanding to >20 m wide elsewhere (creating "pinch points"). The stretch that is <20 m wide is classed as NFI land. Where it expands to ≥20 m wide, the Open land "holes" created are <0.5 Ha in extent therefore they remain NFI land. If the "holes" had been ≥0.5 Ha in extent, they would have been classed as Non-NFI land.

4.6 Minimum section size

A section is mapped within the sample square as:

1. A single discrete polygon ≥0.05 Ha in extent, or
2. Two or more separate but identical polygons ("multi-parts"), each ≥0.01 Ha in extent and which sum to ≥0.05 Ha.

Sections and individual multi-parts must be ≥5 m average width, although an exception is made for certain non-NFI open sections. Non-NFI land should be mapped separately to NFI land wherever possible and within the constraints of the software. To facilitate this, the minimum size for a non-NFI section is ≥0.01 Ha where the remainder of the square is NFI land. For example, if a non-NFI tarmacadam road runs the entire length of the square, but the road margin extends only 1 m into the square, and the remainder of the square is NFI woodland, then the non-NFI road should be mapped out as a separate section, even though it is only 0.01 Ha in extent.

Normal rules apply to situations where the total extent of NFI land within the Square is <0.05 Ha i.e. the NFI land must not be mapped out as a separate Section (but can instead be recorded as an NFI component group within the adjacent Non-NFI Section, as outlined below).

Always double-check that each of the mapped Sections is ≥0.05 Ha in extent (exceptionally 0.01 Ha for certain non-NFI sections). The software will automatically calculate section area but does not alert surveyors when the area is <0.05 Ha.

Homogenous areas too small to map as discrete or multi-part sections should be identified as component groups and included in either the most similar adjacent section or the largest adjacent section if no adjacent section is similar. For example, a small area of oak adjacent to a section of Sitka spruce and a section of Douglas fir. Neither adjacent section is similar so the oak is included in the larger section.

4.7 Mapping section boundaries

As previously described a section boundary occurs where there is a change in land use or habitat within the sample square and using the rules that have been described above in this chapter the surveyor should identify each section. Surveyors are then required to map the edge of the section/s within the sample square. The rules outlined in this section should be used to ensure that the boundaries are accurately mapped within the sample square.

There is a variety of support materials included within the software, for example the Ordinance Survey (OS) 10 k Map GIS layer and the NFI. When mapping section boundaries it is important to remember that the hard features that appear on the ground may or may not be depicted within the support material.

4.7.1 Section mapping: new square

If the sample square has not been previously assessed the surveyor will be required to identify all the sections within the sample square and map the boundaries for the first time.

4.7.2 Section mapping: remeasure square

In a remeasure square assessment the section mapping from the previous cycle is supplied to the surveyor for verification or amendment as appropriate. Surveyors are expected to alter any section boundaries if they observe that the mapped section boundaries do not reflect what is on the ground and/ or are outwith tolerances. Alteration may be necessary if the section boundaries previously recorded have changed on the ground, for example due to felling or expansion of the woodland or if there is an error with the previous mapping.

4.7.3 Mapping rules

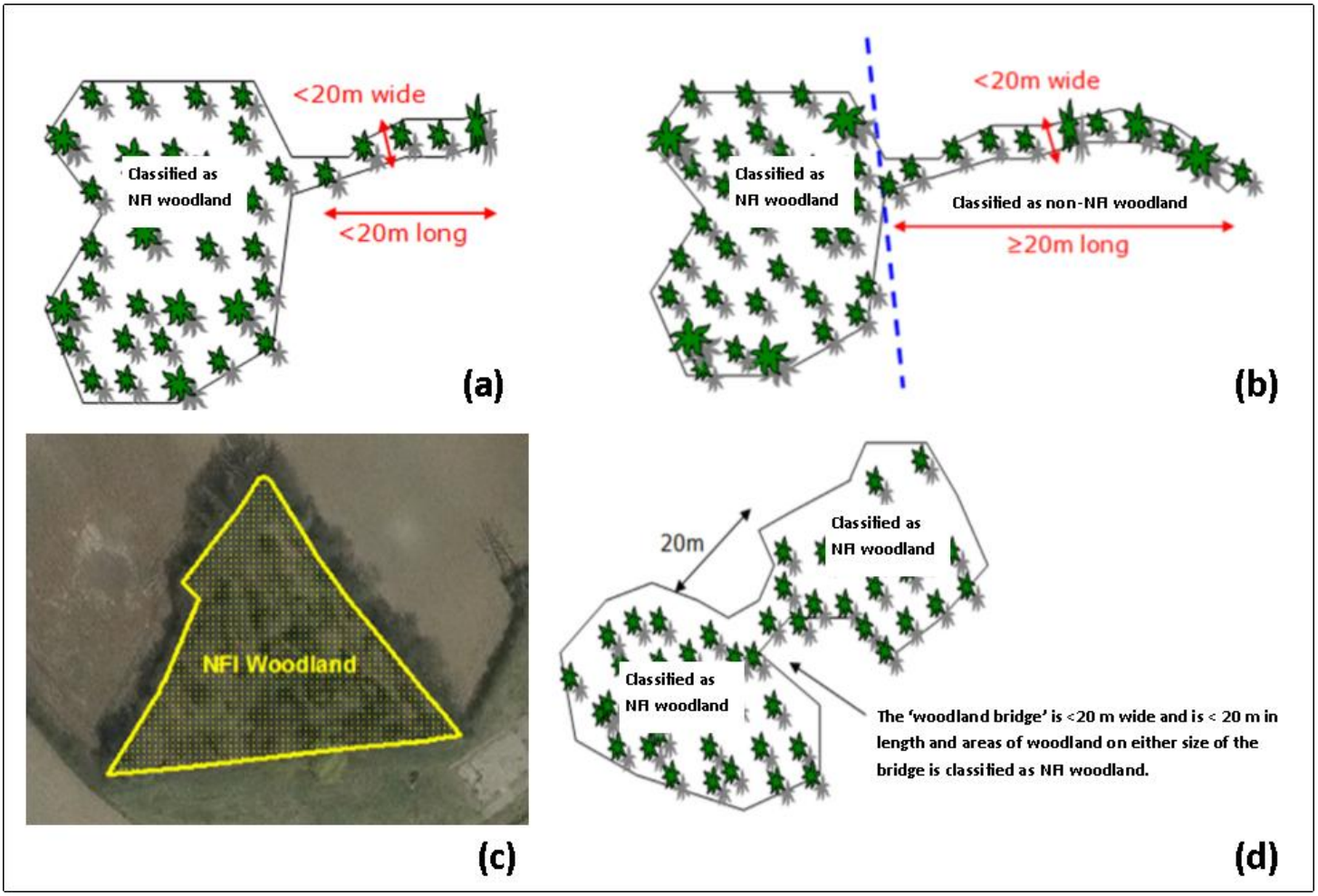
The following rules will help identify where to correctly map woodland boundary lines within the sample square.

4.7.3.1 Mapping woodland boundaries

Detailed above are the definitions for NFI woodland and NFI land with trees. However, the following exceptions are applied when mapping:

- **Protrusions from the main body of NFI woodland:** Stubby protrusions <20 m wide and <20 m long are considered to be part of the NFI Woodland. However, if the protrusion is <20 m wide but ≥20 m in length then it is classed as non-NFI woodland from point at which it becomes <20 m (see
- Figure 4.10).
- **Woodland corners:** Woodland corners are included in the NFI woodland even if they narrow to <20 m (
- Figure 4.10).
- **Woodland Bridge:** Where two bodies of NFI woodland are connected by a narrow neck of woodland that is <20 m wide and <20 m in length, this 'woodland bridge' is included as part of the NFI woodland area (
- Figure 4.10). If the bridge is ≥20 m in length then it is classified as non-NFI woodland.

Figure 4.10 woodland protrusions, corners and bridges



(a) Protrusions <20m wide and <20m long are considered to be NFI Woodland if the main body of woodland is also NFI woodland. (b) Protrusions <20m wide and ≥20m are not considered part of the main body of woodland and classified as non-NFI woodland. The dashed blue line is at the point at which it narrows to <20m and classed as Non-NFI Woodland. (c) Woodland corners are included in the NFI woodland even if they narrow to <20 m. (d) Where two bodies of NFI woodland are connected by a narrow neck of woodland that is < 20m wide and <20m in length, this 'woodland bridge' is included as part of the NFI woodland area. If it is ≥20 m in length then the bridge section would be classified as non-NFI woodland. If the bridge contains no trees or few trees refer to the open space definition.

Where the tree canopy extends over an area that could not support trees (e.g. open water, a road, a quarry, etc.), the boundary of that non-woodland area is taken as the section boundary. This rule takes precedence over the drip line. It is not subject to change over time to the same extent as the drip line. The branches of the treed section do not determine that the open water or road below it is a forest or woodland land use as it is not the principal land use; the open water or road is the predominant land use.

Table 4.4 Mapping woodland boundaries

Where land uses overlap	Rule

Where a non-treed area is overlapped by another non-treed area	Permanent non-treed areas take precedence over temporary non-treed areas E.g. where a tarmacadam/metalled road, or railway, and a powerline cross-the tarmacadam road is mapped and the powerline is therefore truncated by the road. Note that linear features for the entire length of both the road and the powerline individually will still be mapped A powerline crosses a river: the river takes precedence A wayleave crosses agricultural land: the agricultural land takes precedence, but the wayleave is still mapped as a linear feature. Where there are two permanent or temporary landuses (e.g. a road crossing over a railway) map the uppermost landuse. A powerline over a minor road (unsealed) or ride where the ground vegetation is actively managed for the powerline – the powerline takes precedence. If in doubt about the active ground management then the powerline will take precedence. Tarmacadam/metalled road, or railway, over a river/ride: the road/railway takes precedence.
Where a treed area is overlapped by a non-treed area	For example, a road or railway line (a flyover) above a Christmas tree crop, the road or railway would take precedence.
Power lines	A powerline through a wooded gorge where the trees are not affected by the powerline then the woodland takes precedence. A powerline where a wayleave is cut through NFI areas (the ground vegetation actively managed to prevent tree growth) the powerline takes precedence. A powerline over a Christmas tree plantation: Christmas tree area takes precedence.

4.7.3.2 Mapping the NFI woodland boundary with hard features present

The following rules will help to correctly map woodland boundaries where a hard feature is present along the woodland edge.

The hard feature is taken as the NFI woodland boundary. Where the hard feature is depicted on the OS 10k Map GIS layer, surveyors must check the accuracy of the OS mapping, and then either trace along the OS detail or map the woodland boundary in freehand, as appropriate.

Where the woodland edge is set back from a hard feature on the ground by**<5m** (measured to the outside face of the tree stems) then the hard feature is taken as the NFI Woodland boundary i.e. the intervening strip of Open land is included within the NFI Woodland (but may need to be classed as a separate Component Group).

Where the woodland edge is set **back** from a hard feature on the ground by **≥5m** (measured to the outside face of the tree stems) then the true woodland edge is taken as the NFI Woodland boundary. This should be mapped in freehand, taking the boundary to the outside face of the tree stems.

Where the woodland edge **overlaps** a hard feature on the ground then the true woodland edge is always taken as the NFI Woodland boundary The boundary should be mapped in freehand, taking the boundary to the outside face of the tree stems.

Do **not** extend the NFI Woodland boundary across a hard feature on the ground to take in single trees.

Table 4.5 Mapping woodland boundaries in relation to hard features

Feature	Rule
Treed area abutting non-treed area	a. Non-treed is agricultural land: i. Fence/wall – boundary follows line of fence/wall ii. Unfenced – boundary follows outer face of tree stems. This takes into account the field margin which is part of the agricultural land use. iii. Ditch/woodbank – boundary follows centre of ditch/woodbank on the agricultural side.

	b. Roads, tracks and rides (sealed and unsealed) – to outer face of tree stems UNLESS the road, track or ride has associated with it a: i. Fence/wall/hedge – map the boundary to fence/wall/hedge. ii. Ditch – map boundary to centre of the ditch. iii. Non-treed verge – map to outer edge of verge. (if the verge is >=5 metres average width and is 0.05ha ten map as a separate section. Use the road edge or centre of roadside ditch as the boundary. A ditch takes precedence over the road edge.) If the verge is too small to map as a separate section then include it as a component group of the road and map to fence/wall/hedge/field/face of stems as appropriate. c. Railway lines – map to associated fence/wall where applicable. d. Water bodies (rivers/open water): i. Where trees grow down to the waters' edge map to the waters' edge. ii. Map to the bank top, or the waters' edge where there is no bank top UNLESS the water body has associated with it a fence/wall/hedge-in which case map to the fence/wall/hedge. e. Quarries - where there is a fence/wall associated with the quarry then map to the fence/wall. Otherwise, map to the edge of excavation. f. Wayleaves – map to the face outer face of tree stems of treed sections where these abut the wayleave. Wayleaves should have parallel borders following pipelines, gas lines, etc. g. Glade – map to outer face of tree stems.

4.7.4 Mapping section boundaries using the drip line with no hard features present

The drip line is the furthest tip of the widest branch in the crown of a tree, in other words the last point from which the tree can drip if wet. If a treed section is adjacent to an open section but no hard feature is present such as a fence, wall or ditch the drip line is not used to position the section boundary. Instead, the boundary is drawn along the outer face of the tree stems (in large-crowned trees this may be some distance in from the drip line of the crowns). Where two treed sections are adjacent the mid-point between the two drip lines is used. The rules for using the drip line to map boundaries is summarised below.

Table 4.6 Mapping woodland boundaries using the drip line

Land use or habitat change	Rule
Two adjacent treed sections	If two treed sections have drip lines that cross over each other the boundary should be mapped using the centre line of the cross over.
Young crop	The Section boundary is located where the surveyor assesses that the drip line will be upon maturity of that crop or if a young crop is planted on ground prepared for planting then the section boundary should be mapped such that it includes the entire area that is prepared for planting.

4.7.4.1 The sphere of influence and mapping section boundaries

Where there are multiple storeys of trees occupying one area of land the drip line rules can become more complicated to implement. In some crops, for example seed tree stands, the upper storey may be sparse, but it exerts an influence over the lower storeys. It is then necessary for the surveyor to determine the extent over which the storeys are working together to form a homogenous woodland area.

4.7.4.1.1 Determining the size of the sphere of influence

The rule of thumb in terms of the sphere of influence is ~one tree length, this may increase or decrease depending on factors including; light competition, shelter, microclimate (humidity, gaseous composition), physical protection from predation, proximity to next upper storey tree or trees. Determining the extent of the sphere of influence will be subjective and the surveyor is expected to apply knowledge and details observed on the ground to make an informed assessment.

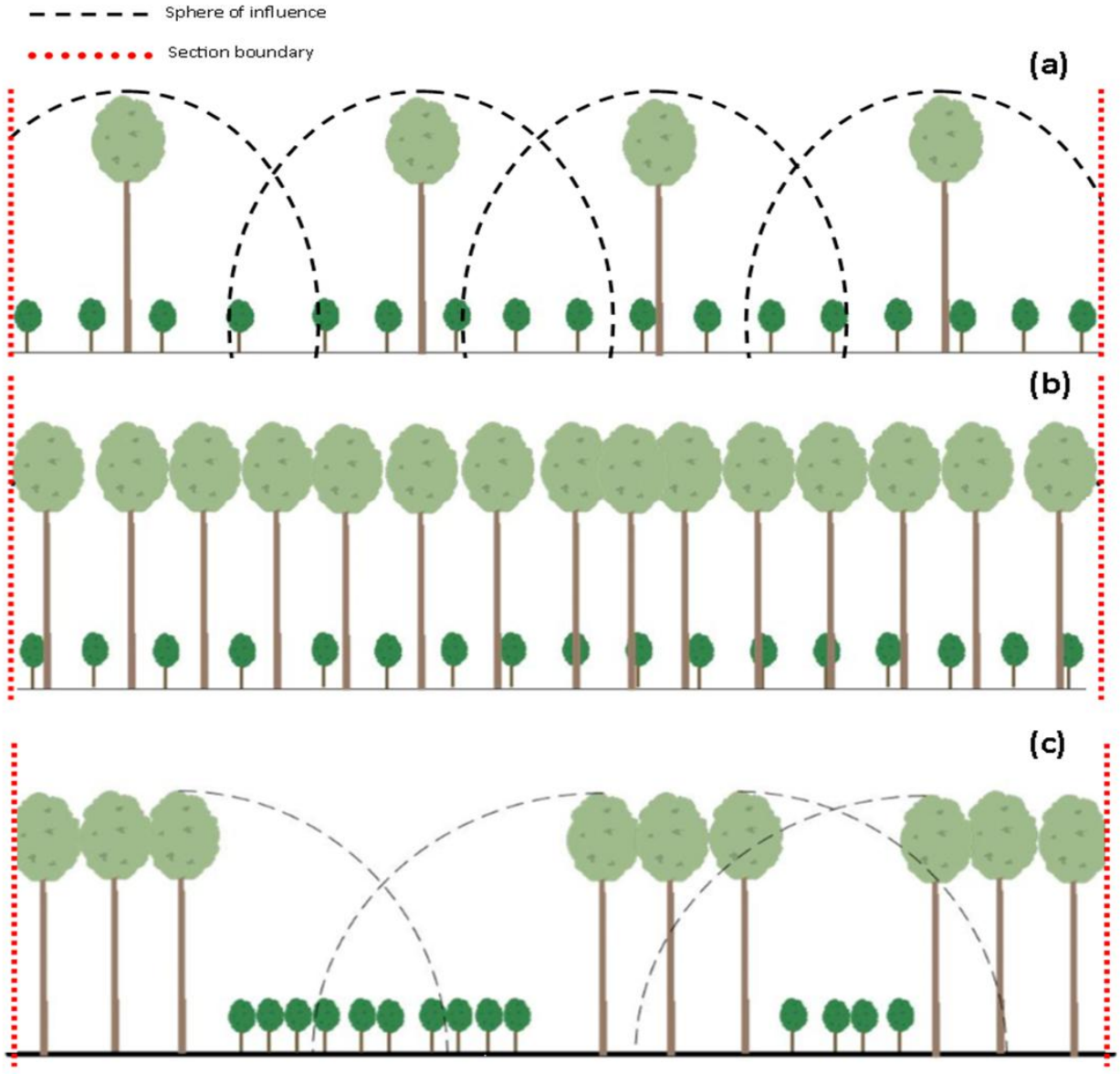
Determining the extent of the sphere of influence is important because if the homogenous woodland area is ≥0.05 Ha then the area is considered a section, if the area is <0.05 Ha then the area is considered a component group.

Where areas containing trees have multiple storeys the sphere of influence exerted by the upper storey will determine the extent of the section (i.e. homogenous woodland area). The rules for mapping the section boundary using the drip line where multiple stories are present a given below.

Table 4.7 Using the drip line to map the boundary of multiple storey areas with trees in relation to a sphere of influence

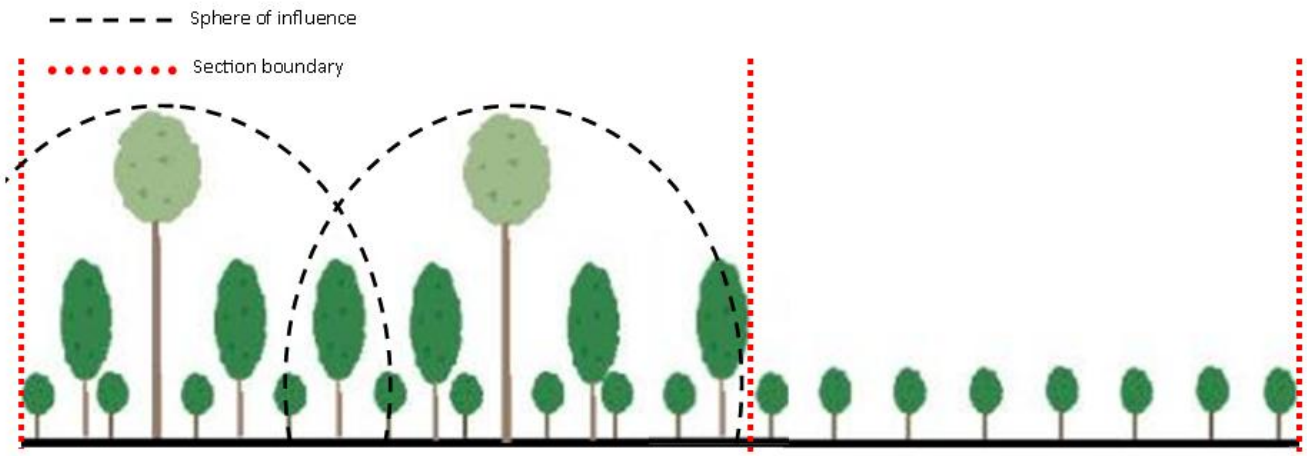
Example	Rule
Upper and lower storeys are evenly mixed forming a homogenous woodland area ≥0.05 Ha (i.e. a section)	The drip line of the trees determined to be on the outer edge of the woodland section (could be any storey) are used to determine the section boundary (see Figure 4.11a and b).
Upper storey is clustered, but it is exerting an influence over the lower storey forming a homogenous woodland area ≥0.05 Ha (i.e. a section)	A combination of the drip lines of the two storeys (dependant on the outermost trees determined to be on the section edge) is used to determine the section boundary (see Figure 4.11c).
The upper storey/s only exerts an influence over part of the lower storey/s, i.e.. the lower storey may span two sections (assuming they are ≥0.05 Ha)	A section boundary should be mapped at the point at which the upper storey stops exerting an influence on the lower storey using the drip line of the trees deemed to be on the edge of the section (or the centre line if the drip lines if two sections overlap, see above rule, Figure 4.12).

Figure 4.11 Using the drip line to map the boundary of multiple storey woodland in relation to a sphere of influence



(a) The sparse upper storey is exerting an influence over the lower storey, such that the two storeys are working together to form a homogenous woodland area and the area is ≥0.05 Ha (Section size). In this example the drip line of the lower storey is used to determine the section boundary. (b) The evenly mixed upper and lower storeys are working together to form a component group and the area is of sectionable size. In this example the drip line of the upper storey is used to determine the section boundary. (c) The clustered upper storey is exerting an influence over the lower storey, such that the two storeys are working together to form a component group of sectionable size. In this example the drip line of the trees deemed to be on the edge of the section are used to map the section boundary.

Figure 4.12 Using the drip line to map the boundary of multiple storey woodland where the sphere of influence only exerts an influence on part of the lower storey



The upper, middle and lower storeys to the left are working together as a component group of sectionable size. The section is unique in character. The point at which the upper storey stops exerting an influence on the lower storey determines the section boundary with the single-storied trees. This single storey area is not influenced by the middle or upper storeys and has a unique character. In the example it is of sufficient size to be mapped as a separate section.

4.7.5 Amending previously mapped section boundaries

The following tolerances should be used to assess whether the previously mapped section boundaries should be amended:

Table 4.8 Rules for determining if previously mapped section boundaries should be amended (remeasure squares)

Boundary Type	Rule
NFI woodland boundary	**NFI woodland boundary** is the boundary between NFI land and Non NFI land.
	External section boundaries should only be changed in exceptional circumstances
	If there is >10m difference between what is observed on the ground (applying the rules and definitions previously described in this chapter) and what has been mapped previously then an amendment should be made.
Section boundaries	**Section boundary** is the boundary between one type of NFI land and another type of NFI land. After the square has been sectioned into NFI land and non-NFI land, the NFI land with trees is further sectioned to distinguish different types of NFI woodland, for example and change in tree species.
Section boundaries	The section boundary should always be amended where there is strong evidence of real change. Where there is no evidence of

	real change but a difference is observed a tolerance is applied to determine if the section boundary should be amended: If there is a difference >10% of the total section area between what is observed on the ground (applying the rules and definitions described in this chapter) and what has been mapped previously then an amendment should be made.

5 Recording section boundary Mapping in the Field Software

5.1 Introduction

Surveyors are required stratify the sample square into sections, check the accuracy of the NFI woodland map and verify the section mapping recorded from any previous sample square assessment and amend if necessary. These observations on section stratification are recorded within the field software.

It is important to produce an accurate and representative map of the section stratification in each sample square because the number and type of sections will determine the following stages of the survey, for example the number of circular plots that are to be sampled within the square.

5.2 Aim

The following chapter describes how to use the field software and associated editing tools to create a map of the sample square. The editing tools do not require expert knowledge and the information included within this manual should be enough to competently use this tool. This chapter describes how to use the software to:

- Split Sections i.e. split a Section into two, smaller Sections.
- Modify Sections by moving/adding/deleting individual vertices.
- Copy existing geometry
- Merge Sections i.e. join two or more Sections together.
- Reshape Section boundaries by drawing a new shape that the Section will then adopt as the boundary. The newly drawn shape needs to cross the existing Section boundary twice to be accepted.
- Slide boundary nodes i.e. adjust the node that sits at the intersection of two or more Sections without this tool it would be fiddly and involve multiple reshape/modify operations.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

5.3 Section boundary mapping using the software: New square

If the square has not been assessed in previous survey cycles the software will present the sample square as a single section and land use will not be assigned. The square should be assessed and number and type of sections should be mapped and recorded in the field software.

5.4 Section boundary mapping using the software: remeasure square

If the square is a remeasure the software will present the section mapping that was recorded during the previous assessment. It is likely that the previous assessment will have been carried out several years prior to the current visit, therefore previous section mapping should be checked and verified and any amendments should be recorded using the software.

5.4.1 Acceptable tolerance

Standard GPS and survey techniques are unlikely to have an accuracy of <10 m. Therefore, if a difference of <10 m in section boundary assessments is identified then, unless there is strong evidence to suggest otherwise, no change to the boundary is necessary and none is recorded.

5.4.2 Section assessment in a remeasure square

The section visualisation tool should be used to look at the section mapping recorded in the previous assessment. Within each mapped section the number of storeys, components, component groups and species will also have been mapped and recorded and will be visible in the software.

On the ground the surveyor should identify all sections that were previously mapped and assess if anything has changed. If anything has changed since the previous survey the surveyor is required to remeasure, map and record the changes to bring the mapping up to date, within the level of tolerance set out.

There are four types of change at the section level; no change, real change, surveyor error and spatial error.

5.4.2.1 No change

If after assessment the surveyor deems that no significant change to the sample square sections has occurred since the previous survey cycle assessment.

Tree growth and biological competition are not events that are considered to cause significant change.

5.4.2.2 Real change

Change in land use

Some sections may have undergone a complete change in landuse between surveys, for example a change from high forest to clearfell or clearfell to young trees. These changes may or may not require editing of section boundaries.

Examples of landuse changes that have been identified within the survey include:

- High forest to river
- High forest to quarry or young trees
- High forest to road construction site or young trees
- High forest to urban development
- High forest to agriculture

Changes in extent

Real change in extent includes significant expansion or contraction of woodland areas. Changes in extent can occur through natural (e.g. water features can shift or grow or wind blow) or anthropogenic processes (e.g. clearfell, restocking, urban development).

Changes in extent are likely to be a key driver of significant change in the woodlands over time. Particularly, when they include permanent and irretrievable loss in woodland area (e.g. urban development).

Experience tells us likely levels of real change

Conifer sites: ~10% of conifer sites will have been clear felled since the last survey cycle and if all things are equal 10% of such clearfell sites will have been restocked.
Broadleaf sites: The proportion of broadleaved clearfelling is likely to be low, ~0%, but sites may have been thinned and will have grown since the previous survey cycle. Where clearfelling does occur it introduces significant change to the stand structure and may involve changes to the section boundaries, the removal of components (such as high forest) and the creation of new components (such as clearfell and seedlings).

5.4.2.3 Sampling error

Some circumstances may suggest an error in the previous section mapping. This should be amended, and the change classified as surveyor error.

5.4.2.4 Spatial error

Spatial error in relation to OS data and aerial photography

Ordinance Survey (OS) data collected prior to the use of GPS and satellites had a level of spatial inaccuracy. During the first cycle Forestry Commission (FC) aerial photo imagery was stretched to fit the OS map. Therefore, the FC aerial photo imagery inherited any spatial inaccuracies present in the OS mapping. In rural upland areas this inaccuracy can be as much as 40 m to 80 m. Occasionally the first cycle square location, section mapping and plot locations will have been referenced to these inaccurate maps and aerial photos. Where the mapping has been improved this may present spatial differences in the mapping between surveys.

Spatial error is rare and in these instances the surveyor is not expected to relocate or remap the whole square. Instead it is expected that the surveyor refers to the original aerial photography to confirm that it is a spatial error. Then provided that the sampled portion of woodland has been mapped accurately within itself, the offset of the exact location is acceptable.

Spatial error in relation to surveyor error

If the sample square corner has been incorrectly marked in a previous assessment, then it is likely that the whole sample square will be slightly offset from the planned location of the sample square. In this instance the survey is carried out at the offset sample square location mapped in the previous assessment. The surveyor can record that the square was located incorrectly within the 'peg comments' field at the square level and as 'spatial error' within the Sections. NFI analysts can track and manage this distortion.

To help ascertain change and spatial issues since the last survey, copies of the original aerial photography used at the time of last survey will be issued.

5.4.2.5 Impact on plots when editing section boundaries

Within sections circular plots are randomly located. In remeasure squares plots are not deleted if sections are merged, split or their boundaries are modified. Continuity of plots between surveys is preferred and relocation plots is a last resort option.

5.4.2.6 Subjectivity in measurements

Maximising continuity and reducing the impact of subjectivity on section stratification and sampling measurements has multiple benefits. Therefore, amendments should only be made when the section stratification mapped in the previous survey is significantly misrepresentative of what is observed on the ground (in general >10 % difference is considered significant). Some situations are more subjective than others. The

differentiation between a house plot and a woodland is for example more objective in nature than, for example, the differentiation between a mosaic of wet woodland and upland Oak habitats.

5.4.2.7 Creating a new survey

In extreme circumstances the section mapping and other measurements may be so misrepresentative of what is observed on the ground that it would undermine both the quality of the survey and the ability of the surveyor to complete the square assessment within a reasonable time. In these instances, we expect the surveyor to delete the previous assessment data and assess the sample square as a new square. There may be provisions within the contract to compensate for the extra time taken to do this.

6 Recording and mapping linear features

6.1 Introduction

Linear Features represent features that are linear in nature but are too small to be a section. Linear features may also be a section if they meet the definition for a section. In this instance the linear feature requires both a section assessment and a linear feature created in the software.

Linear features are divided into several categories:

- Cultural boundaries (e.g. walls and fences)
- Woodland edge
- Transport (e.g. rides and roads)
- Recreational use (e.g. cycle path or bridle path)
- Hazards (e.g. powerline)
- Water features (natural and man-made, e.g. stream or canal, respectively)
- Small woods hedge

Linear features are only recorded within NFI land and ≤10 m outside the woodland edge (i.e. external boundary). The only exception to this is where the linear feature presents a health and safety risk to the surveyor. If line features falling outside the stated parameters are present in the software, due to having been mapped during a previous survey, then they are not expected to be removed. In addition, whilst not necessary as part of the survey, line features can be mapped outside these parameters if, for example, they assist the surveyor with orientation.

The definition of H&S in this instance is where it would impact upon a surveyor getting to, and assessing, the sample square. For example, if the western 50% of a square is non-NFI open land which needs to be crossed to access the woodland then any H&S issues should assessed. However, if the surveyor approaches this square from the east and does not need to cross the western 50% then mapping of the H&S issues within the western part of the square is not required.

6.2 Aim

The following chapter describe how to use the Forester Geo Database and associated editing tools to record linear features in the sample square. The editing tools do not require expert knowledge and the information included within this manual should be enough to competently use this tool. This chapter describes how to use the software to:

- Create Linear features in the software
- Modify linear features in the software
- Theme data
- Woodland edge

- Transport
- Recreation
- Hazards
- Water feature

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

6.3 Linear feature mapping: new square

The square should be assessed and number and type of linear features should be mapped in the field software as described in this chapter.

6.4 Linear feature mapping: remeasure square

If the square is a remeasure the software will present the linear features that were mapped during the previous assessment. It is likely that the previous assessment will have been carried out several years prior to the current visit, therefore previous mapping should be checked and any amendments should be recorded using the software.

It is recommended that the surveyor ensures they are familiar with the linear features that were recorded as present in the previous assessment before visiting the sample square. Depending on the features present this may impact your risk assessment and the way you carry out the survey once you are in the field (i.e. a large river may have access implications). The linear feature may also aid in the navigation of the site.

6.4.1 Acceptable tolerance

Standard GPS and survey techniques are unlikely to have an accuracy of <10 m. Therefore, if a difference of <10 m in linear feature assessments is identified then, unless there is strong evidence to suggest otherwise, no change is recorded. Placement of the linear feature relative to other features should also be checked (i.e. is the linear feature on the correct side of a building or section?)

Mapping linear features can be difficult, particularly where there are no or few landmarks to help map the feature (e.g. a powerline running through a large Sitka Spruce monoculture forest). It is suggested that the surveyor use the aerial photography and OS base maps to help. Therefore, the tolerance means that the surveyor is not expected to map every individual small bend in a stream. Mapping the stream running in the correct general direction and running through the correct part of the Section is good enough.

6.4.2 Linear feature assessment in a remeasure square

The section visualisation tool should be used to look at the linear features recorded in the previous assessment.

On the ground the surveyor should identify all the linear features that were previously mapped and assess if anything has changed. If anything has changed since the previous survey the surveyor is required to remeasure, map and record the changes to bring the mapping up to date.

6.4.2.1 New or evolved linear feature

If a linear feature is identified during the assessment that was not previously mapped the surveyor is required to report whether the linear feature is new, missed or evolved.

A new linear feature is a linear feature that has been created since the last survey e.g. a new forest road has been created.

A missed linear feature is a linear feature that was obviously present during the last survey but was not recorded by the previous surveyor

An evolved linear feature is a linear feature that has changed and evolved since the last survey. For example, a drystone wall that was only partially built at the time of the last survey but now extends further than the previously created linear feature.

6.5 Theme data

Within the software a linear feature can denote a single or multiple themes along a line. By changing the 'from' and 'to' data fields along the length of the linear feature, different themes can be allocated to a single line along different parts of the length. For example, a fence may share the same line in parallel to a hedge or first one half and then the other. A full list of the initial theme data fields (e.g. woodland edge, cultural boundary), common theme data fields (visit status and reason for change) and cultural boundaries theme data fields (e.g. fence) are included in Annex F-H. These data fields will appear in the software to record observations.

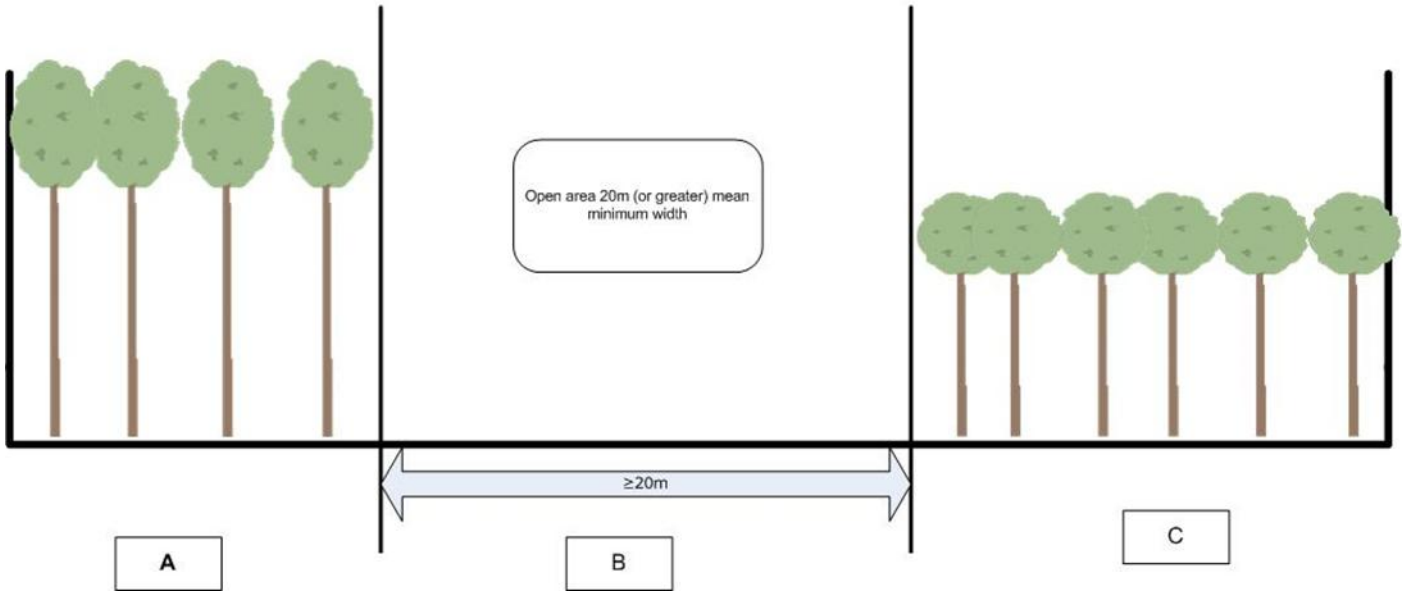
6.5.1 Woodland edge

Where a section containing trees is adjacent to an open section (whether within or without the NFI external map boundary), which has a minimum mean width of 20 m (including going outside the Square boundary) then a linear feature description of the woodland edge between the two sections is required. Details of the woodland edge data fields in the software are included in Annex I.

6.5.1.1 Abrupt edge

An Abrupt Edge is defined by an abrupt change from an area with tree to one without. For example, a section with trees next to an agricultural field or a public highway (see Figure 6.1).

Figure 6.1 An example of an abrupt woodland edge

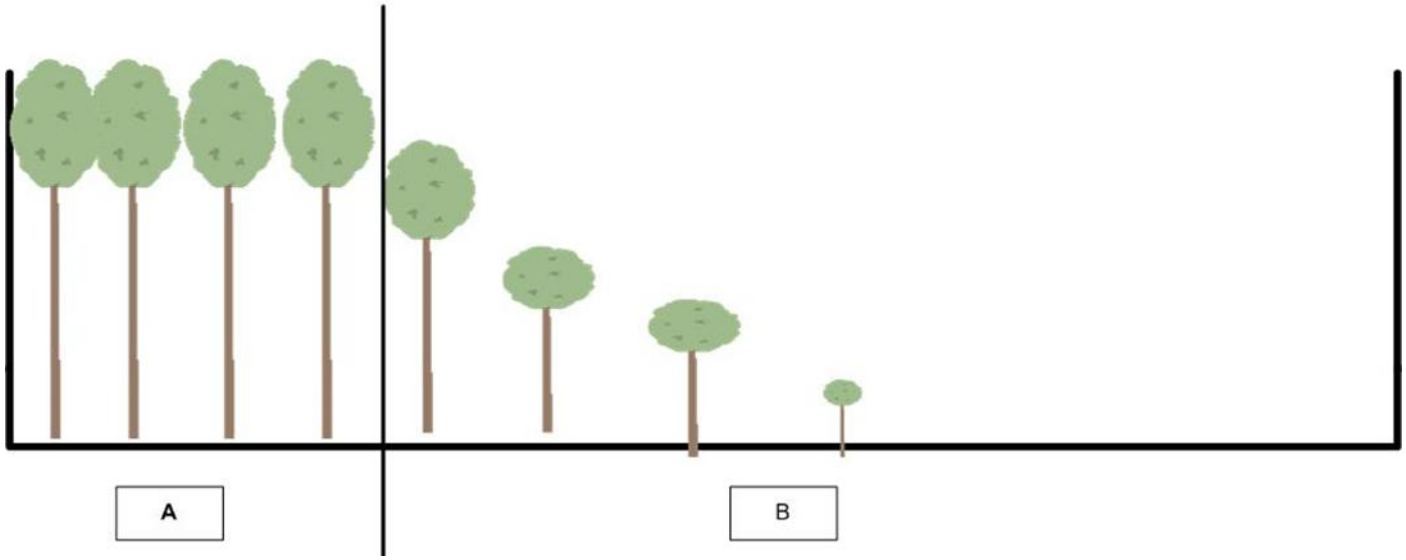


Woodland edge – abrupt; a distinct fall in height between an area with trees and one without. A = section with trees, B = section of open space, C = section with trees.

6.5.2 Tapered by height

The boundary between a section with trees and an open section is less abrupt (than the abrupt edge, above) and gradually reduces moving from the section with trees into the open area. An example would be natural regeneration spreading from the section with trees out into an open area (Figure 6.2).

Figure 6.2 An example of a tapered woodland edge

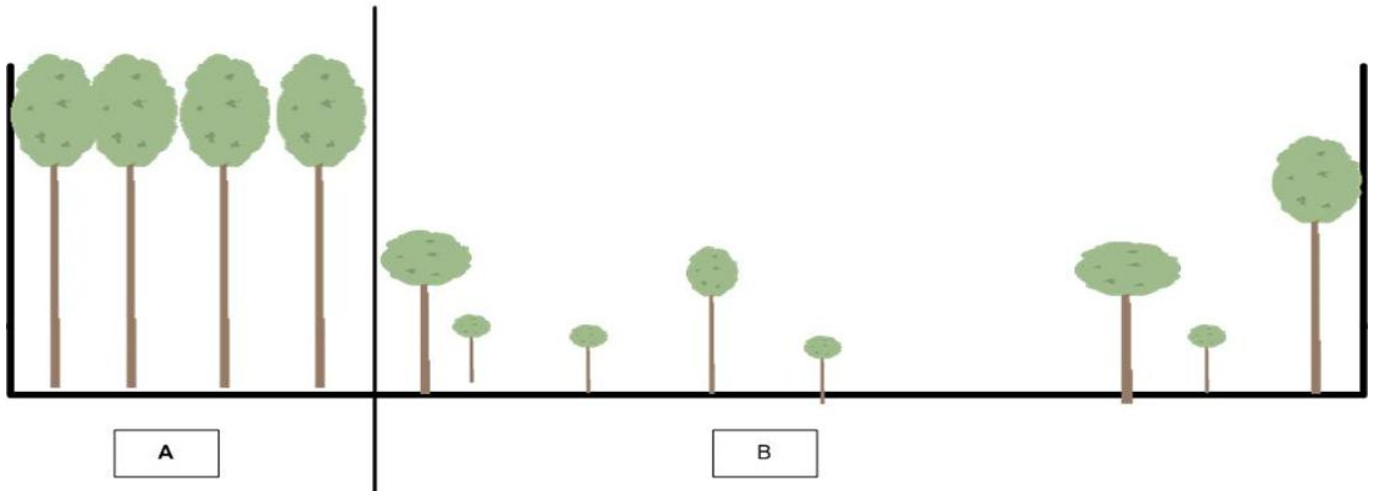


Woodland edge – tapered; a tapered fall in height between an area with trees and an open section. A = section with trees, B = Open space section.

6.5.3 Variable density ecozone

A variable density ecozone is where there is as the fall in height from a section with trees to the open section and tree heights do not decrease as regularly moving away from the section with trees to the open section (Figure 6.3).

Figure 6.3 An example of a variable density ecozone woodland edge



Woodland edge – variable density ecozone; variable fall in height of the trees between a section with tree and one without. A = section with trees, B = Open section.

6.6 Transport, recreation, hazards and water feature linear features

A list of data fields included under transport, (e.g. public road, railway), recreation (e.g. public right of way, informal path), hazards (e.g. power line, electric fence) and water features (e.g. stream, inc. contaminants) are included in the Annex J-M.

7 Point features

7.1 Introduction

Point features represent a feature or an area that is too small to map with a polygon or as a linear feature. In the NFI this is generally < 0.01 ha. All point features within the sample square are recorded. Features that are recorded as points include (see also Annex N for the point feature themes that are surveyed):

- Hazards; any point feature that poses a risk to personnel.
- Water features: any non-linear water feature (refer to Chapter 6 for information in linear features)
- Veteran trees
- Monuments
- Historic structures

Point features provide data and information on key features that are of particular interest. Point features are also useful to the surveyor as they can be used as reference points to help navigate the sample square and find sample locations, i.e. plots. Point features also highlight features that may present a risk to the surveyor, for example, a mine shafts or sink hole. It is recommended that the surveyor is familiar with point features before visiting the survey site.

Point features need only to be recorded within NFI Treed and NFI Open Sections and up to 10m outside the woodland edge (in Open non-NFI sections). The exception to this is where the Point feature is a H&S issue. The definition of H&S in this instance is where it would impact upon a surveyor getting to, and assessing, the sample square. For example, if the western 50% of a square is non-NFI open land which needs to be crossed to access the woodland then any H&S issues should assessed. If, however, the surveyor approaches this square from the east and does not need to cross the western 50% then mapping of the H&S issues within the western part of the square is not required.

NOTE: Individual trees within plots are also recorded as 'points' but this is different to point features discussed in this chapter. Refer to chapter 14 for details on mapping trees as points within plots.

7.2 Aim

The following chapter describes how to use the Forester Geo Database and associated editing tools to record point features in the sample square. The editing tools do not require expert knowledge and the information included within this manual should be enough to competently use this tool.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

7.3 Point features mapping using the software: new square

The square should be assessed, and number and type of point features should be mapped and recorded in the in the software.

7.4 Point features mapping using the software: remeasure square

If the square is a remeasure the software will present the point features that were mapped during the previous assessment. It is likely that the previous assessment will have been carried out several years prior to the current visit, therefore previous mapping should be checked and verified, and any amendments should be recorded using the software as described in this chapter.

It is recommended that the surveyor ensures they are familiar with the point features that were recorded in the previous assessment before visiting the sample square. Depending on the features present this may impact your risk assessment and the way you carry out the survey once you are in the field (i.e. a sink hole may have health and safety implications). The point feature may also aid in the navigation of the site.

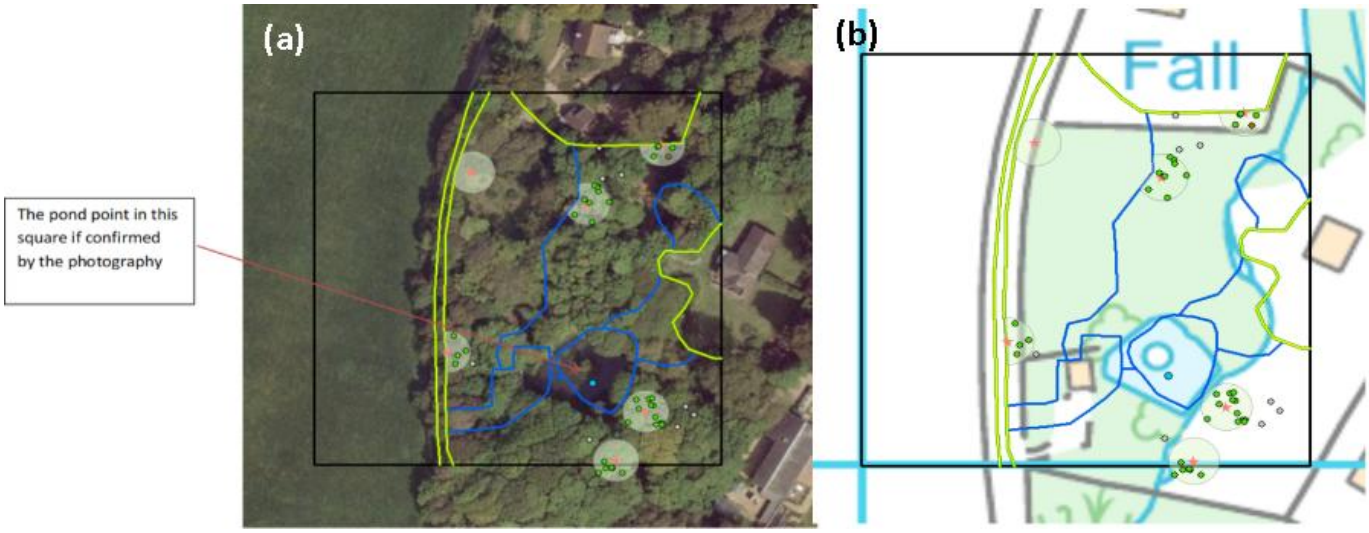
7.4.1 Acceptable tolerance

Standard GPS and survey techniques are unlikely to have an accuracy of <10 m. Therefore, if a difference of <10 m in point feature assessments is identified then, unless there is strong evidence to suggest otherwise, no change is recorded. Placement of the point feature relative to other features should also be checked (i.e. is the point feature on the correct side of a building or section?)

7.4.2 Locating point features

It is recommended that the surveyor locates the point features early on in the survey to help navigate the square and manage risk. The location of point features can be identified using information recorded during the previous survey, Ordinance Survey data, aerial photographs, GIS, GPS or map, compass and pacing.

Figure 7.1 A remeasure square with point feature (and other features) mapped; photograph and OS Map



An example of a sample square that has been mapped and a pond point feature identified. (a) an aerial photograph of the sample square. (b) The sample square on the OS Map.

Features such as ponds and veteran trees are useful navigational aids and should be used to confirm plots locations and section boundaries. Most features will already have been identified by the previous surveyor, but some may have gone since then, such as the removal of a veteran tree or a pond being drained. There may also be new point features, such as a pond being built. The current surveyor should use the original surveyor's assessments of where features are, making reference to the Ordnance Survey data and aerial photography (see Figure 7.1). In addition, the surveyor should make observations during the survey and confirm or amend what has been previously reported. Points feature locations can be identified and confirmed via any of; GIS, GPS or map, compass and pacing. Tolerances for locating the features are +/- 10 m.

7.4.3 New or evolved point features

If a point feature is identified during the assessment that was not previously mapped the surveyor is required to report whether the linear feature is new, missed or evolved.

A new point feature is a point feature that has been created since the last survey.

A missed point feature is a point feature that was obviously present during the last survey but was not recorded by the previous surveyor

An evolved point feature is a point feature that has changed and evolved since the last survey.

Occasionally the survey protocol changes resulting in a difference in the way things are recorded. Therefore, a protocol change is reported for a point feature that was not recorded or was recorded differently in the previous survey due to a change in protocol.

7.5 Create a point feature in the field software

Details of the data fields associated with point features, theme data fields (e.g. water feature, veteran tree or hazard), water features data fields (e.g. pond) and veteran trees are included in the Annex O-Q.

7.5.1 Veteran Trees

A veteran tree or legacy tree is a tree which, because of its great age, size or condition, is of exceptional cultural, landscape or nature conservation value. A veteran tree is identified by:

- A diameter breast height measurement (DBH) >75-150 cm (depending on the species, see Table 7.1) and/ or;
- The tree has at least 3 attributes or features combined that are deemed to make the tree of exceptional cultural, landscape or nature conservation value (see Table 7.2).

Table 7.1 Minimum diameter breast height (DBH) measurement for veteran trees by species

Tree Species	DBH (cm)
Alder	>100
Ash	>100
Beech	>150
Birch	>75
Cherry	>75
Elm	>150
Field maple	>75
Holly	>75
Hornbeam	>75
Horse chestnut	>150
Lime	>150
Oak (lowland)	>150
Oak (upland)	>100

Tree Species	DBH (cm)
Other Exotics	>150
Other pine	>150
Other small tree species	>75
Poplar	>150
Rowan	>75
Scots pine	>100
Sweet chestnut	>150
Sycamore	>150
Willow – Goat	>75
Willow – Grey	>75
Willow – other	>150
Yew	>75

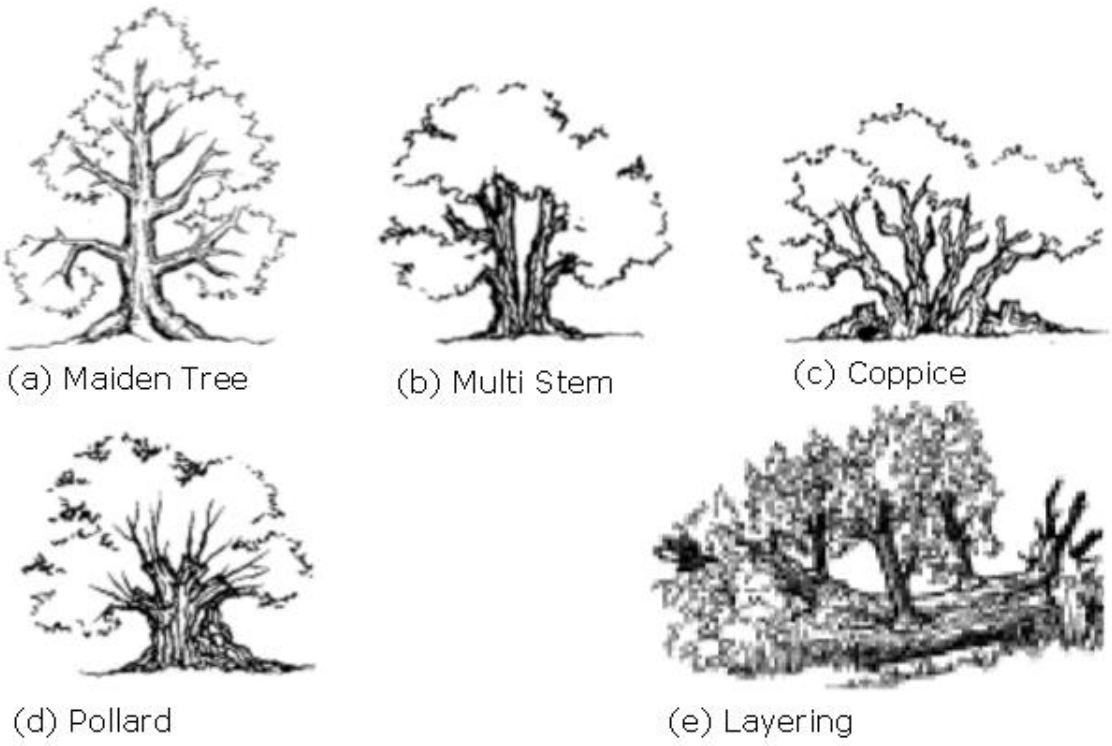
Minimum DBH is one way to identify a veteran tree. A tree may still be classified as a veteran tree if its DBH is less than the measurements listed above but it has at least 3 of the attributes and/ or features listed Table 7.2.

Table 7.2 Attributes and features of a veteran tree

Attribute	**Notes**
Rot Holes	Must be ≥ 5 cm diameter
Rot Sites	Must be ≥ 300 cm^2
Dead Wood in Crown	Must be ≥ 1 m in length and ≥ 25 cm circumference
Hollowing of Trunk/Major Limbs	
Water pockets	
Bark Fluxes	Liquid from inside the tree leaking through the bark. Fluxes may emerge from wounds, cracks or fissures without obvious signs of decay.
Tears, Scars or Lightning Strikes	
Bird Nests	When recording just note that at least one is present, no need to count all of them
Woodpecker Holes	
Bat Roosts	
Other Animal Activity	
Feature	
Foliose lichens	When recording just note that this is present, no need to count all occurrences
Bryophytes	
Ferns	
Mistletoe	
Vascular plants	
Other trees	
Suckers	

A tree may be classified as a veteran tree if it has at least 3 of the attributes and/ or features, combined, listed here. If none of these attributes or features are present on the tree it may still be classified as a veteran tree if it has a minimum DBH of >75-150 cm (depending on species, see **Table 7.1**).

Figure 7.2 Veteran tree forms



(a) Maiden tree - free grown with natural crown; **(b) Multi stem** - Trunk naturally crowned with multiple stems; **(c) Coppice** - Cutting of stems creating a multi-stem tree, cutting carried out near the ground; **(d) Pollard** - Similar to coppice but stems start much higher from the ground (e.g. to prevent grazing of new stems); **(e) Layering** - Tree with main stem on the ground and new stems arising from it. Diagrams are taken from Fay & de Berker (1997) The Specialist Survey Method.

Data fields for Veteran Trees features and veteran tree attributes are detailed in Annex Q.

8 Recording and editing the section attribute assessment using the field software

8.1 Introduction

Once the sample square has been divided into sections the surveyor is required to assess the attributes of each section. This includes recording tree species, number of storeys, type of vegetation and any plant health issues.

The Forestry Commission can use the section attribute information to analyse how GB woodland, and neighbouring open areas, are composed in terms of the vertical structure (storeys) and the horizontal differentiation and landscape fragmentation. Fragmentation of the landscape is particularly important when looking at wildlife corridors and the impact of change to these corridors. The pattern of tree cover and open space is important in terms of environmental policy and planning and the timber industry.

8.2 Aim

The following chapter describes how to use the Forester Geo Database and associated editing tools to record the section attribute assessment. The editing tools do not require expert knowledge and the information included within this manual should be enough to competently use this tool.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

8.3 Section attribute assessment: new square

Once the Sectioning has been completed data can be recorded. If data is recorded during Sectioning, you will need to be careful that any subsequent Splitting and/or Merging of Sections does not give rise to erroneous data.

8.4 Section attribute assessment: remeasure square

An element of data recording has to be carried out whilst checking that the original sectioning is still valid. Again, once the section boundaries are confirmed you will need to ensure that the data for that section is correct.

The main factor to be aware of is the 'Reason for Change' field. For a remeasure square the current surveyor must choose from the options; no change, real change, error.

In allocating these values it is important to remember that this field is to determine the type of change in the section boundaries and section values only. It is not to reflect the nature of changes in the subservient levels of components, subcomponents and plots. For example, there may have been no real change in the section boundaries and its values such as plot type and access status and here you should record 'no change'. But there may have been change in the height of the stories and this should be recorded as 'real change' at the component level.

Differentiating change at different levels within the data model, i.e. square, section, component group, and subcomponent plot, allows us to discern between minor change (all the trees will have grown) and major change (the section has doubled in size) in the analysis and reporting of the NFI.

8.5 Selecting a section

Data entry will depend on square accessibility. Details of the selection data entry fields are in Annex R.

8.6 Herbivory assessment

Surveyors are required to record physical evidence of herbivory, such as browsing, fraying, and stripping and the presence of any key herbivores sighted during the square assessment.

Surveyors are not expected to carry out a specific herbivory assessment, however while carrying out the other sample square assessments the surveyors are expected to be vigilant and record obvious and clear signs of the presence of herbivores. This includes the sighting and sounds of animals, burrows, scats, dens, fur, wool, hair, drays or tracks/ prints. Surveyors are expected to recognise browse lines within vegetation, height, and type of browsing, stripping or fraying and reasonably estimate the animal that did the damage.

Table 8.1 Common herbivores found in British woodlands and signs that indicate their presence

Common herbivores found in GB woodlands	Evidence of their presence in woodlands
Deer Squirrels Sheep Cows Horses Rabbits Hares Pigs/wild boar Beaver	Sighting and/ or sound of animal (NB. In the field software a sighting or a sound of an animal should be recorded as a 'sighting' in the drop-down menu options). Presence of; ground disturbance, burrows, scats, dens, fur, wool, hair, drays or tracks/ prints Presence of; browsing, stripping or fraying.

8.7 Social use assessment

From Cycle 4 of the NFI, social indicators are no longer required. The field is still present and a return of 'Not Surveyed' should be entered. The assessment is still used for TOW squares and is retained for that purpose.

Surveyors are required to record evidence of anthropogenic interaction with the woodland, such as recreation, amenity management, abuse/ damage, research, education, enterprise or fire. Surveyors are not expected to carry out a specific social use assessment, however while carrying out the other sample square assessments the surveyors are expected to be vigilant and record obvious and clear indicators of anthropogenic interaction.

Details of the social indicator category data fields and social use sub classes (inc. recreation, amenity management), and abuse, fire, education and enterprise and research data fields can be found in Annex S-X.

Table 8.2 Indicators of social use common in British woodlands

Social use indicator	**Social use category**	**Evidence that would result in the surveyor recording the presence of the social use category**
Recreation	**Informal path** (made through repeated use); where people walk informally but there is no	Areas of vegetation that are supressed or flattened in relation to surrounding vegetation such that it has formed an obvious pathway.

	formal rights to this, signs, POW etc., excludes historical transport routes such as old drove roads, Roman roads etc.	Areas where bare earth has replaced vegetation and takes the form of an obvious pathway. This may be difficult to distinguish from areas specifically cleared to encourage people to roam off formal paths (see below). However, vegetation cleared in informal path use would likely have snapped/ broken branches, rather than purposefully pruned branches to encourage people to roam from paths.
	Formal path; A planned and created pathway.	This includes Public Rights of Way and waymarked paths and historical transport routes such as old drove roads, Roman roads, etc
	Outdoor education activity;	This option under 'recreation' is now redundant. If there is evidence of outdoor education activity it should be recorded under 'education, enterprise and research\ education' (see below). Note that Den Building is recorded separately (see below).
	Den Building	This includes witnessing of den building taking place or the presence of dens that suggests den building has taken place recently. 'Recently' is considered to be in the last 9 months and determination is at the discretion of the surveyor. For example, if the den/s look like they have been there for a while (i.e. very overgrown or barely recognisable as having been used for an organised activity) then this does not represent evidence of this indicator.
	Off-road motorcycle tracks/ mountain bike tracks; formal and informal	Tracks are the tread marks that a tyre makes on the ground (as opposed to a trail). Formal tracks would be present on authorised trails, whereas informal tracks would be anywhere that these activities are not formally authorised. This also includes the observation of people on mountain bikes or motorcycles, and infrastructure to support motorcycles or mountain bikes. However, if there is evidence that the observed mountain biking or

		motorcycle use is supported by a private enterprise then it should recorded in the software under 'education, enterprise and research\ private enterprise' (see below).
	Informal gathering/ camping; for example, wild camping	The surveyor should observe an informal gathering, a party, crowd, or event, where a group of persons assemble for a social occasion or activity that is not part of an official pre-organised event. Wild camping is a pitched tent that is in an area away from a formal campsite. The tent should appear as if it is being used (i.e. not abandoned or damaged or only partially pitched). Semi permeant camping (i.e. accommodating people without permanent housing) is not evidence of this social indicator.
	Equestrian use; any equine use except grazing (grazing is recorded as part of the herbivory assessment)	Equestrian use must be observed. Signs of use. Horse dung or hoof tracks are not reliable indicators of this social indicator due to the presence of wild ponies in parts of the UK
	Dog walking	This includes the observation of anyone walking or running with a dog on or off a lead. If there is evidence that the walkers/ runners may be on a paid-for guided walk (i.e. company branded clothing worn by a guide) then the observation should be recorded under 'private enterprise' (see below). Dog fouling is reported separately under 'abuse' (see below).
	Able/ encouragement to roam from paths;	Paths with vegetation cleared, brashing of adjacent trees, off path facilities, signs encouraging access off the path and into the wood. This may be difficult to distinguish from informal paths. However, vegetation cleared in informal path use would likely have snapped/ broken branches, rather than purposefully pruned branches to encourage people to roam from paths.
Amenity management	**Vegetation management;** for example, swiping, mowing, pruning	This includes any observed vegetation management (i.e. mowing) and evidence that vegetation management has occurred, i.e.

		grass piles, mulch and freshly pruned branches are evidence of current management.
	Furniture; for example, picnic table, benches	Furniture must be permanent and intentionally placed and meant for outdoor use in a specific location. This does not include furniture that has been dumped (see fly tipping below).
	Signage; for example, narrator boards, finger posts	Signage must be permanent and intentionally placed, providing information relating to the area in which it is located.
Abuse/ damage	**Litter;**	This includes that observation of any recreational litter such as bottles, crisp packets, etc. Litter such as industrial/ household waste is evidence of fly tipping (see below).
	Fly tipping;	Deliberate tipping of industrial/household and garden waste. Recreation litter (i.e. crisp packets) is evidence of litter (see above).
	Dog fouling	This includes the observation of dog faeces on a formal pathway and dog faeces that has been collected in a bag and left on a formal pathway. It does not include faeces that has been purposefully cleared from the formal pathway (i.e. stick and flick) or faeces that has been disposed of in a bin.
	Vandalism;	Damage is any physical harm that impairs the value, usefulness, or normal function of something. This includes any observed anthropogenic (i.e. as a result of human activity) damage to biotic (i.e. trees) and abiotic features (i.e. furniture). This excludes damage caused by fire (see below).
	Farm waste;	High nitrogen content waste such as slurry, effluent, bedding / dung mixes from intensive farming methods that has been dumped, as opposed to disposed of at a designated site.
	Forester contractor waste;	Includes all waste related to forestry activities/ working, e.g. oil drums, containers, planting bags, herbicide bottles, general litter resultant from forestry operations.
Fire	**Damage caused by fire**	This does not include controlled campfires and naturally occurring fires.

Education, enterprise and research	**Private enterprise;** Any form of non-forestry business, for example Go Ape, Mountain biking, etc.	This includes all paid for activities that are non-forestry business. Evidence includes observed purpose built infrastructure designed to support specific activities (i.e. signage, hire shops, branded mini buses in the carpark, etc.). It also includes the observation of the activity taking place provided there is also observed infrastructure designed to support the activity. It also includes guided walks/ bike trails/ etc. that are paid for. This would be evidenced by the leaders wearing company branded clothing or other company branding (i.e. on the bikes). If there is no evidence that the walk/ bike trail is guided then the observation should be recorded under 'recreation' (see above).
	Research; Any form of research activity	Research plots can be distinguished by looking out for tree numbering, staking and labelling and specialist equipment.
	Education: Any form of educational activity, for example scout camps	This includes witnessing of educational activity taking place (i.e. Scouts or Forest Schools) or the presence of infrastructure that suggests that educational activity has taken place recently. For example, infrastructure may include a campfire set up with stumps arranged around a central fire or bug hotels Note that Den Building is recorded separately under 'recreation' (see above).'Recently' is considered to be in the last 9 months and determination is at the discretion of the surveyor. For example, if any infrastructure looks like it has been there for a while (i.e. very overgrown or barely recognisable as having been used for an organised activity) then this does not represent evidence of this indicator.

8.8 Mapping formal and informal paths and tracks

Surveyors are required to map any formal or, well established, informal paths, public rights of way, off road motorcycle tracks, bridleways, cycle ways, paths with way

markers, or other linear features associated with outdoor education activity or access routes used for recreational activity.

9 Component groups

9.1 Introduction

Homogenous areas (differentiated by habitat or land use) of ≥0.05 Ha are mapped into sections, however, often there can be important areas of interest that are <0.05 Ha. These smaller areas are called component groups. Like a section, the component groups are areas of homogeneous land use or habitat, which are too small to map but important enough to identify separately (in effect sub-sections). All Sections must have at least one component group and can have up to 30, although there are rarely more than 5.

Recording of these small component groups is important and enables the NFI to provide an accurate picture of the biodiversity of British woodland habitats. For example, wet woodlands are inherently small and often too small to map. However, they are recorded as a component group and as a result we now know that wet woodlands are one of the most common woodland types in Britain, whereas before we thought it one of the rarest. Furthermore, it is important for the timber forecast that the net area of timber stands is known accurately. Recording component groups means small but significant areas of minor species or open space can be assessed increasing the precision of timber forecasting in Britain.

9.2 Aim

The following chapter describes how to correctly identify component groups within a section and provides examples.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

9.3 Component group identification

9.3.1 Key definitions

Component group: Homogeneous areas that are too small (<0.05 ha) to practically map as a discrete section, but with most of the same defining characteristics as a section. They can represent features of the natural or built environment. Every section contains at least one component group and the maximum number of component groups recorded in one section was six in the first survey cycle. Component groups have no minimum size, to include very small features - those important enough to record, but too small to map (such as one-metre of railway line intruding into a sample square, a

pond or small area of woodland habitat). Component groups can be subdivided into components.

Component or sub-component: Individual elements (components) of the component group. For example, each tree species will be recorded under a separate component, as will each habitat type if two habitats are intimately mixed (such as upland birchwood and wet woodland).

See Annex Y for a flow chart to help the surveyor decide whether the area should be a section or a component group.

9.3.2 Component grouping: new square

Component grouping is carried out as part of the sectioning process. While sectioning the sample square areas of homogenous habitat or land use that are <0.05 Ha should be identified as a component group and allocated to a section. This allocation can be to an adjacent section or to a section elsewhere in the square to form a multi-part Section.

9.3.3 Component grouping: remeasure square

Component groupings will have been recorded in previous survey. The surveyor is required to assess each the component groups within each section of the sample square and record no change, real change or surveyor error compared to what was recorded in the previous survey.

9.3.3.1 No change

After assessment the surveyor deems that no significant change to the component group has occurred since the previous survey cycle assessment.

9.3.3.2 Real change

Component groups may have undergone significant change since the previous survey, or a new component group may have become evident. Real change generally as a result of human activity (e.g. felling, development or planting) and, less often, as a result of natural processes (e.g. windblow, natural regeneration or disease). These changes should be recorded in the software.

9.3.3.3 Sampling error

Some circumstances may suggest an error in the previous component grouping. If the differences are minor and appear as if they may be due to differences in subjective interpretation, then accept the component groups as they are and record in the software as no change. In general differences of <10 % are attributed to differences in subjective interpretation and no change is recorded. However, if the difference is significant and

notable then the surveyor is required to correct the previous component grouping. Correction can be done by either;

- Assigning the existing components (i.e. those identified in the previous survey) under new component groupings, or;
- Creating new components and assigning these to component groups.

Either way these amendments are classified as surveyor error.

Occasionally the component grouping and component allocation is so different on the ground, compared to what was recorded during the previous survey, that it would undermine the survey and the square assessment cannot be completed within a reasonable time frame. In these instances, it is recommended that the surveyor disregard and delete the previous assessment and start a new survey.

9.3.4 Examples of component grouping

All Sections must have at least one component group and can have up to 30, although there are rarely more than 5.

Table 9.1 Examples of differences in land-use or habitat that would result in the creation of component groups; both clear and less obvious examples

Clear component groupings	Subjective component groupings
One pure species grouping vs. another.	One set of tree mixtures versus another set of tree mixtures, with an overlap in species between the two and a common priority habitat.
One clear separation of a distinct habitat versus another.	Two native or non-native clusters
One landuse versus another.	Two clustering's similar in species and different by only one storey.
Open versus forest landuses.	Two CG's different by only a weak / thin understory.
Non-native versus native.	Two CG's different by a weak / low impact treatment.
Conifer versus broadleaved.	A very minor species composition difference (less than 10% of canopy).
Woodland / open	Through a poor NVC assessment
NFI / Non NFI.	A small part of a housing estate is found in the corner of a wooded square

9.3.4.1 Example 1: a mixture of buildings and trees within a section

An NFI woodland Section (0.7 Ha) contains a Scout camp with several small buildings scattered throughout, resulting in an intimate mixture of trees and buildings. The total

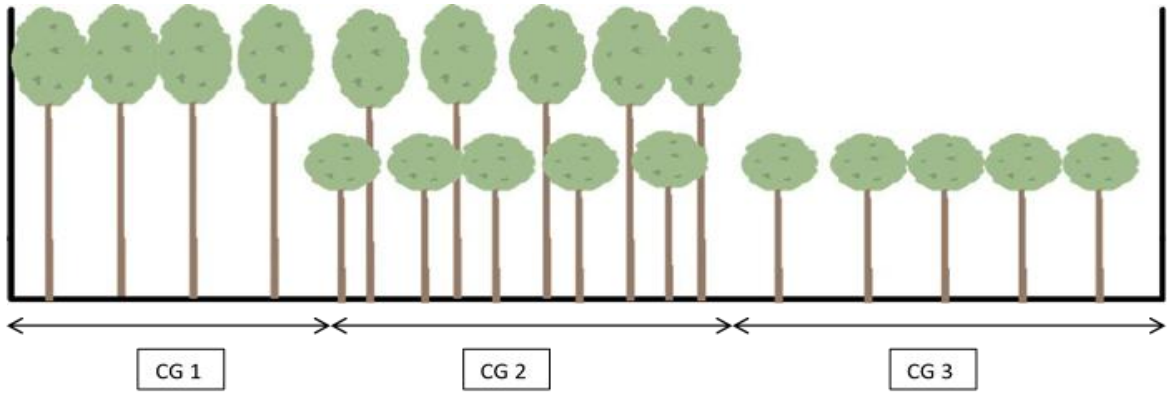
area covered by the buildings is greater than the minimum section size (i.e. 0.05 Ha) but it is not possible to map each of the small buildings individually. In this case it is permissible to create a single Section with two component groups; one of trees and one of buildings. Therefore, if the Section was composed of 50% trees and 50% buildings each Component Group would be 0.35 Ha in extent.

9.3.4.2 Example 2: a single storey, single species section

If the section is a homogenous area and there are no small areas within it that are discrete in their nature or land use, then the section will have one component group which will occupy the entire section. For example, a section with a single storey and a single species, for example upper storey, Scots pine, would have one component group.

9.3.4.3 Example 3: three component groups

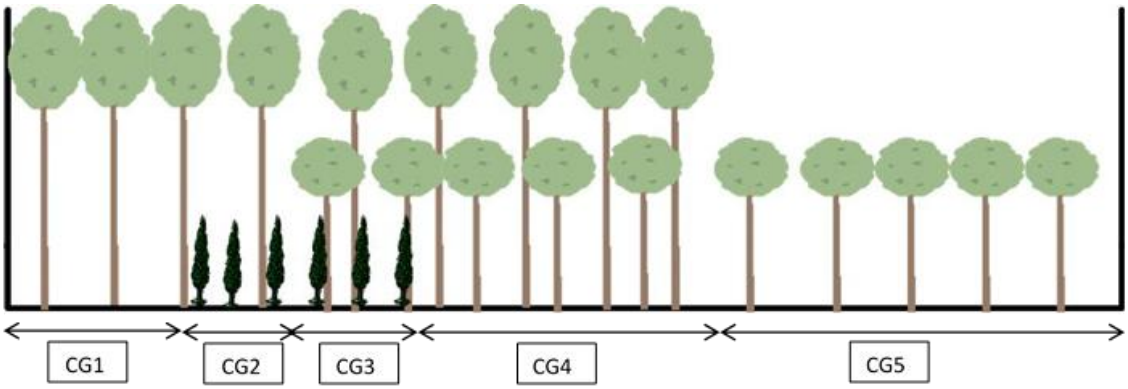
Figure 9.1 A schematic example of a section with three component groups



A single species within a section but there are two distinct storey heights that overlap. CG = component group. CG1 = upper story, single species; CG2 = Upper storey and lower story, single species; CG3 = lower storey, single species.

9.3.4.4 Example 5: four component groups

Figure 9.2 A schematic example of a section with four component groups



Two species present within the section and two storeys. CG – component group. CG1 = upper storey, species [a]; CG2 = upper storey, species [a] and lower storey, species [b]; CG3 = upper and middle storey, species [a] and lower storey, species [b]; CG4 = upper and middle storey, species [a]; CG5 = middle storey, species [a].

Component groups can also be used to 'attach' small areas of other stands or other land parcels to a section with trees. This is used when the feature itself, as it exists within the square, does not have a sufficient minimum mappable area to form a Section in its own right. It generally occurs where a square boundary just cuts into another land parcel and the remaining fraction is too small to form an independent section.

10 Components

10.1 Introduction

Components are the individual elements, or building blocks, of the forest that account for much of its nature and all of its recorded area. The component data collected should enable a person who has not visited the Square to get an idea of the representative character and composition of the sections.

Components describe each element associated with an area. This area is generally a section but may also be a smaller area such a component group. Components of areas that contain trees are identified by species, storey (vertical structure) and component group within the section. Components are also be used to describe an area that does not contain trees, such as a house or a garden. Components are not mapped, they are recorded as a proportion (e.g. % occupancy of a storey) of the section with which they are associated.

The minimum area for an individual component is 1% up to 100% of a section. If there is more than one component, then the % area allocation of the section must be shared between the components until they equal 100% per storey.

Recording components provides valuable insight about how the land is stocked/ occupied, both vertically (via the storey structure) and horizontally (in conjunction with the Sections and Component groups). This information contributes to the analyses of a variety of outputs such as Gross:Net area for timber production forecasting and biodiversity indices.

10.2 Aim

The following chapter describes how to identify components in the field and how to record observations in the field software.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

10.3 Components: new square

During the initial walk around the sample square the components making up the land area should be noted as part of the sectioning and component grouping process. Once the Sample square has been divided into its mappable sections and their component groups the more detailed information about the individual components can then be collected on a component group by component group basis. New square assessment require the surveyor to collect and record information on the components.

10.4 Components: remeasure square

Identifying real change and understanding differences and tolerances between the current assessment and previous surveys. When assessing a square that has been previously assessed the primary aim is record evidence that will allow the NFI to assess change. The surveyor will have access to the section visualisation tool and the components to gain a detailed view of what was recorded during the previous survey. During an initial walk through each section, the surveyor should look out for; the features that were previously identified, evidence that those features are still present or not, evidence of any change to the previously described features and evidence of any new features.

Common modest features of change in woodlands that will arise between surveys include:

- storeys moving from one height layer to another (15 to 20 M to 25 m plus)
- storeys splitting from single to multiple storeys
- the loss of a seedling layer
- the development of a sapling layer
- new management activity

If the surveyor is content that the stand is as described previously and has simply 'grown on' for 5 years, a few changes to the component attributes may be all that it required to bring the section up to date, such as the revision of the storey height bands, estimated crown diameters and stocking.

Some stands may have evolved more significantly or be very different from what has been recorded previously. In this instance the surveyor may have to identify and record factors such as:

1. A thinning event:
    a. Its impact on stocking.
    b. Its impact on component / species %'s.
    c. The presence of new rides or racks.
    d. A change in silvicultural practice.
    e. The presence of tree damage such as bark skimming.

f. Notice its impact on the amount and type of deadwood.

2. Any other new management practice.
3. The loss of a seedling layer.
4. The change of a seedling layer to a sapling layer.
5. A new tree species colonising the stand.

The main cause of significant change that will be encountered in survey will be management events such as harvesting, thinning, restocking or new planting. Equally natural events such as wind damage, fire and flood can bring about significant change. It is important to record such changes accurately.

The primary aim is to record evidence that will allow the NFI to assess change over time. For example, approximately 10% of conifer sites will have been clear felled since the last survey – the survey needs to establish that estimate. All things being equal approximately 10% of these clearfell sites will have new section boundaries, the removal of components (such as high forest) and the creation of new components (such as clearfell and seedlings) within the section will need to recorded (real change). This will reduce the amount of work required to assess the stand overall, as it will reduce the amount of mensuration work, but time will need to be put into assessing the extent and nature of any new clearfell and restocking.

Occasionally you may find a site where you disagree with the previous surveyors basic sectioning and stratification of the site. In these instances we give guidance on what to accept and what to reject.

Once you have confirmed or updated the basic section structure of the square and have confirmed or amended the stands characteristics in its associated component data fields you will need to start thinking about locating the plots.

As previously noted the key to understanding and recording real change in components is that once you have observed differences between your assessment and the previous one you need to discern between errors, differences due to subjectivity and real actual change.

10.4.1 Subjective and objective component assessments

At the component level there are elements within the assessment that are subjective and those that are more objective (see Table 10.1). The higher the degree of subjectivity involved in making an assessment, the greater the likelihood of differences (not attributed to real change) being observed between the current surveyors' observations and those recorded by the previous surveyor. In comparison, differences observed between objective measures recorded by the previous surveyor and current surveyor are more likely to be as a result of real change. It is suggested that the

assessments with the greatest degree of subjectivity are sectioning in habitat mosaics, storey allocation and % area allocation and there are examples and rules discussed around these in the relevant sections within this chapter.

Table 10.1 Component assessments described as subjective or objective

Measure	**Suggested degree of objectivity**
high = objective, low = subjective	
Distance to road	High
Plot data	High
Number of trees in plot	High
Tree height	High
Diameter	High
Crown measures	High
Live dead	High
Presence of tree species	High
NFI / Non NFI land	High
Shrub acting as tree	High
Presence of pests and diseases	Medium
Herbivory	Medium
Planting year	Medium
Section boundary differences	Medium
Setting a strata as component group or a section	Medium
Storey allocation	High
Component % area allocations	High
Canopy height	Medium
Stocking	Medium
Visual height assessment	Medium
Visual DBH assessment	Medium
Estimated crown diameter	Medium
Silviculture systems	Low
Historic management	Low
Ease of harvesting	Low
Propagation	Medium
Woodland origin	Low
Landuse	Low
Priority habitat	Low
Broad habitat	Low

10.4.2 Rules to deal with differences in observations

As a general rule of thumb, if the assessment is non-numeric (e.g. land use or silviculture system) then the default should be to record what is observed by the current surveyor. If the measurement is numeric (e.g. planting year) then provided that the observations recorded by the previous surveyor is no more than 10% different to that observed by the current surveyor, then the previous surveyors' observations can be accepted.

10.4.2.1 Numeric measures

The general rule, described above, applies easily to planting year (apply the % to the trees 'age' not the planting year), stocking, canopy height, visual height assessments, visual DBH assessments, and estimated crown diameters. These are all visual assessments and contain some element of measurement error or subjectivity and, in light of this, it is sensible to apply tolerances.

10.4.2.2 Non-numeric measures

The majority of the non-numeric measures are objective in nature, therefore, tolerances or acceptable bounds are small. For example, a landuse of agriculture is quite different to one of high forest as compared to a stocking assessment which is assessed on a continuum. Therefore, there is a difference in the assessment of the current surveyor with that of the previous one, it I likely to be either real change or surveyor error. Therefore, it is expected that the current surveyor records their observations rather than accepting those of the previous surveyor if there is a difference.

Exceptions would be where two categories are very close by definition. An example might be under timber potential where the previous survey selected a potential timber crop and you see a fuel wood crop. In this instance, the current surveyor should record their assessment, if there is a difference in observations from the previous assessment because it is likely that the difference may be as a result subjectivity, error or changes in market conditions. Although note that only when there is clear evidence of error should it be recorded as such.

10.4.2.3 Not observed

If the current surveyor does not observe a component (after a day + surveying) that was previously recorded, but they have reason to believe that they may have just missed seeing it then this can be recorded in the software as not observed. For example, broadleaf seedlings are hard to see, particularly if they were previously recorded as a low % area allocation and at a very low density during the winter. Therefore, it is understandable that the current surveyor may miss this during their survey. Similarly, if a components area allocation was at 0% and was, for example, a small tree in a lower storey it may also be easy to miss. For these very small components the surveyor is not expected to search for more than 20 minutes before recording 'not observed'.

10.4.2.4 Real change

Where there is evidence that a component has been removed, for example, thinning or felling, then real change is recorded.

10.4.2.5 Error

Where there is evidence that a component is unlikely to have been previously observed, there is no evidence of removal or likelihood that it could have been missed, it is likely to be due to error. For example, a previously recorded component of very large old broadleaves at a high stocking density and a high % area allocation is unlikely to missed by the current surveyors. Therefore, if there is no evidence of removal (e.g. stumps) then it would be acceptable to conclude that the previous surveyor may have made an error in their recorded observations.

10.5 Component attributes

A range of attributes are recorded for each component. This is information specifically associated with the component such as species, planting year and storey. There is a full list of component attribute level data is included in Annex Z.

10.6 Woodlands of Ancient Character

Ancient woodlands are an important component of British woodlands. If the surveyor identifies an area of ancient woodland character depending on the size of the area it should be recorded as either a section (≥0.05 Ha) or component group (<0.05 Ha).

The Ancient Woodland Layer map can be used to help identify the location of Ancient Woodland (this is supplied separately but can be viewed in the software). However, the Ancient Woodland Layer map does not include all ancient woodland (woodlands <2 Ha are not included) and some areas on the layer were not identified in the field. Therefore, the Ancient Woodland Layer map should be used in conjunction with other evidence observed on the ground during the sample square assessment. Details of Ancient Woodland indicators can be found in Annex AA.

10.7 Multiple components; add, delete and clone

If the Section has more than 1 Component, further Components can be added by right-clicking on components and selecting 'Add New Components'.

If too many Components have been created delete them by right-clicking on the Component to be deleted and selecting Delete Component.

In some instances a Component may be cloned instead of Added. Instead of having to enter the entire data set for a new Component again the Cloning function clones a selected Component, and all of its associated Component and Sub-Component attribute

data, significantly speeding up the data collection BUT the newly cloned data must then be edited.

10.8 Component % Area

The occupancy of each component within each storey needs to be assessed and recorded in the % Area field of the software. Note that occupancy is not necessarily the same as canopy cover.

Across a section all the uppermost components (land with trees and land without trees) must add up to 100% of the section area otherwise the full section area is not accounted for and the software will not validate.

10.8.1 % area allocation: remeasure square

Allocation of % area to component groups is a visual and a somewhat subjective assessment. Therefore, it is likely there will be small differences in % area allocation between two surveyors, particularly in complex stands with several components. However, there should not be notable or significant difference between the two unless real change has occurred.

Some forms of real change will be easier to observe, such as the introduction of recent windblow to a stand, the removal of one species from a mixture during thinning, or the establishment of a new species through seedling regeneration. Harder to observe are subtle shifts in canopy allocation, for example, between two competing species within the same storey. Discussed below are examples of hypothetical scenarios that the surveyor may encounter while assessing a remeasure square and details of how the surveyor may deal with these.

10.8.1.1 Example 1: % area allocation and subjective differences

In this hypothetical the previous surveyor observed a mixture of Scots pine 50% and 50% Norway spruce, in the Upper Canopy. However, the current surveyor has observed Scots pine 55%, 45% Norway spruce, in the Upper Canopy

There is no evidence of thinning, mortality or crown suppression. Therefore, the difference in observations may be attributable to real change, previous surveyor error or just subjective differences in a visual assessment.

To help to decide the most likely reason for the difference in the observations of % area for each species there are rules that can be applied (Table 10.2).

Table 10.2 Remeasure square: % area allocation rules

% Area Allocation Rules
If a % area allocation is out by ≤10% of the value (i.e. if % area allocation is 20%, 10% of this would be 2%) between the two surveys, accept as is unless there is evidence of real change (mortality, removals etc.).
If a % area allocation is out by >10% of the value between the two surveys, and there is evidence of real change (mortality, removals etc.), change the values
If a % area allocation is out by > 10% of the value between the two surveys, and there is no evidence of real change (mortality, removals etc.), change the values and record that you found survey errors.
Exceptions:
If a component was missing from a previous assessment, whether that is less or greater than 10% of the section area, create a component and a % area allocation and adjust the other components accordingly.

Using the above rules, the current surveyor can make a decision about how to treat the observed difference in example 1 between their observations and that of the previous surveyor.

In example 1 there is no evidence of real change on the ground such as thinning or mortality. Observations from the current surveyor suggest that the % allocation of Scots Pine is around 10% greater than the previous surveyors (50 * 10% = 55), and the assessment of Norway Spruce 10% less (50*-10% = 45). Therefore, the current surveyor should accept the previous assessment.

10.8.1.2 Example 2: % area allocation and real change

In this hypothetical example the previous surveyor reportedly observed Scots pine 60%, 20% Norway spruce, 20% Sitka Spruce in the Upper Canopy. The current surveyor observes Scots Pine 60%, Norway Spruce 5 %, Sitka Spruce 20 %, live windblow 15% (Norway), in the Upper Canopy.

Therefore, the current surveyor has observed that much of the Norway is live windblown and this assessment is current (i.e. occurred within the last three years). Therefore, this is real change and should be recorded.

10.8.1.3 Example 3: % area allocation and error

In this hypothetical example the previous surveyor recorded Scots Pine 60%, 40 % Norway Spruce in the Upper Canopy. The current surveyor observed Scots Pine 60%, Norway Spruce 20 %, Sitka Spruce 20 %, in the Upper Canopy. Therefore, the difference in observations between to two surveyors may be because the previous surveyor did not discern between the Sitka and Norway Spruces. In this instance the current surveyor need to correct the data.

10.8.1.4 Example 4: % are allocation and seedlings

In this hypothetical example the previous surveyor recorded Scots Pine 50%, 50% Norway Spruce, in the Upper Canopy. The current surveyor has observed Scots Pine 50%, 50% Norway Spruce, in the Upper Canopy and 100% Scots pine seedlings.

In this example the current surveyor has made the same observation for the upper canopy as the previous surveyor, however, the current surveyor has also observed seedlings on the ground. Provided none of these seedlings look older than 3 years it can be concluded that this is real change. Therefore, this change needs to be reported using the tools specific to remeasure squares. These are additional tools in the field surveyor software that are only available for remeasure squares.

10.8.2 Classification of change as a result of biotic or abiotic processes

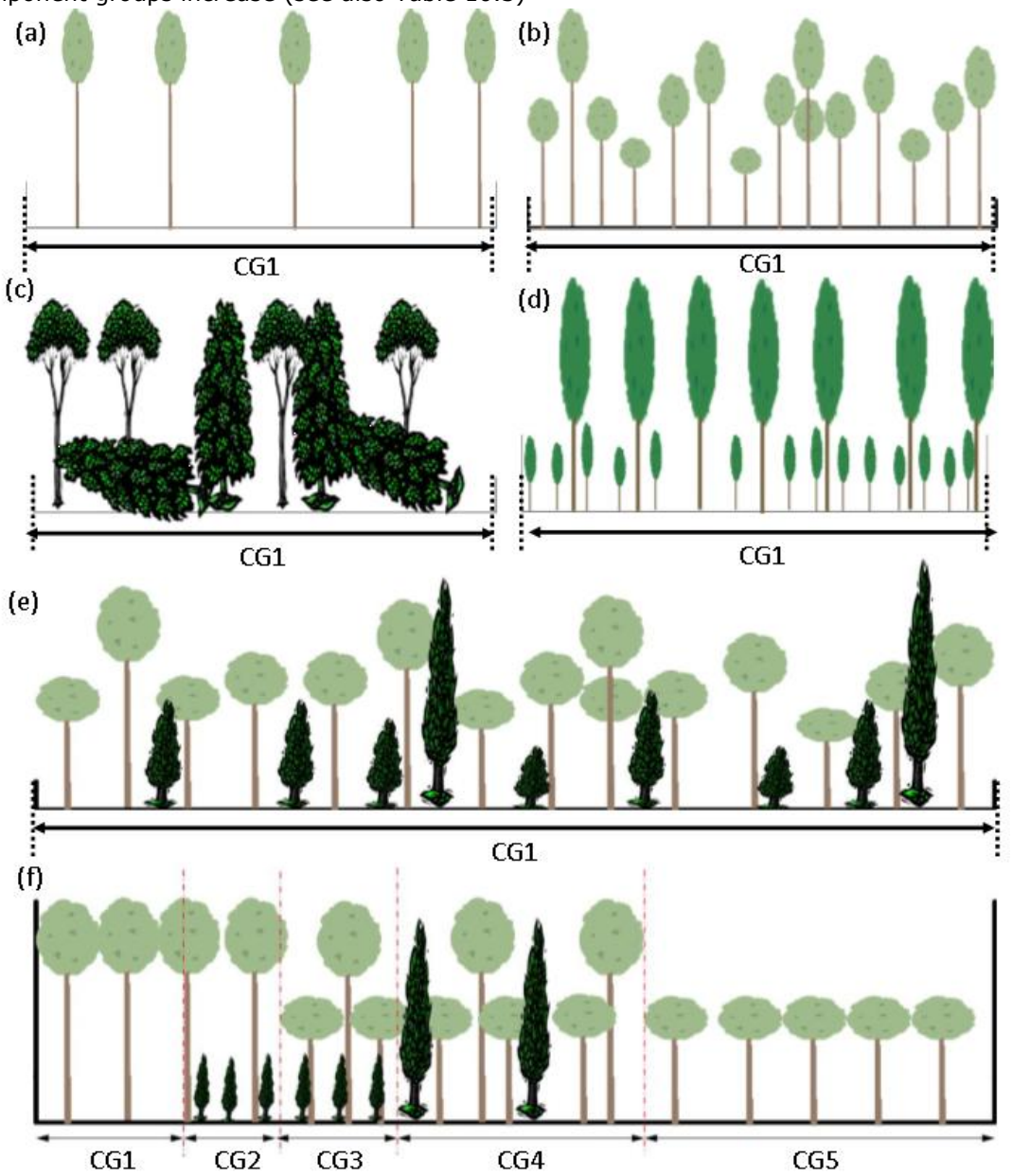
Table 10.3 Rules for the classification of change in response to biotic or abiotic process

Component rules:
Evolved: If a component was physically present during the previous survey, but part of it has changed through natural, biotic factors such as growth, natural mortality, grazing, or pests & diseases, such that a new additional component is necessary, then classify that as 'evolved'
New: If a component was physically present at the previous survey, but part of it has changed through 'external' abiotic, factors such as wind, fire and human activity intervention such that a new additional component is necessary, then classify that as 'new'.

10.8.3 The number of storeys and component groups

As the number of storeys and component groups increases then the complexity of the storey assessments increases. The following examples will help to clarify the range of situations in the field (see Figure 10.1 and Table 10.3).

Figure 10.1 Examples of how the complexity of the storey assessment increases as the number of storeys and component groups increase (see also Table 10.3)



As the number of storeys and component groups increases then the complexity of the storey assessments increases. The above examples demonstrate a range of situations that may be observed in the field. All figures (a-e) represent a single section. CG = component group (a) One component group, one storey, one component. (b) one component group, complex storey, one component (c) one component group, one storey (upper), three components (d) one component group, two storeys (upper and lower), one component per storey (e) one component group, complex storey, multiple components (f) five component groups, three storeys (upper, middle, lower), one or more component per storey. Refer to the Table below for more details.

Table 10.4 Examples of how the complexity of the storey assessment increases as the number of storeys and component groups increase (see also Figure 10.1)

Example in Figure 10.1	Component Group (CG)	Storey	Example of a component	% Area cover
(a)	1	Upper	Scots pine	100
Although the component occupies 100% of the storey, in this example the canopy only covers 50% of the section area. This low stocking will be captured in the stocking assessment.				
(b)	1	Complex	Scots pine	100
(c)	1	Upper	Scots pine	40
		Upper	Sitka spruce	30
		Upper	Sitka spruce (wind blown)	30
Note how the section has been divided up between the constituent components. The storey of the windblown trees is assessed as though they were still standing.				
(d)	1	Upper	Scots pine	50
		Lower	Scots pine	50
(e)	1	Complex	Scots pine	50
		Complex	Western hemlock	20
		Complex	Western hemlock	30
(f)	1	Upper	Scots pine	15
	2	Upper	Scots pine	10
		Lower	Western hemlock	10
	3	Upper	Scots pine	13
		Middle	Scots pine	13
		Lower	Western hemlock	13
	4	Upper	Scots pine	12
		Upper	Western hemlock	10
		Middle	Scots pine	22
	5	Middle	Scots pine	40

As the number of storeys and component groups increase then the complexity of the storey assessments increase. The above examples demonstrate a range of situations that may be observed in the field. All figures (a-e) represent a single section and describe the examples in Figure 10.1. CG = component group. % area cover = the % area of the storey covered by each component. Therefore, each storey occupies 100% of the component group in its own height band, meaning the area sums to 100% for each storey. Any single storey should not occupy >100% of the component group it is within.

10.8.4 Deciding the percentage area figures for each component

In order to arrive at the % area figures for each Component:

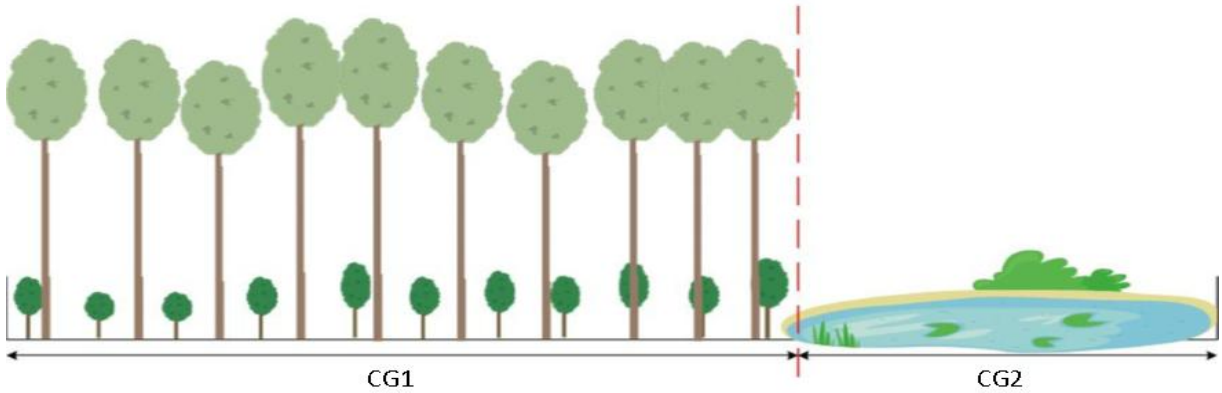
1. Decide what proportion of the Section each Component Group covers. For the above example this would be: CG1:15%, CG2:10%, CG3:13%, CG4:22% & CG5:40%

2. Within a Component Group – assign each Storey with the % that was assigned to the Component Group in (1) above regardless of actual canopy cover of the Storey within that Component Group. For example, in CG4 above: each Storey is assigned 22%

3. For each Storey, split the % allocated to the Component Group in (2) above between its constituent Components. For example, in CG4 above: the Upper Storey pine is assigned 12% and the western hemlock 10% reflecting their relative abundance in the Storey

10.8.5 A mix of land with trees and open component groups

Figure 10.2 An example of a section containing both land with trees and open component groups



CG = component group. CG1 = land with trees. CG2 = open land, in this example it is a pond.

Table 10.5 An example of a section containing both land with trees and open component groups (detail for Figure 10.2)

Component Group (CG)	**Storey**	**Example of a Component**	**%Area**
1	Upper	Scots pine	60%
	Lower	Scots pine	60%
2	Open Water (varies with IFT/IOA used)	Open Water	40%

The total occupancy of the uppermost Storeys (Scots pine Upper Storey and Open Water) = 100%. However, if an open space component is intimately mixed within woodland and this open space is permanent open space (and not the temporary open space between growing trees), then record the open space within the same component group. The sum of the uppermost canopy % area and the % area for the open space should add up to 100%

10.8.6 Zero (0%) Components

Zero (0%) can be used but only where there is either a very low representation of a particular Component, such as a single tree or where the component is outwith the square but found within a circular plot. Here allocating 1% area would be too great, but the presence of the tree needs to be recoded. For example if a component group has six components but the overall group is allocated 4% of the Section area, then four of the components (the most abundant) are allocated 1% each and the remaining two components allocated 0%. Alternatively, if one component in the above example is very dominant and the other five components essentially take up no area then the dominant component could be allocated 4% and the rest 0% each.

10.9 Land use

Land Use is a means of classifying all land and open water within GB, with all land falling into one category or another. Land is categorised according to its use or type and these types are often set in relation to land management choices or the physical nature of land, for example high forest and agriculture or open water.

It is important to get Land Use correct as it is the basis for how we account for woodland area and any open space within woodland and it also determines what is to be recorded within the survey.

Land Use is assigned at a component level, because sites sometimes have intimate mixtures of different landuses, such as high forest and open. However, in the majority of cases the landuse will be common across a section or Component Group (and therefore to all Components within the Group).

As noted in some circumstances where different landuse are intimately mixed within the site a Component can have a different Land Use to the rest of the Components within a Component Group.

For example:

Windblow – If the windblow is intimately mixed i.e. scattered throughout the standing tree matrix the windblow has a Land Use of Windblow (Code: PWB) whereas the rest of the Components within the Component Group can have a Land Use of High Forest (Code: PHF).

Intruded Broadleaves – Components of self-sown broadleaves can be intimately mixed in a conifer crop. These broadleaves have a Land Use of Partially Intruded Broadleaves (PIB) whereas the conifer crop would be High Forest (PHF).

The land use high forest may often be split into several woodland habitats such as a land use of PHF and within that high forest, both wet woodland and upland oak habitat is found.

10.9.1 Land use codes

A full list of land use codes used in the field software and descriptions are detailed in Annex BB.

10.9.2 Deciding which land use to enter into the field software

Refer to annex CC and DD for flowcharts that guide the surveyor through the process of how to decide which land use codes for use.

Note: Where ≥20% of the trees in an area of fire-damaged woodland are alive, the landuse for the entire area (Component Group) would be High Forest.
Note: only cabin and campsites managed by Forest Holidays Joint Venture Company should be assigned 'Cabins/Holiday Houses' or 'Campsite'. Forest District run campsites should be 'Other Recreation'.

When choosing land use surveyors need to remember the importance of the definition of NFI land with trees, especially the tree cover element. If an abandoned quarry has ≥20% tree cover it is an IFT (e.g. broadleaved) rather than an IOA (e.g. quarry) and the land use is therefore a treed land use such as High Forest rather than an open land use such as Mineral Working.

10.10 Broad Habitat and Priority Habitat Type

The surveyor is required to record UKBAP Habitat type and NVC community for any section containing trees (NFI and non-NFI) and component groups.

UKBAP Habitats cover a wide range of semi-natural habitat types and are those that have been identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP).

NVC Community. The National Vegetation Classification (NVC) is one of the key common standards developed for the country nature conservation agencies. The original project aimed to produce a comprehensive classification and description of the plant communities of Britain, each systematically named and arranged and with standardised descriptions for each.

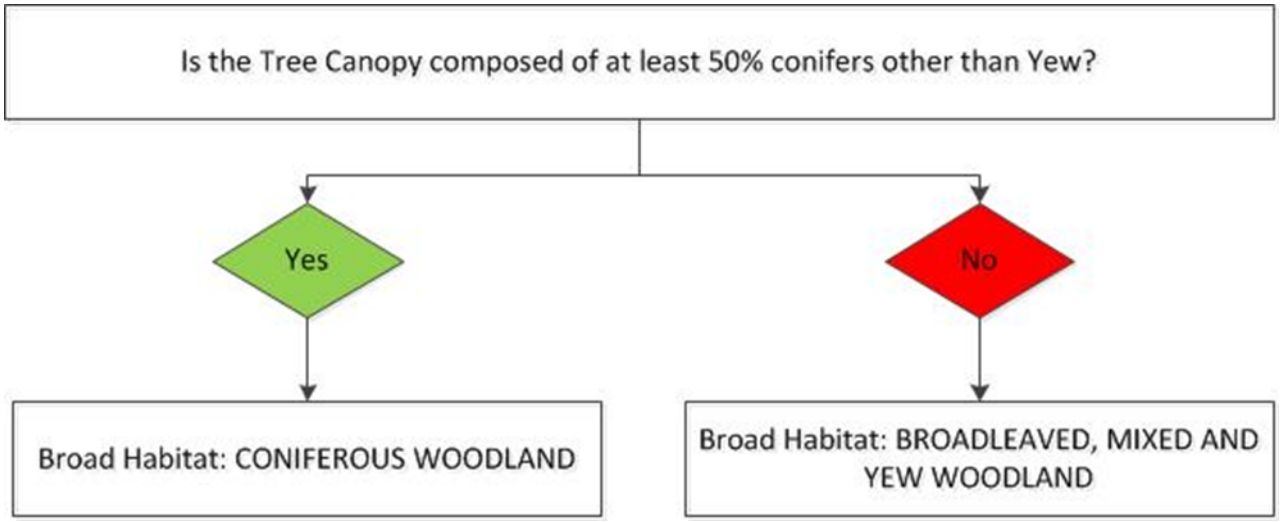
10.10.1 Habitat type; NFI and non-NFI land with trees

Where a priority habitat is present this should be recorded. If no priority habitat is present, or the surveyor cannot be certain that a priority habitat is present, then a broad habitat only should be recorded.

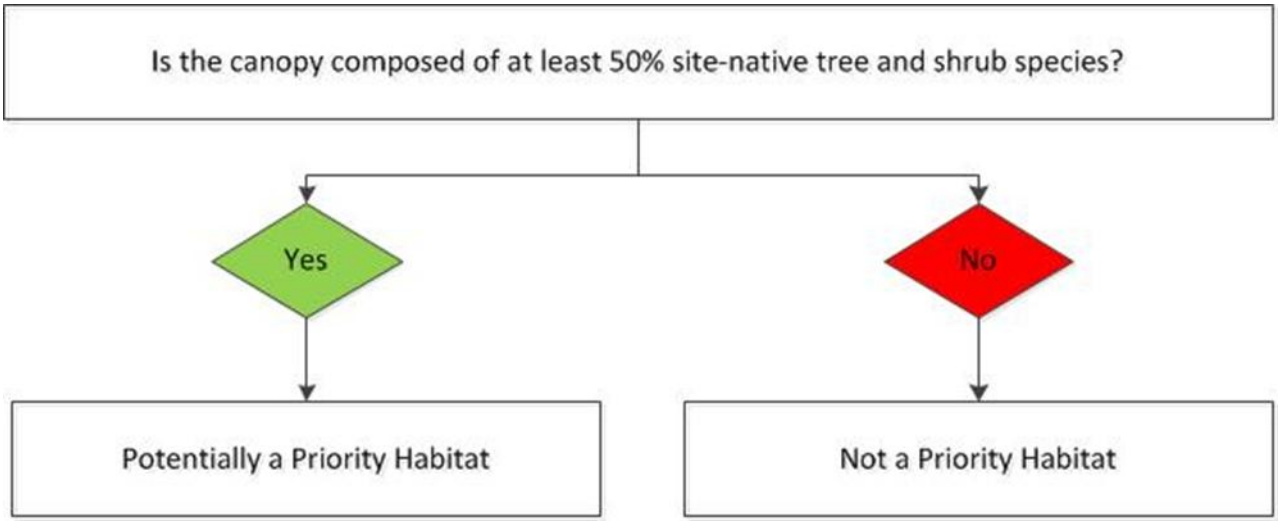
10.10.1.1 UK BAP Habitat type

The following steps are recommended for deciding habitat type:

1. Decide which of the two woodland broad habitat types best describes the section or component group:



2. Decide if a priority habitat is present (refer to Annex GG for the NFI tree species list for details of which trees are regarded as native within the NFI).



3. If the canopy is composed of at least 50% site-native tree or shrub species then the surveyor must decide which of the woodland priority habitats are present. Surveyors can do this by reading through the published priority habitat descriptions or assign a broad priority habitat type (Annex EE) according to the NVC community identified in the field (see Annex FF).

Notes:

- Create a separate Component Group for each habitat type within the section.
- Surveyors may need to section on the basis of habitat alone e.g. a sizable area of uniform oak plantation straddling the transition from lowland mixed deciduous Woodland to upland oak woodland might be better split into two separate sections.
- Clearfell:
    - If the ground vegetation is readily identifiable as a Broad or Priority open habitat then record as such. If not, then record as Broadleaved, Mixed and Yew Woodland Broad Habitat or Coniferous Woodland Broad Habitat, as appropriate.
- Roads, rides, tracks and railways:
    - If in a rural setting, class as Boundary and Linear Feature Broad Habitat- unless at least 50% vegetated, and then classify according to the ground vegetation (e.g. Neutral Grassland, or Fen/Marsh/Swamp etc.).
    - If in an urban setting, always class as Built-up Areas and Gardens Broad Habitat.

10.10.1.2 Non woodland or non-treed Sections and Component Groups

For NFI and Non-NFI sections and component groups without trees surveyors are required to record the UK BAP Broad Habitat type only.

Record the Priority Habitat type where one is present and is identifiable, if it is not possible to identify the priority habitat record surveyed, unknown habitat.

10.11 Storey assessments

Once a section has been defined an assessment across the entire section identifying the presence of distinct storeys (banding) must be made which will define and describe the vertical structure of the Section.

There are two main purposes for identifying storeys:

1. As a measure of Forest structure and diversity.
2. As a way of attaining a better sampling representation of the distribution of heights and diameters of trees in a Section (e.g. for timber forecasting).

When the distribution of the heights and diameters of the trees within a Section is assessed, it is better to vertically stratify trees into bands of relatively equal heights, or storeys, to gain a more representative and efficient measure of this distribution. Thus, ensuring that if a tree is selected to represent the height of the storey its height is such that it will not significantly distort the mean height of that storey. When deciding whether to separate out a storey it is important to bear this principle in mind.

Note, a single tree can be a storey by itself if:

- This tree would unduly distort the mean height of a storey it was 'brought into' or chosen as a sample height tree, or;
- If it covers greater than 5% of the Section.

10.11.1 Remeasure square: Storey assessment

At the component level there are some elements that are more subjective of which storey assessment is one. Discussed below are examples of hypothetical scenarios that the surveyor may encounter while assessing a remeasure square and details of how the surveyor may deal with these.

10.11.1.1 Example 1: storey allocation

In this hypothetical example the previous surveyor has recorded three storeys within the sample square. While the current surveyor now finds a stand composed of four discernible storeys; a complex storey.

This one storey difference may be a legitimate subjective difference that two good surveyors would make on the same day. Therefore, in this instance it is best to keep with the previous storey allocation as this will maintain continuity with the storey stratification at the plot level. Therefore, the current surveyor should record no change.

However, if the current surveyor can see that the upper storey (for example) has split out into two distinct storeys over the last 5 years, then that is real change and the current surveyor should record as such and the storeys reassigned.

10.11.1.2 Example 2: storey rules

If the surveyor observes evidence of real change in storey structure since the previous survey then this should be recorded.

When the current surveyor determines that there has been no change in measurable trees storey structure (Upper, Middle, Lower and Complex) since the previous survey but their interpretation differs to that recorded by the previous surveyor, then the current surveyor should accept the previous surveyors observations if there is no more than one storeys worth of difference (excluding seedlings and saplings). However, if there is more than one storeys difference between the current surveyors observations and that of the previous surveyor then corrections should be made.

For example, the previous surveyor observed an upper and lower storey. While the current surveyor found a differentiation in the upper canopy giving three distinct layers and therefore an upper, Middle and lower categorisation. In this example, there is only one storey difference in interpretation between the two surveyors, therefore, the current surveyor should accept and use the previous surveyor's stratification.

10.11.2 How to assess Storeys

There are four classes used to separate storeys:

1. Definitely one storey
2. Definitely more than one storey
3. Complex storeys
4. Borderline cases, which could be fairly interpreted as any of the above.

Upper Storey is the uppermost storey of trees (≥4cm DBH) across the section.

Middle Storey is a storey of trees (≥4cm DBH) with a tree storey (also ≥4cm DBH) above it and below it.

Lower Storey is the lowest storey of trees (≥4cm DBH) with 1 or 2 storeys above it.

Complex is a canopy structure with a wide range of heights where it is not possible to distinguish individual storeys within it, or where there are more than three distinct bands.

10.11.2.1 Use of Mid-crown Height or Total Height to determine storeys

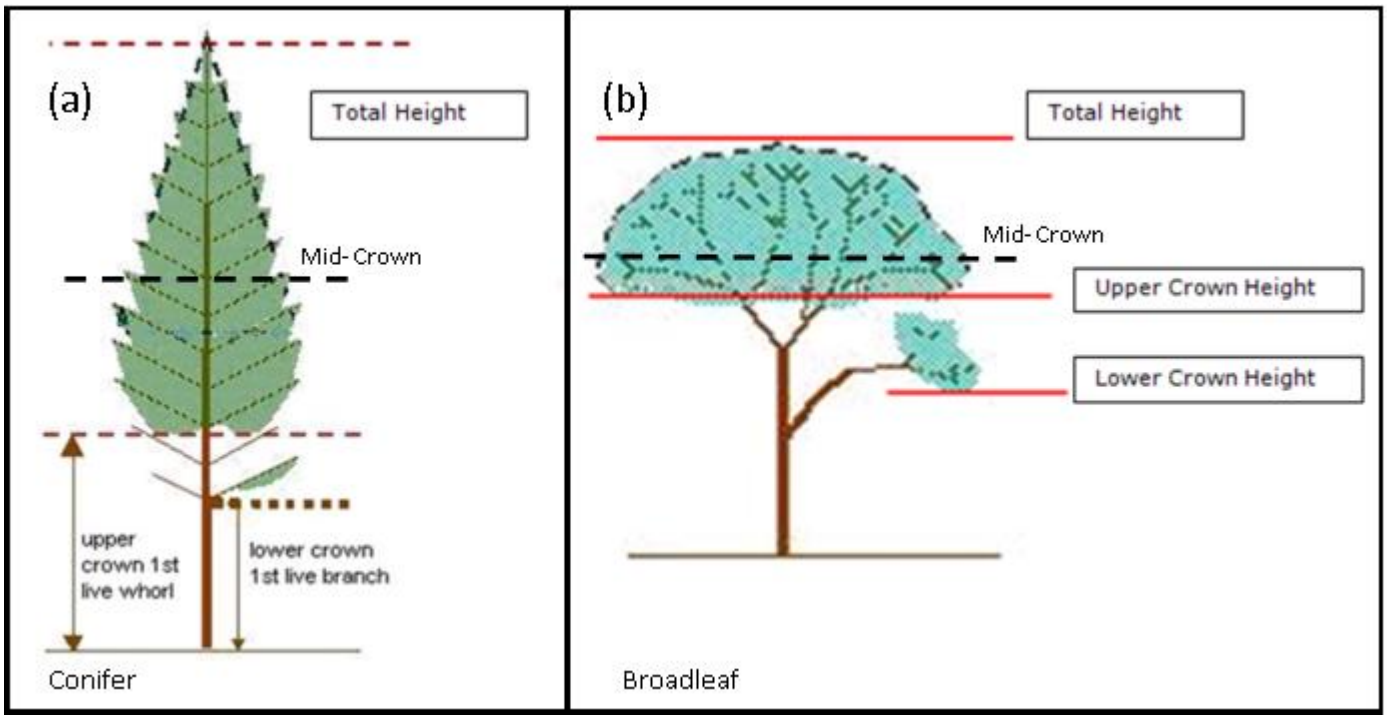
Mid-crown height is normally used to determine the storeys. However, in some circumstances total height may be more applicable.

The mid-crown height is defined as the midway point between the lower crown height and the total height of the tree (see Figure 10.3).

The lower crown height is slightly different in conifers and broadleaves:

- Conifers: The height of the lowest live branch (excluding epicormics and forks) insertion point that is connected to the crown, recorded to the nearest 0.1 m.
- Broadleaves: The height of the lowest level of foliage that is connected to the crown (excluding epicormics and forks), recorded to the nearest 0.1 m (see Figure 10.3).

Figure 10.3 The positioning of the upper, lower and mid crown and the total height of conifer and broadleaf species.



(a) Conifer species (b) Broadleaf species. The mid-crown height is defined as the midway point between the lower crown height and the total height of the tree. However, in practice the mid-crown generally represents the height which is 'halfway up' the crown of a tree. Lower crown height in conifer species is the height of the lowest live branch and in broadleaves it is the height of the lowest level of foliage.

The mid-crown height is normally used to discern separation between storeys. However, in certain situations using the total height of the trees is more appropriate to classify separate storeys, e.g. where it is impractical or difficult to use mid crown heights.

10.11.2.2 Examples of where is it may be suitable to use total height to separate storeys.

Example 1: Where crown depth varies greatly within trees of the same age and height

This variability in crown depth can occur where a stand has edge trees in the upper canopy, whose foliage reaches to the ground, whilst the main body of the stand has lost its lower foliage through light competition even though the trees are the same age and height.

In this example, if the mid crown height was used to discern separate storeys the mid-point of the edge trees crowns would be lower than that of the trees in that stand, there would be two separate storeys. Clearly though if trees are the same total height and age, it is better to use total height to keep them within the same storey classification.

Likewise some shade tolerant trees such as cypresses can be planted alongside light demanders such as larch and even though the trees are the same total height and age the crown depths very significantly even though the both tree species are in rude health and are competing well and have the bulk of their crown in the upper canopy. Again, in this example it is better to use total height to discern storeys.

Crown mid-point works well when crowns are deeper on average and there is strong competition between trees, which will drive ongoing separation of the height bands. This can lead to situations where there is a clear sub dominant layer lower in the canopy (on average) then a clear dominant layer within the canopy. Yet the suppressed trees manage to keep a leader in the higher levels of the canopy. Thus both strata have a leader at the same height and the same total height, but the weighted centre of the crown mass is separate. Here it is best to use crown mid points to discern storeys.

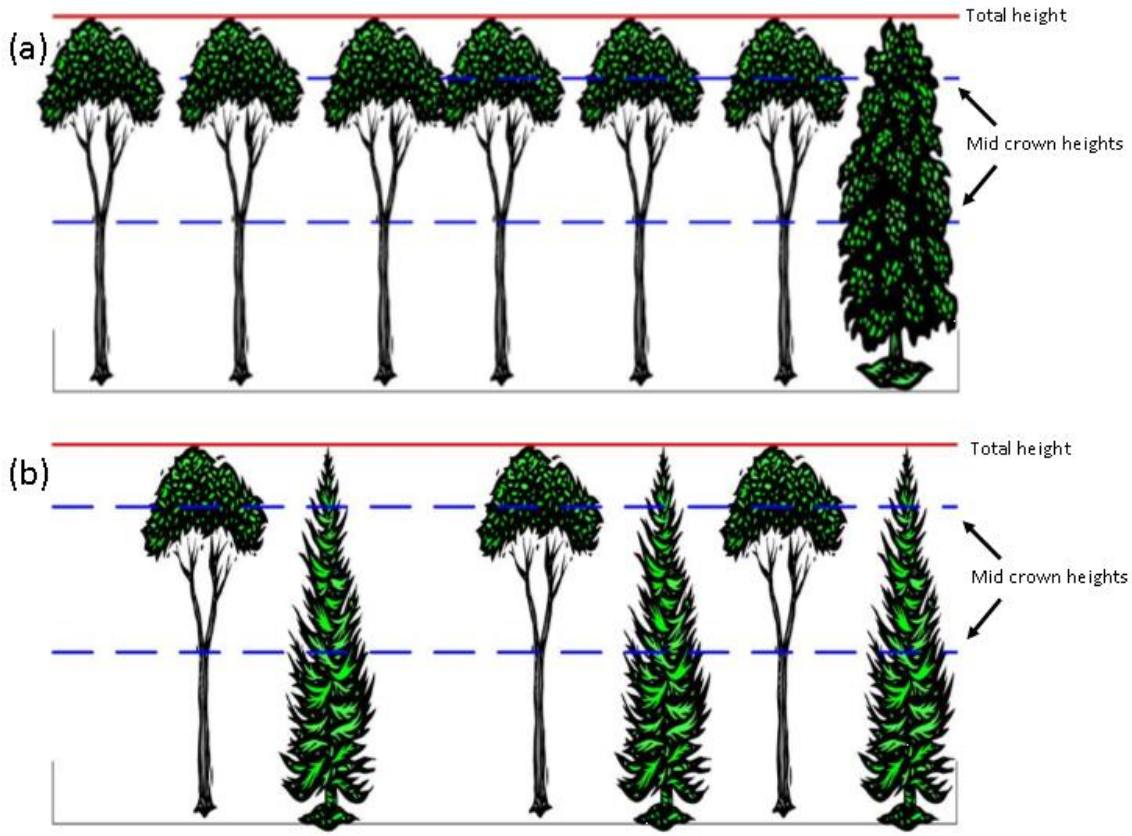
Example 2: The edge trees have a crown that reaches the ground while the main body of the crop has a much shorter crown

In this situation, if the mid-crown height is used the edge trees can be put into a different storey to the main crop, even though the edge and main crop trees are the same height. Using total height and ‘common sense’ will keep them in the same storey and will not distort the mean height of the storey (Figure 10.4(a)).

Example 3: The trees are different species with the same total height but some species have a much deeper crown that others

For example, a mixed crop Western hemlock and Scots pine where all the trees are the same total height, but the hemlock has canopy to the ground and the pine has a short canopy (Figure 10.4(b))

Figure 10.4 Examples of where is it may be suitable to use total height to separate storeys.



(a) The edge trees have a crown that reaches the ground while the main body of the crop has a much shorter crown. (b) The trees are different species with the same total height, but some species have a much deeper crown that others.

10.11.2.3 Banding and using gap distance to define storeys

Consideration should be given to the vertical distribution of the mid-crown/total heights of measurable (≥4cm DBH) trees within the section to assess whether these heights cluster into two or more groups on the vertical scale across the section. If there is a distinct difference between bands of tree mid-crown heights/total heights these bands are allocated to separate storeys (Figure 10.5).

To help decide whether there is an identifiable multi-storey structure first decide if an upper storey exists in the section. This is the case if there is a distinguishable cluster of

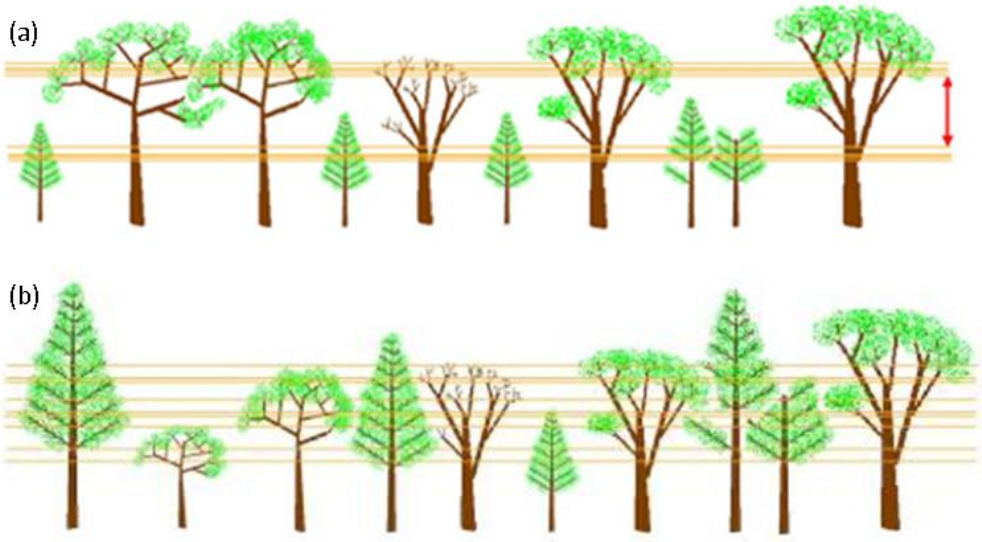
heights in which the lowest member of a group is at least 4 metres/25% of storey band height (whether using mid-crown or total height) higher than most of the rest of the trees within the section. Most trees, rather than all trees, are used because there are likely to be situations in which there is a well-defined highest group and one or more lower groups but also an occasional tree/s (<5% by %Area) whose height is spanning the vertical 'gap' between the highest group and the others. In this case, unless the trees are of a significantly different height (e.g. they would distort the mean height of the storey if chosen to represent the height of that storey), then they should be allocated to the storey they are closest to in terms of height. If these trees would distort the mean storey height of the storey they were pulled into then they must be treated as a storey in their own right, even if this new storey is composed of only a single tree

To distinguish storeys:

1. Look at the trees within the Section to get a 'feel' for whether there are different storey bands.
2. Decide whether the 4m gap rule or the 25% of storey height rule is most appropriate for each storey using the priority rules below:
    i. Storeys where maximum band height is <10m: use 25% of the upper band height to distinguish storeys.
    ii. Storeys where lowest band height is >20m: use 25% of the lower band height to distinguish storeys.
    iii. All other Storeys: use the 4m minimum gap distance.

Where there is no distinct gap between mid-crown heights/total heights bands, the Section is considered to be single storey or Complex. If the banding is relatively shallow (<4m between upper and lower band) it is a single storey, where the banding is quite deep then the Section is more likely to be complex (Figure 10.5).

Figure 10.5 Using banding to define storeys



(a) An example of where there is a distinct difference between bands of the tree mid-crown heights/ total height indicating two storeys. (b) An example of where there is no distinct gap between the mid-crown/ total height bands indicating a single storey or complex.

10.11.2.4 Worked examples using banding to define storeys

Example 1:
If the band range of the lower storey is 7-9m and the lowest member of the upper storey is at 12m. Then because th maximum height band in the lower storey is <10m we use the 25% of storey height rule (see above).

Worked example:

- Upper band height of lower storey (7-9m range) = 9m
- 25% of upper band height of lower storey = 9/4 = 2.25m (maximum allowable gap)
- Lowest band of upper storey = 12m.
- 12m – 9m = 3m, this is > the 2.25m allowable gap therefore the section is considered as a two storey section.

Note: if the gap between the storeys had been <2.25m then the section would be considered a single storey.

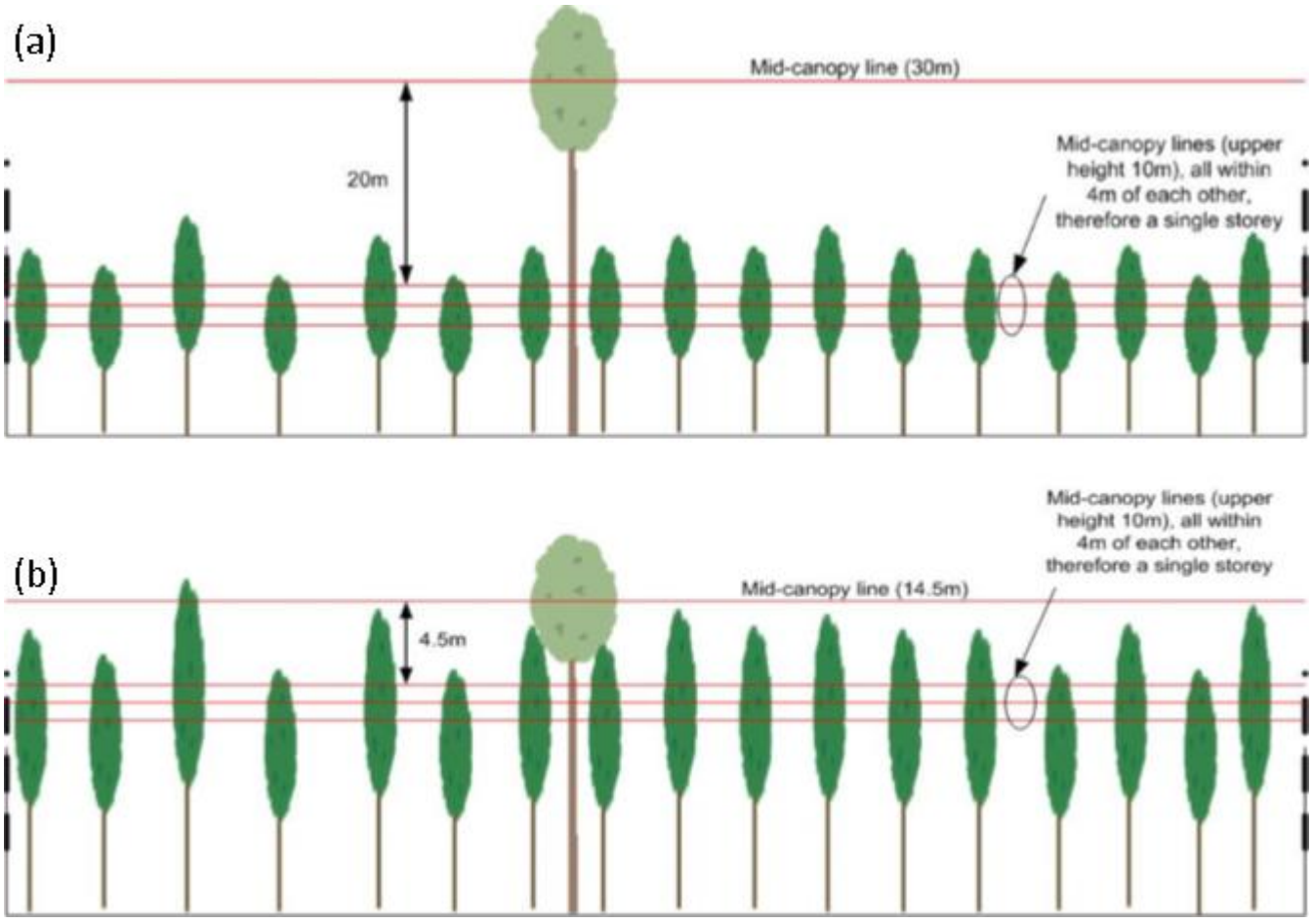
Example 2:
If the upper band height of the lower storey was 12m then the 4m rule would be applied (see above).

Worked example:

- Lowest band of Upper storey (15m) - Upper band of Lower storey (12m) = 3m.
- 4m maximum gap allowed under this rule
- Actual gap (3m) is less than allowable gap (4m) therefore the Section is considered as a single storey Section.

10.11.2.5 Single tree as a storey

Figure 10.6 An example of a single tree as a storey



(a) In this example there is a distinct gap >4m between the mid-crown heights (in this case the gap is 20m), therefore, the single tree must be a separate storey. If it was brought into the lower storey and it was chosen as a height sample tree, then its height would significantly affect the mean height of the storey. (b) If the gap between the single tree and the lower storey was only 4.5m then there is a case for bringing this tree into the single storey below it. The allowable gap between storeys can vary in certain circumstances. If the single tree only occupies 5% or less of the section, then it can be brought into the lower storey. If, however, it occupies more than 5% of the Section, or there are a number of trees at that height which occupy greater than 5% of the Section, then the tree/trees are allocated as a separate storey.

10.11.3 Storey Labels

A maximum of three measurable tree storeys are allowed within a Section. See Table 10.6 for the combinations of storeys that are possible.

Table 10.6 Combinations of storeys

Label	Number of Storeys
Upper	One
Upper and Lower	Two
Upper, Middle and Lower	Three
Complex	One
Upper and Complex (Complex is acting as a lower storey in this case)	Two
Complex and Lower (Complex is acting as an upper storey in this case)	Two

10.11.4 Seedling and sapling storey classifications

There are two storey classifications for trees <4 cm DBH, including seedlings and saplings. They do NOT count towards whether a section is complex or not, or the total number of measurable tree storeys.

In some situations, the seedling or sapling tree storey can be of the same height as a measurable tree storey (either separate or intimately mixed within a Section) and it is important not to confuse the two types of storey.

The surveyor should record a separate component for each species of seedling (trees <50 cm height) and each species of sapling (trees ≥50 cm tall and <4 cm DBH).

In the first cycle all trees <4 cm DBH were grouped into components of 'young trees'. In the second cycle these are split into seedlings and saplings, as per the definitions used in the young trees transect and plots. Where in the first cycle young trees were recorded, these components were automatically split into seedling and sapling components based upon their age (less than 4 years) and their canopy height. In the second cycle (remeasure square) the surveyor had to assess if these classifications still applied after 5 years of growth. They had to assess if seedlings have been recruited to saplings and saplings to measurable trees in the lower, middle, upper or complex storeys, and if any new seedlings or saplings had established themselves in the intervening 5 years. In the fourth cycle for a remeasure square the surveyors are also required to check and assess what was previously recorded.

10.11.5 Leaning trees and windblown trees and story classification

If there are windblown or leaning tree present then the surveyor should enter the storey the component would have been in if it was vertical.

10.11.6 Fire damage and burnt trees and storey classification

Where ≥20% of the trees in an area of fire-damaged woodland are live, the entire area (Component Group) is landuse High Forest. The 'dead Component' protocol would be applied as normal in this scenario i.e. where dead stems account for ≥30% of measurable stems across all storeys in the Component Group, then one or more dead Components would be recorded (depending on the number of species present), each at 0%. The dead Component(s) are landuse High Forest because landuse Burnt does not generate tree data fields (species etc.)

10.11.7 Standing dead trees and storey classification

Dead tree components are assessed at the component group level and are applicable to measurable trees only, except for component groups where there are no measurable trees. In these cases the seedling and sapling dead components should be recorded.

A dead tree component must be created if there is visually estimated to be ≥30% of dead stems by basal area (BA)/volume within a component group across all storeys combined. If a dead tree is found within a plot a dead tree component is NOT required.

Where there are 1 or 2 species of deadwood present then the surveyor should assign each species a deadwood component. Where there are 3 or more dead species in the stand, up to 3 dead components are recorded, in which:

- One component is that corresponding to the predominant species (as per presently proposed)
- If there are dead conifers present, other than the predominant species, make an MC component with those
- If there are dead broadleaves present, other than the predominant species, make an MB component with those.

The surveyor should assign a mean canopy height, mean DBH, mean total height and stems per hectare to the dead component across all storeys for that component (activated when Trees Alive? Field = No in the software). Note that dead tree heights are based upon their actual total heights at the time of the survey and tops are not 'added on'.

The surveyor should not assign a storey unless the dead tree component is in a separate storey by itself. Do not assign complex to the section based on having a distinct dead tree storey.

The surveyor should assign as 0% for the dead components where the component group they are found in also contains live trees. If the component group only has dead components then assign these to total 100% of the component group (e.g. if component group two is 30% of the section and only contains dead components then these dead components must total 30%).

10.11.8 Multiple storeys from the same root stock

The following examples discuss multiple storeys from the same root stock.

Example 1:
A Hazel coppice stool which has both measurable and non-measurable stems. Assuming the measurable stems form a single storey then the data should reflect two components, one describing a storey of measurable stems (e.g. Upper) and one describing a storey of Young Trees.

Example 2:
A crop of Hornbeam where the root stock has a tall main stem alongside a much shorter stem – if the heights of the two types of stems are significantly different (as per the storeys rules above) the stems are assigned to different storeys.

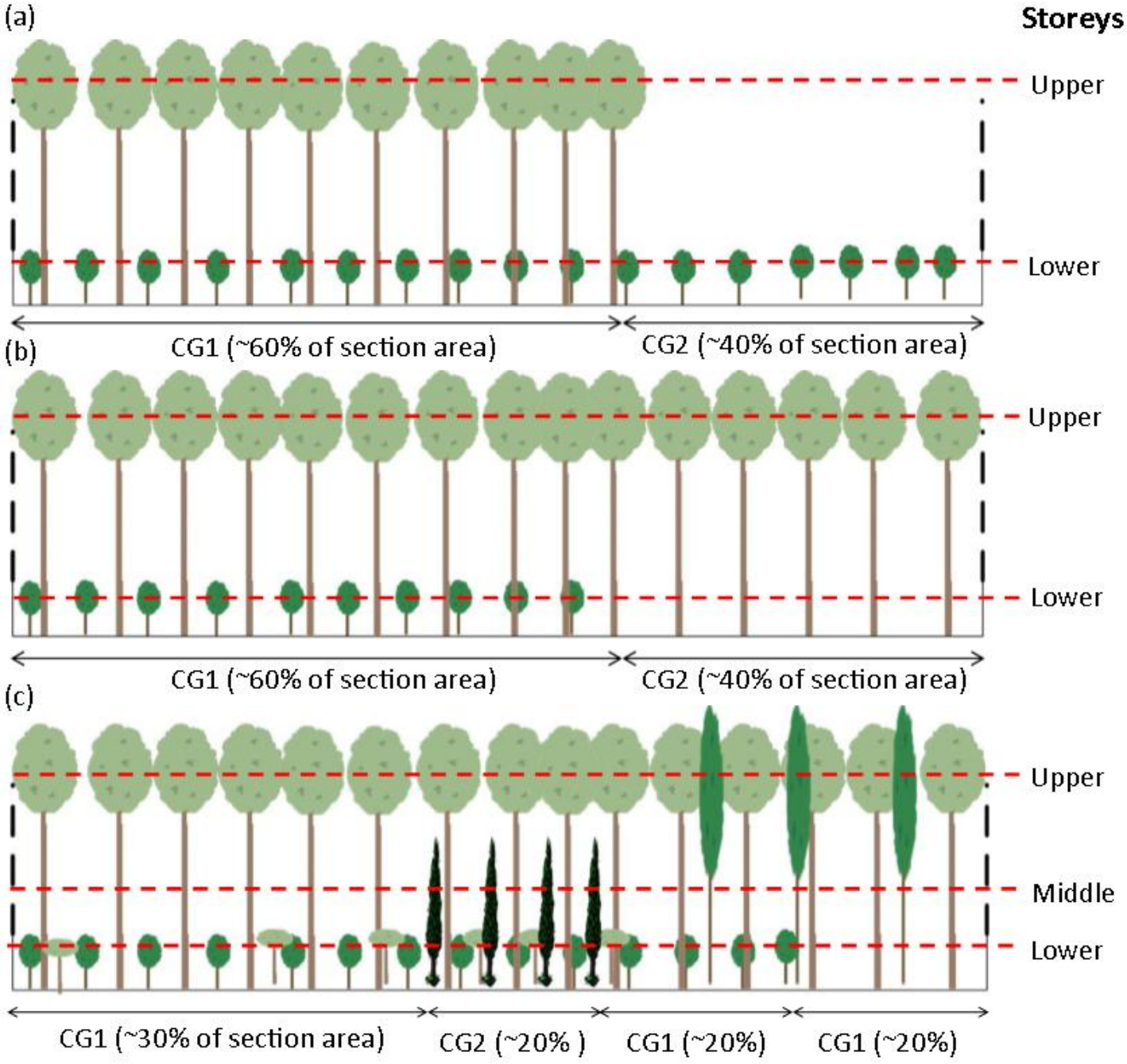
10.11.9 Defining and recording storeys within sections with more than one component group

The following rules apply when defining and recording storeys within sections with more than one component group:

1. When assessing the storey to which a component is to be assigned, a section level assessment of the storey structure must first be undertaken.
2. If a component is assigned as upper storey then for any other component within that section (whether in the same or a different component group) to also be assigned as upper storey they must have a storey height within tolerance.

The following examples demonstrate how to apply the above rules in different circumstances.

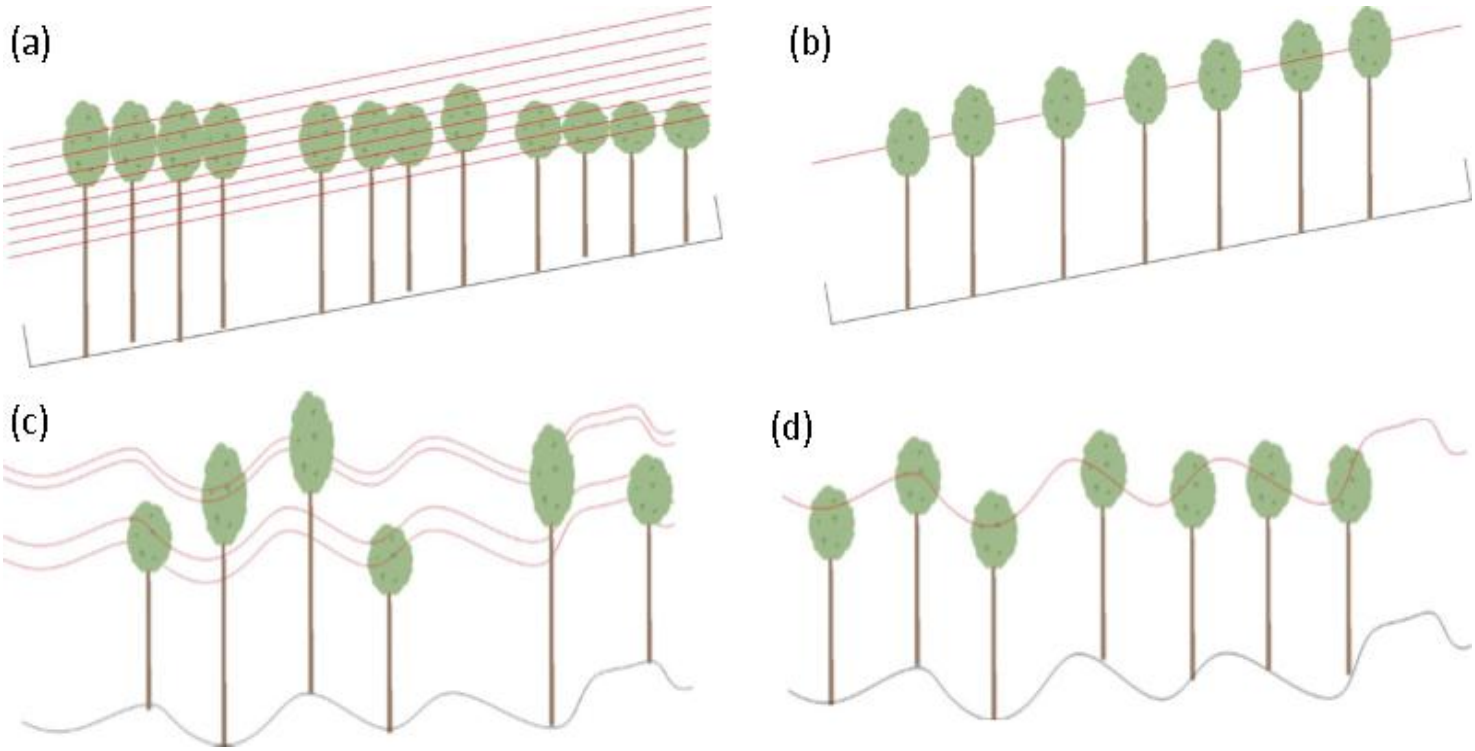
Figure 10.7 Examples of defining storeys within sections with more than one component group



(a) A section with two component groups and two storeys (60% of the total section area upper and 100% lower) (b) A section with two component groups and two storeys ((100% of the total section areas upper and 60% lower). (c) A section with four component groups and three storeys (100% of the total section area upper, 20% middle, 70% lower).

10.11.10 Storey assessments on slopes and undulating ground

Figure 10.8 Examples of storey assessments on slopes or undulating ground



(a) A storey assessment on a slope: trees which look similar in height but are in fact of different heights and may therefore be in different storeys. In this case the trees are in a Complex storey (no distinct height differences) (b) A storey assessment on a slope: Trees which look different in height but are in fact very similar. This is a single storey – Upper in this case. (c) A storey assessment on undulating ground: The undulating ground makes storey assessment more difficult. Trees A and B look similar in height but due to their positions in a gully or ridge, the trees are actually different heights and are in different storeys. A is an Upper storey tree whereas B is in the Lower storey. (d) A storey assessment on undulating ground: The trees look like they are different heights but are in fact all the same giving a single storey component – in this case Upper storey.

10.12 NFI Tree Species

Included in Annex GG is the list of NFI tree species. Whilst it is important to get all tree species identification correct, those trees in red font are those that all survey staff are expected to know and identify correctly. These species are important for the production forecast and are generally common throughout the UK. The tree species in bold red font are considered, within the NFI, to be native. The tree species within the software are listed (mostly) in alphabetical order.

10.13 Planting year estimation

10.13.1 Methods of Ageing Trees

The field software requests the planting Year of the component. Surveyors can either estimate this directly or can assess the age of the tree and subtract this from the current survey year. The following sections describe different methods for ageing trees.

10.13.1.1 Estate/Owner Information

Reliable information from 3rd parties e.g. owners or estate information with good records.

10.13.1.2 Whorl Counting (Conifers)

A whorl is the circular pattern of branching up the stem, with each whorl indicating one years' growth. Counting the whorls or marks of old whorls, on trees is a reliable method up to the point when it is no longer possible to get a good view of the whole tree. Care needs to be taken to count all whorls and not miss those close together due to the tree being held "in check", for example due to poor site conditions such as waterlogging, or due to frequent and persistent browsing, root compaction etc.

Figure 10.9 Whorl counting (conifers) to estimate tree age

(a) A conifer tree with each whorl indicated with a red line. (b) The lower part of a conifer tree with branch scars indicated with red lines. It is important to remember that branch scars become fainter as they are gradually grown over, therefore, ridges and change in bark texture around the stem can indicate the position of a whorl.

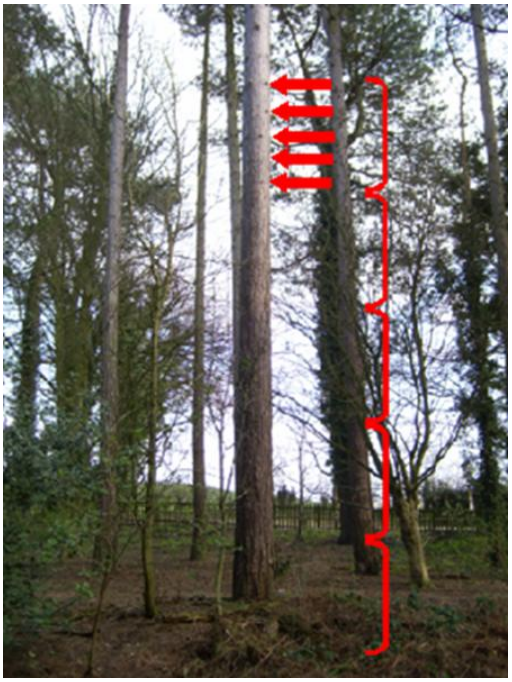
10.13.1.3 Flattened and stag tops

Older trees, and those that have grown out of shelter, can display flattened and stag-headed tops where branch whorls are no longer obvious, so making age estimation difficult. In this instance, follow the line of the main stem and kinks and prominent side branches can indicate annual growth limits in the same way as whorls.

10.13.1.4 Bracketing (Mature conifers)

Where all there is little external evidence of whorls in the lower stems, bracketing should be used to estimate number of whorls in the stem (see Figure 10.10). However, bracketing does not work well as growth rate slows, i.e. annual length put on by the growing tip is often less than half that estimated by bracketing so this method should be used with caution.

Figure 10.10 Example of the bracketing method that can be used to age mature conifers



The lower stem of a mature conifer with brackets indicating estimated annual growth.

10.13.1.5 Young conifers

Whorl counting should be used to estimate the age of young conifers. However, current years seedlings and 1-year olds have no growth whorls (see Figure 10.11).

Figure 10.11 A young conifer that has no growth whorls

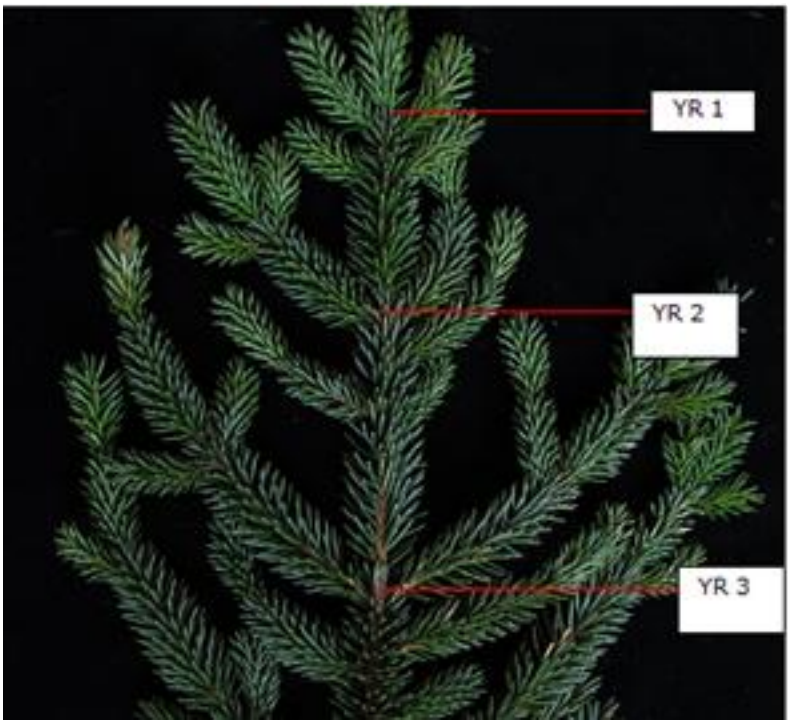
Figure 10.12 A Sitka spruce that is estimated to be four years old

A Sitka spruce estimated to be four years old. Annual growth indicated by each of the circles.

10.13.1.6 Branching patterns

Where a lower main branch can be clearly seen (excluding epicormic or partial/damaged branches) it is possible to count the number of pairs of opposite shoots, normally associated with a change in colour and texture of needles along the central spine. Add the number of pairs of shoots to the number of whorls on the main stem below the point of insertion of the branch to give an estimated age of the tree (see Figure 10.13).

Figure 10.13 An example of estimating age using branching patterns

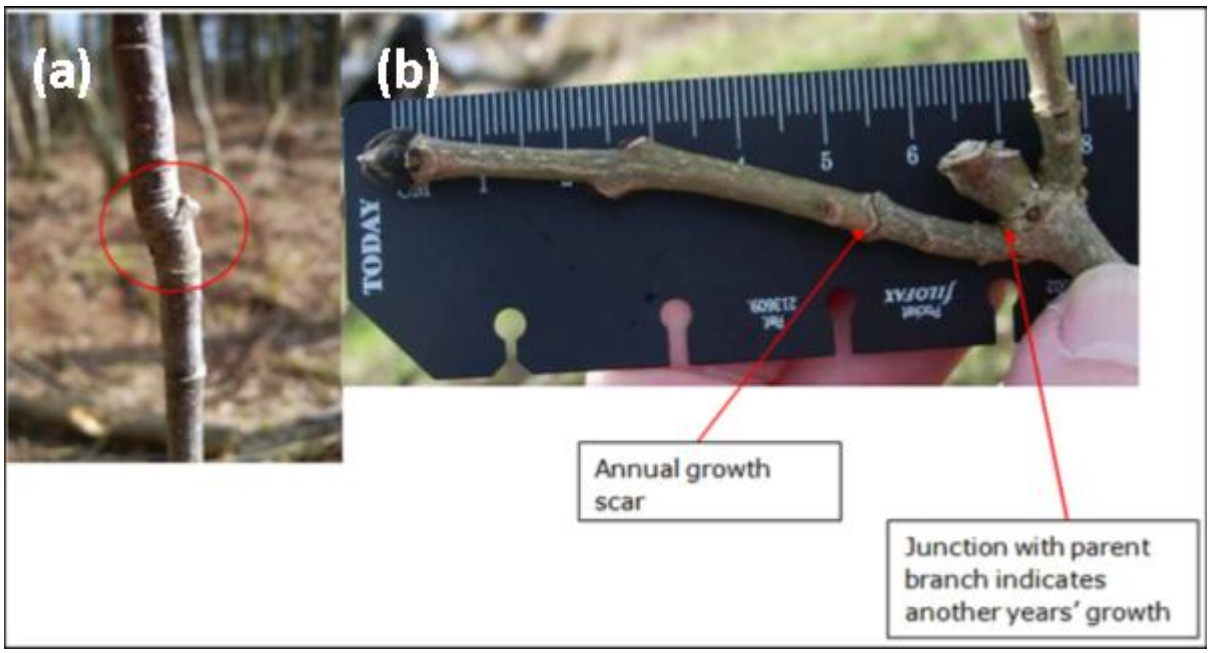


An example of counting opposite shoot pairs on branches, note the change in the needles along the central spine of the branch.

10.13.1.7 Annual Growth Scar Counting (Broadleaves)

Counting the number of scars on the whole tree (if visible) or the lowest main branch would be equivalent to counting whorls on conifers. If the lowest main branch is counted then the main stem below the branch also needs to be aged and the two counts added together (see Figure 10.14).

Figure 10.14 Annual Growth Scar Counting (Broadleaves)



(a) An example of a scar on the lower stem of a broadleaf species, the circle indicates the location of the scar. (b) Annual growth scars on the branch of a broadleaf species.

10.13.1.8 Date of earliest planting for conifers and broadleaves

For a number of exotic trees the earliest known planting dates are detailed in Annex HH. This information can be used to define the maximum planting year. However, this information is for guidance and is not a guarantee of planting dates.

There are only 3 native species of conifer in the UK, the Scot's pine (Pinus sylvestris) (within the pine zone), yew (Taxus baccata) and juniper (Juniperus communis). Therefore, all other species of conifer have been introduced into the UK. The earliest dates of introduction of many species are reasonably well catalogued.

10.13.1.9 Stump ring counting

Counting the rings of stumps on site will give an approximation of the age of the stump. This may be extrapolated to give the approximate age of surrounding standing trees in many circumstances.

10.14 Estimation of stems per hectare

The surveyor is required to estimate the number of stems per hectare of each component, within its component group (CG).

The best method to assess stocking requires some experience but may be best achieved by imagining a 5.64 m radius plot and counting the number of trees, of the component of interest, that fall within that plot. Multiply that count by 100 and this will give the stocking per hectare for that species in that story. For example, in a stand of mature Oak, if five trees are counted within the imaginary plot and multiplied that by 100 this give a stocking of 500 stems per hectare. If this method is repeated as the surveyor walks around the square by averaging the counts and stems per hectare it will provide the broad estimate that is required. By comparing this estimate to the mensuration plot tree count it will help to calibrate your visual assessment accuracy.

Trees included in the visual assessment of stocking:

- All trees over 4 cm DBH
- Maidens/Standards: measurable stems (≥4 cm DBH) are counted (including natural multi-stemmed trees)
- Coppiced trees (at any time in their lifetime – ensure that coppice is entered under Manual Intervention, either as greater, or less than 3 years) the stool is counted
- Seedlings (Trees <50 cm in height) and saplings (Trees >50 cm in height and <4 cm DBH) in a Young Tree Storey
- Live Components only count live stems/stools
- Dead Components only count dead stems/stools

10.14.1 Coppice stools

Count the stools only (using the methods below) but ensure that:

1. Stools are assessed and not stems
2. Where there is more than one storey, the number of stools for each storey is assessed.

For example, where a coppice crop has stools that have stems in more than one storey these stools are counted for each storey: 500 stools per hectare each of which has one or more stems in the upper and lower storey then the surveyor should record 500 stools per hectare for each storey.

10.14.2 Maidens/Standards

There are two other methods for estimating stems per hectare:

1. use the mean tree spacing of the component within the component group and look up the estimated stems per hectare from the table below.
2. count/estimate the number of stems for each component and divide by the component groups area.

The following hypothetical example is evaluated using the two methods mentioned above:

Section a = 0.2ha

CG1: 20% of the Section (0.04ha)

Upper storey: SP - 100% occupancy by stems within this storey, %Area = 20%

CG2: 80% of the Section (0.16ha)

Upper storey: SP - 50% occupancy by stems within this storey, %Area = 40%
Upper storey: DF - 50% occupancy by stems within this storey, %Area = 40%
Lower storey: Birch (a single tree) - 100% occupancy by stems in this storey, %Area = 80%

Method 1: using mean spacing within the component group storey

1. From the mean spacing of the Upper storey trees CG1: 3.0m -> 1,111 sph and multiply by the proportion of stems (100% in this case) so sph = 1,111 x 100% = 1,111 for the Upper storey SP

2. From the mean spacing of the Upper storey trees CG2: 2.5m -> 1,600 sph and multiply by the proportion of stems (50% each in this case) so sph = 1,600 x 50% so sph = 800 for both the Upper storey SP and DF

3. From the mean spacing of the Lower storey trees CG2: a single tree only across the CG therefore use 'no. trees'/CG area = 1/0.16 = 6 sph (since deriving mean spacing for a single tree is not possible).

Method 2: Count/Estimate the number of stems for each Component and divide by CG area

CG1: (0.04ha) -
Upper storey: SP - 100% occupancy within this storey, %Area = 20%: 45 trees counted within the 0.04ha CG -> 45/0.04 = 1100 sph

CG2: (0.16ha)

1. Upper storey: SP - 50% occupancy by stems within this storey, %Area = 40%: 260 trees estimated within the 0.16ha CG -> 260/0.16 = 1625 sph

2. Upper storey: DF - 50% occupancy by stems within this storey, %Area = 40%: 260 trees estimated within the 0.16ha CG -> 260/0.16 = 1625 sph

3. Lower storey: Birch - 100% occupancy by stems in this storey, %Area = 80%: 1 tree counted within the 0.16ha CG -> 1/0.16 = 6 sph

The approximate stems per hectare for a given metric mean spacing between trees is given in Annex JJ.

11 Sub-component data

11.1 Introduction

Sub-components are used to describe events or characteristics of a component group that can occur more than once per component. For each Component a variety of data is recorded:

- Vegetation (Lowest storey components only)
- NVC (Lowest storey components only)
- Browsing damage
- Bark stripping damage
- Tree health symptoms
- Tree Pests/Diseases
- Manual Interventions

The sub-component data is used in many analyses reporting on the condition and management of the trees within woodlands. For example, tree health and tree pests/disease data is sent to the FC Plant Health team to monitor the spread of pest and diseases and to assess the general health of our woodlands and individual components. Damage to trees is also used in reports such as the condition calculator, deer damage is of interest to many woodland owners and managers.

11.2 Aim

The following chapter describes how to identify subcomponents in the field and how to record observations in the field software.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

11.3 Sub-component: new square

During the initial walk around the sample square the subcomponents making up the component group/s should be noted as part of the sectioning and component grouping process. Once the Sample square has been divided into its mappable sections and their component groups the more detailed information about the individual components and subcomponents can then be collected. A new square assessment requires the surveyor to record all details of all subcomponents.

11.4 Sub-component: remeasure square

Identifying real change and understanding differences and tolerances between the current assessment and previous surveys. When assessing a square that has been previously assessed the primary aim is record evidence that will allow the NFI to assess change. The surveyor will have access to the details of observations that were recorded during the previous survey. During an initial walk through each section, the surveyor should look out for; the features that were previously identified, evidence that those features are still present or not, evidence of any change to the previously described features and evidence of any new features.

11.4.1 Reason for change

There are three additional fields in field software in the remeasure square subcomponents to record the nature of any changes between the survey cycles. These are specific to the subcomponent level and the surveyor will be prompted to complete these for all sub-component records, primarily when records are added or delete. This step applies equally to all subcomponent records; NVC, browsing, stripping, tree health, pests and diseases and management intervention.

11.4.2 Types of change

The surveyor should decide how to record observed changes that have occurred since the previous survey. There are three categories of change:

- **New**– you believe that the plant category is new to the site.
- **Missed** – there is a plant/ vegetation type present at the current survey that it is well established, therefore likely that the previous surveyor 'missed' its presence.
- **Evolved** – The layer has 'grown on' and has split into two new layer categories. An example would be a field layer of holly saplings in the first cycle, evolving through natural growth into both a field layer and a shrub layer, through some of the holly trees achieving over 2 m in height. If the entire layer changes its height category, you do not need to add a new record, simply change the layer field from 'field layer' to 'shrub layer'.

There are three reasons why a record may be deleted:

1. **Not observed** - If during the current assessment a previously recorded vegetation is not found then the previous record should be deleted and classified 'Not observed'. No more than 20 minutes should be spent try to find a previously recorded observation.

2. **Real Change** -If during the current assessment there is evidence that a previously recorded observation has gone from the site (e.g. rhododendron clearance) then delete the previous record and record 'real change'.

3. **Surveyor error** - If during the current assessment there is evidence to suggest that a previous observation may have been incorrect (i.e. there is no evidence of real change and it is unlikely the current surveyor would have missed it if it were present) then record the reason for the change as surveyor error.

11.5 Vegetation

The vegetation that sits underneath a tree canopy and the vegetation that grows between the gaps in canopy are an integral part of the woodland ecosystem. Similarly, the vegetation that grows adjacent to woodland also has a direct impact on the quality of that woodland habitat.

The location, the composition, and the richness of vegetation both in and around woodland impacts directly on the overall condition of woodland habitat. Rich and diverse vegetation combined with good quality tree cover results is a that can host the highest levels of overall biodiversity. Therefore, the surveyor is required to assess vegetation cover, including:

- Vegetation under canopy
- Vegetation outside the canopy.
- The extent of that vegetation.
- The species composition of vegetation.
- The physical layering or structure of the vegetation.

11.5.1 Vegetation: remeasure square

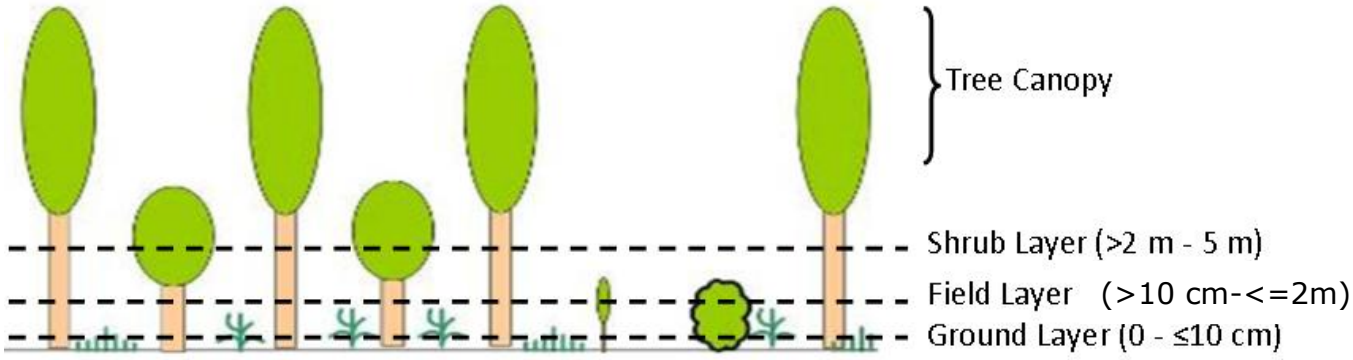
The surveyor should assess the vegetation present using the observations recorded by the previous surveyor to inform. It is expected that vegetation will change between the survey cycles. Change in vegetation is most likely due to the natural development of the vegetation layers as plants and shrubs compete with one another and go through natural life cycles. Change may also be due to other factors, e.g. the presence of trees, animals and humans. The time of year that the previous assessment was made in comparison to the current assessment will also have an impact on how vegetation observed in the two surveys may compare. Even just a few weeks difference may have significant impact on the coverage, height and presence of certain species. Thus, the application of the appropriate tolerance is very important when assessing the nature of differences in observations.

Note that if a new component becomes the lowest storey then the vegetation (and NVC) records will need to be moved to the new lowest storey.

11.5.2 Vegetation classification

The physical 'layering' and structure of the vegetation present (its height) is important to ascertain because the different layers and structure of vegetation provide different habitat niches for different species. The NFI classifies vegetation into 3 height strata; shrub layer, field layer and ground layer (see Figure 11.1).

Figure 11.1 NFI classifications of vegetation based on height



A schematic of a woodland indicating the three height strata used by the NFI to classify woodland vegetation. The dashed line indicates each height strata.

Vegetation data is always assessed for each individual component or component group within all sections regardless of whether the component group is in open, with trees, NFI or non-NFI land. The data is recorded against all the components within the lowest storey of the component or component group. If there is a seedling trees storey then it is recorded against all the components within this storey. If there is only an upper storey then the vegetation is recorded against the components in this Storey.

A table detailing the vegetation layer, ground layer, field layer, shrub layer, of the dropdown menu can be found in Annex KK-NN.

11.5.3 Shrubs acting as trees

A shrub species displaying the morphology of a tree is defined as a woody perennial forming a single self-supporting main stem with the potential to reach over 2 m and having a definite crown that has the potential to reach 5 m. Where a proportion of a shrub species is displaying the morphology of a tree then that proportion should be recorded separately and as a 'tree component'. For example, Laurel may cover 50% of a component group of which 20% is acting as a tree.

Where a shrub is acting as a tree the shrub also needs to be recorded as a measurable component as though it was a tree species, i.e. the shrub stems must be ≥7cm DBH. In the component record in the software in the shrub acting as tree field, select 'yes' and

the species list provided will swap from tree species to a list of shrubs that can act as trees. Mensuration assessments will be taken of these shrubs where they are included within a mensuration plot as though they were trees.

11.6 National Vegetation Classification (NVC)

The National Vegetation Classification (NVC) is the standard classification for describing vegetation in Britain. It is a "phyto-sociological" classification, which means it classifies vegetation solely on the basis of the plant species of which it is composed.

The surveyor is expected to assess and record NVC types within woodland areas, but not in open areas. Whilst often there may be more than one NVC type per section, component group or component, occasionally there will be more than one NVC per component. Different components within the same Component Group can have different NVC's depending upon the plants etc. associated with that component. The protocol and software thus allow you to assess and record more than one NVC per component.

The NVC breaks down each broad vegetation type into communities. These communities are designated by a number and a name, woodland and shrub communities are numbered W1-W25, e.g. W10 *Quercus robur - Pteridium aquilinum - Rubus fruticosus* woodland. Communities contain sub-communities which describe the range of floristic and structural variation within the community. These are designated by a letter e.g. W10b *Quercus robur - Pteridium aquilinum - Rubus fruticosus* woodland, *Anemone nemorosa* sub-community.

11.6.1 NVC: Remeasure square

NVC should not change greatly between survey cycles as it is a broad ecological classification driven by underlying site characteristics.

An NVC community may have changed in condition since the previous survey. For example, a healthy site in the first cycle may lose condition through spraying or cultivation in the intervening years. This does not however change its NVC classification. It is only rarely that operations or natural events (erosion, land slip, fire) are so intense or extreme that all traces of the previous NVC are removed.

In most instances the current surveyor should make an assessment of NVC and make a record. If there is an observed difference between the current survey and the previous survey in terms of the type of NVC observed then the current surveyor should record as an error and change where appropriate. If there is a difference in % area allocation, then a tolerance of 10% of the original estimate is acceptable before records are amended.

11.6.2 NVC recording rules

NVC is recorded against the lowest storey within the component or component group. Therefore, if the component group only contains an upper storey then NVC is recorded against the components within this storey. If it contains an upper and a seedling tree storey then the NVC is recorded against the seedling tree storey.

NVC is always assessed for each individual treed component group regardless of whether the component group is NFI or non-NFI. The data is recorded against all the components within the lowest storey of the component group.

Software note: For all Storeys above the lowest Storey delete the red NVC record by right clicking on it and choosing Delete. Failure to do this will result in a validation error.

11.6.3 Woodland NVC references

The NVC woodland classification is based on more than 2500 samples taken from natural, semi-natural and planted woodlands throughout Britain.

There are 18 woodland communities and 7 scrub/underscrub communities. Full descriptions of each of the woodland and scrub NVC communities and sub-communities are given in "British Plant Communities Volume 1: Woodlands and scrub", edited by J.S. Rodwell (1991). This includes information on the general species composition and appearance, the associated habitat, zonation and successional characteristics, and the geographical distribution. It also includes a detailed floristic table showing frequency and abundance values for all species found in the samples upon which the classification is based.

Summary descriptions are given in "Summary Descriptions of Woodland NVC Communities (and their Relationships with UK BAP Priority Habitats) and UK BAP Broad Habitats", compiled by Ben Averis (2010). This includes notes on how to distinguish between certain NVC communities, in summer and in winter.

Summary descriptions for communities are given in "JNCC National Vegetation Classification Field Guide to Woodland" by J.E. Hall, K.J. Kirby and A.M. Whitbread (2004). Species names are in Latin.

See also the "NVC Woods table" compiled by Ben Averis (2010). This lists the dominant/common plant species associated with the various acid, neutral, base-rich, wet and dry communities. Species names are in Latin.

11.6.4 NVC keys references

NVC keys can be used to help find which of the published NVC community descriptions best fits the stand of vegetation you're attempting to identify in the field.

A concise key to woodlands and scrub can be found in "JNCC National Vegetation Classification Field Guide to Woodland" by J.E. Hall, K.J. Kirby and A.M. Whitbread (2004). Species names are in Latin.

NVC Key edited by Julie Gardiner (2010). Part 1 is for native woodlands, Part 2 is for plantations and non-native woodlands. Species names are in English.

Please note that keys alone are not enough to confirm identification. Before accepting a result, check the composition of the stand against the description for the NVC community. If the stand seems very different, then review the sequence of steps that have been taken and see whether an alternative community would be a better fit.

Also consider the following:

- Not all of the species mentioned in the community description need to present in the component group.
- Species referred to as "constant", including those used to name the community, may be absent in the component group.
- Differences in grazing levels can change the appearance of a community
- Intermediate stands do occur, but most can be identified as closer to one NVC community than another.
- A community can occur in a place not shown on the distribution map.

11.6.5 Beech NVC communities

There are three NVC communities in which Beech is overwhelmingly dominant:

- W12 *Fagus sylvatica* – Mercurialis perennis woodland (base-rich and calcareous).
- W14 *Fagus sylvatica* – Rubus fruticosus woodland (neutral to acidic).
- W15 *Fagus sylvatica* - Deschampsia flexuosa woodland (strongly acidic).

These NVC communities are concentrated within the native range of Beech, but do also occur as plantations outwith the Beech Zone, in Wales and as far north as the Scottish Borders (although the latter are better classed as W16 Oak-birch woodland).

Therefore, when matching the stand to an NVC community, remember that W12, W14 and W15 can be assigned to beech-dominated stands of planted origin within and outwith the native range of beech, assuming the ground flora is a good fit. This is a slightly broader definition than that for the Lowland Beech and Yew Woodland Priority

Habitat (which only includes long-established beech plantations outwith the Beech Zone).

Note: regenerating patches within W12, W14 and W15 where beech is scarce are usually classed as W8, W10 and W16 respectively.

11.6.6 Pine NVC communities

There is one NVC community in which Scots pine is dominant:

- W18 *Pinus sylvestris – Hylocomium splendens* woodland (strongly acidic).

This NVC community is confined to Scotland and best represented in the central and north-western Highlands. Planted Scots pine woodlands in England and Wales are considered as replacements of other woodland types, notably W16 *Quercus* spp. – *Betula* spp. – *Deschampsia flexuosa* woodland in southern England. Therefore, when matching a stand to an NVC community, remember that W18 can be assigned to pine-dominated stands outwith the Pine Zone, but only within Scotland. This is a slightly broader definition than that for the Native Pine Woodlands Priority Habitat (which excludes all pine woodlands outwith the Pine Zone).

11.6.6.1 Pine bog woodland

In the National Forest Inventory we have added another NVC category:

- W18 bog Scots pine – *Hylocomium splendens* woodland.

This should be assigned to stands of Pine Bog Woodland, a rare habitat in the UK, but known at a number of sites within Caledonian Pinewoods in the Scottish Highlands. Pine Bog Woodlands develop on peaty ground in hollows and along valleys where the high water table and shortage of nutrients restrict tree growth. They typically occupy the transition zone between pine woodland and bog, where the trees are thinning out. Pine Bog Woodlands have a unique open character (see photo below). They are composed of mire vegetation (dominated by mixtures of Sphagnum bog-mosses, cotton-grasses and heather) with a scattering of variably stunted pine trees and saplings (some trees of considerable age- perhaps 350 years old but only 2-4m tall). The prominence of deep tussocks of Sphagnum bog-mosses can be a striking feature.

Figure 11.2 A Scots pine bog woodland at Loch Morlich in Scotland

The structure and function of this habitat type is finely balanced between tree growth and bog development. Tree growth is always slow (or the trees would take over the bog), trees are likely to be widely-spaced (because much of the bog surface is too wet for them to establish) and dead trees may be common (because their weight depresses the peat, locally leading to waterlogging and death). Open woodland is therefore maintained without loss of bog species.

This habitat is not to be confused with the progressive invasion of bogs by trees (through natural colonisation or afforestation) following changes in the drainage pattern, which eventually leads to the loss of the bog community.

11.6.7 NVC community assessment

The surveyor should record the woodland and scrub NVC communities, W1-W22, where these are present.

Recommended steps:

Stage 1:
Do a quick walk-over survey of the section or component group, identifying homogenous units of vegetation. For each unit in turn, note the tree, shrub and ground flora species present and roughly estimate their individual abundance (e.g. dominant, abundant, scarce etc.).

For beginners with limited plant ID skills, surveyors can still make a good stab at NVC by noting whether the vegetation:

- Is predominantly grassy- if so, is there a good variety of grass species, mostly fine-leaved, or broad-leaved or a mix of both?
- Is predominantly heathy- if so, what is the % cover of heathers, bilberry etc.
- Is predominantly composed of sedges and marsh plants?
- Is species-rich or species-poor- i.e. does it contain a diverse mix of herbaceous plants or just a narrow range of things?
- Contains a lot of ferns- if so, lots of different species or just a few?
- Contains an abundance of mosses- if so, lots of different species or just a few, and are any of these Sphagnum or Polytrichum species?

Stage 2:
Determine which of the published NVC community descriptions best fits each vegetation unit. There are a number of tools to help with this:

- Work through the NVC key in the "JNCC National Vegetation Classification Field Guide to Woodland". Electronic copy supplied in the Additional Documents folder. Species names are in Latin, so for beginners it is recommend that they purchase a hard copy and pencil in the English species names.
- Read through the published NVC community descriptions (and the sub-community descriptions to understand the variation across the community).

11.6.7.1 NVC surveying issues

If there is a choice between two NVC communities, chose the one which best describes the vegetation in the field. If there are several possibilities, none of which are a good fit, or if there is very little vegetation to go on (e.g. spruce plantation with leaf litter and moss) then record "Not Determinable". This also applies when there is snow cover.

Software note: If more than 1 NVC type is present in the Section or Component Group, then right click on the NVC Sub-component record to add another NVC record. Remember that the NVC percentages must sum to 100% for each Component Group.

11.7 Browsing damage

The surveyor is required to record the presence of browsing damage, browsing frequency and browsing severity. Refer to Annex PP for details on the browsing damage data fields used in the field software.

11.8 Bark stripping damage

The surveyor is required to record the presence of bark stripping damage, damage frequency and stripping severity. Refer to Annex QQ for details on the browsing damage data fields used in the field software.

11.9 Tree Health

The surveyor is required to assess tree health, including; general health, crown die back, stem decay, poor health indicators (e.g. wind snap, snow damage) and site indicators (e.g. evidence of plant health issues on live trees or a correspondence from the landowner). Refer to Annex RR for details on the tree health data fields used in the field software.

It most instances the most obvious signs of tree pests and diseases are found on the trees themselves and these are the principal source of evidence as to the presence of a disease. However, there are instances when signs of pests and disease are obvious and clearly apparent in other areas of the sample square. For example, *Phytophthora ramorum* may heavily infect *Rhododendron ponticum*, *Armillaria melia* (honey fungus) may be very evident on stumps or dead trees. Beyond biological evidence there may be actual signs highlighting sanitation felling and asking for the public to take phyto-sanitary procedures when walking through a wood. These can be taken as clear signs of disease. In these instances the presence of such indicators should be recorded under the 'Site Indicators' field of 'Tree Health'. The pest or disease itself should be recorded against the 'Tree Disease' field if evident.

If you find evidence of *Phytophthora ramorum* on *Rhododendron Ponticum*, record the plant within the vegetation layers and fill in the 'Evidence of *P ramorum*?' field accordingly.

11.10 Tree pests and disease

The surveyor is required to record the presence of tree pest and diseases. The surveyor should ensure they are able to identify key pests and diseases located in the area in which they will be surveying. Refer to Annex RR for details on the tree health data fields used in the field software. In addition to recording the presence of tree pests or disease the surveyor should also take a photograph of said tree pest or disease to aid further verification. The photograph can either be uploaded to the software or emailed to nfi@forestresearch.gov.uk.

11.11 Remeasure square: browsing, stripping, tree health and disease

The current surveyor is required to make an assessment as per the protocol described above. The surveyor should observe and record any tree health and/ or damage features. Observations recorded by the previous surveyor can be used as a guide to inform the assessment.

Browsing, stripping, tree health, pests and diseases can change rapidly with time and evidence of their occurrence can also fade rapidly. For example, if the previous surveyor recorded crown dieback but the current surveyor can see no evidence of crown dieback, it does not necessarily mean that the previous surveyor was incorrect in their assessment. A crown can suffer minor or moderate dieback and recover several times in the five years between surveys. In these circumstances the current surveyor should delete the record and classify the change as 'not observed'. Spend more than 20 minutes looking for evidence of previous observations.

It would unusual that the current surveyor would find evidence to suggest that a previous observation was recorded in error because of the nature of browsing, stripping, tree health, disease and pests, however occasionally there is evidence to suggest error. For example, evidence of severe stripping can remain evident for the five years between surveys and it is possible to determine a broad age of the damage to ascertain if it was present at the time of the last survey.

11.12 Management intervention

The surveyor is required to assess evidence of management intervention and management activity (e.g. brashing, clearfell, fencing, planting, conservation, etc.). Refer to Annex TT for details on the management intervention data fields used in the field software.

11.12.1 Remeasure square: management intervention

The current surveyor should assess and record observations of management intervention at the site. The current surveyor should review any existing management intervention records from the previous survey and check if these align with current observations. Although it should be noted signs of previous interventions may have passed since the last survey. Interventions may have occurred since the last survey and therefore the current surveyor may make different observations to that previously recorded, if so differences should be recorded.

Using the field software, the surveyor should update the timing of the interventions. For example, if the management intervention was previously recorded as being in place less than 3 years, then provided the same management intervention is still in place, the passing of time means that this should be updated to ~ 3 – 10 years. The current surveyor should check the date of the previous survey but generally the time between survey is five years.

It would unusual that the current surveyor would find evidence to suggest that a previous observation was recorded in error because of the nature of management interventions can fade over time, however occasionally there is evidence to suggest

error. If there is evidence of an error then this should be recorded as such. If there is no evidence of error but the current surveyor has not observed a previously observed management intervention, then the change is recorded ‘not observed’.

12 Native Relevant Adjacent Stands (RAS)

12.1 Introduction

Where sections within the sample square are regarded as native it is important to know if this native stand extends outside the square and is it greater than 0.5 hectares in extent. This is particularly important where the NFI map has incorrectly noted the Interpreted Forest Type (IFT) as a non-native type (e.g. conifer in England) and gives an indication of where native woodland can be found.

During the walk around the sample square surveyors should note where native sections cross the square boundary. Where the NFI map is showing the incorrect IFT the surveyor will be required to map a native RAS

Recording native relevant adjacent stands is important because it is part of the reporting on Great Britain's woodlands and contributes to the estimate of the area of native woodland. Assessment of RAS need will allow the distinction of native stands greater than half a hectare, and those less than half a hectare where the native RAS is not captured entirely within the square boundary. Having a record of the size of native stands is important because it relates to the formal definition of native woodland (see below) and will impact figures that are reported for native woodland area in GB.

12.1.1 NFI definition of Native Woodland

Native woodland is an area of woodland ≥0.5 Ha in extent composed of ≥20% canopy cover of site-native species in the uppermost canopy.

The above definition of native woodland is used for reporting purposes. Where canopy cover cannot be used, basal area or stems per hectare (in that order) can be used as a substitute. The native woodland may be derived from natural regeneration, coppicing or planting.

Some notes for specific Lots:

- Scots pine is regarded as native in Lots 85 – 108.
- Beech is regarded, for NFI purposes, as native throughout GB
- Sycamore is regarded, for NFI purposes, as native throughout GB

12.2 Aim

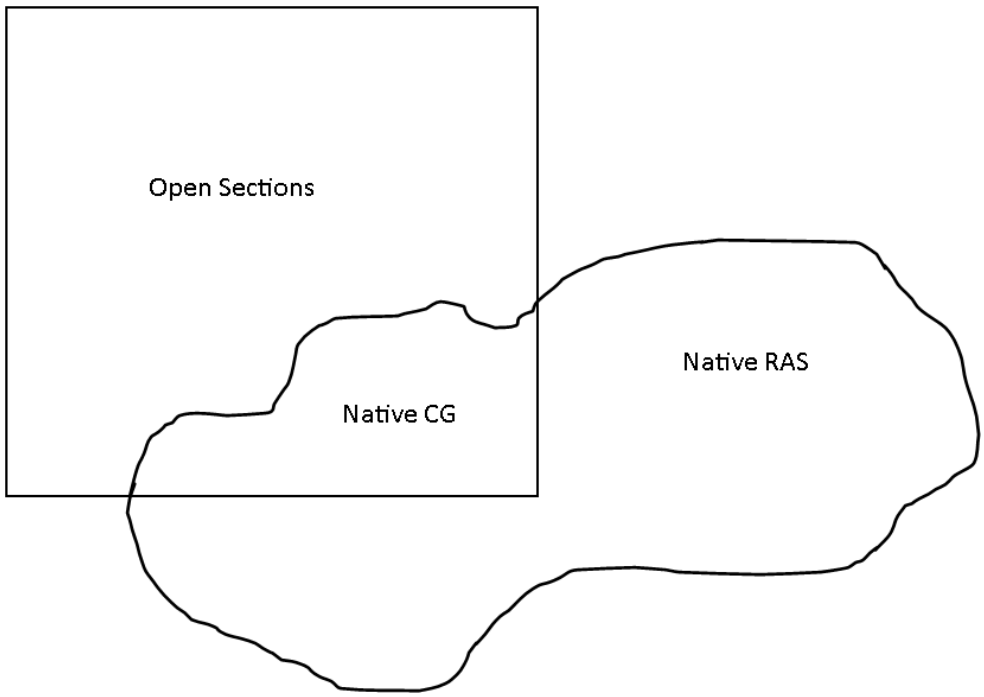
This chapter describes Relative Adjacent Stands in the context of the NFI survey and gives information on how record data and observations in the software.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

12.3 New square: RAS

In a new square the surveyor will be required to map any relevant adjacent stands for the first time in native sections or component groups that occur at the square boundary and continue beyond (see Figure 12.1). This can be done as part of the field survey or can be done using aerial photography (see below for more details) and then confirmed when on the ground.

Figure 12.1 An Example of a sample square with a Native Relevant Adjacent Stand (RAS)



In the example above the square marks the sample square boundary. CG = component group and RAS = relevant adjacent stand. In this example, the native woodland parcel is partially captured within the sample square boundary. The area within the square is recorded as a component group (or it could be a section, see Annex Y for a flow chart to decide if an area is a section or CG) and the area outside the sample square is mapped as RAS.

12.4 Remeasure square: RAS

In a remeasure square, on the ground, the surveyor should confirm if the IFT map correctly indicates that the RAS is native or non-native. If it is correct, then there is

nothing further for the surveyor to do. If the IFT map is not correct, then the surveyor is required to create a RAS to reflect the extent of the native RAS.

Copies of the original aerial photography used at the time of last survey are be issued to look for evidence of change between the previous and current survey. This can help to confirm changes such as clearfell. If the original aerial photography is offset against the current aerial photography the surveyor should not change the section boundaries they have mapped to reflect this, unless they are more than 10 m or 10% out.

The creation of the Native RAS in the software should take no more than 10 minutes on average. It is more important to create a RAS to have a record that there is a need for the RAS, rather than to have a very accurately mapped area, particularly if the RAS is large, i.e. ≥50 m away from the square boundary. Accurate mapping is more important if the RAS is smaller, i.e. no more than 21 m from the square boundary.

12.5 Mapping of Native RAS: notes on specific Lots

Below are details related to mapping RAS in specific Lots (see Annex A for a map of Lot areas in GB).

Lot No.	Native RAS should be mapped where:
1-84	The Section/CG within the square (up to the square boundary) is native, AND;
	The area outside the square and adjacent to the native Section/CG is also native (NB: if does not have to be identical in nature, just native by definition) AND;
	The adjacent area is NOT one of the following IFTs. Note that the IFT on the ground can be different from the map IFT. If it is different then the IFT on the ground takes precedence: • Broadleaved • Mixed mainly broadleaved • Felled • Ground prep • Coppice • Coppice with standards • Young trees
85-108	If the Section/CG within the square (up to the square boundary) is native, AND;
	The area outside the square and adjacent to the native Section/CG is also native (NB: if does not have to be identical in nature, just native by definition), AND;
	The adjacent area is NOT one of the following IFT's (see Table 5 for IFT descriptions).

	Note that the IFT on the ground can be different from the map IFT. If it is different then the IFT on the ground takes precedence: • Conifer • Broadleaved • Mixed mainly broadleaved • Felled • Ground prep • Coppice • Coppice with standards • Young trees
	Where the NFI map shows a conifer IFT adjacent to a native Section/CG a Native RAS is to be drawn if the conifer area is ≥20% Scots pine.

Where the IFT in the NFI map is incorrect (and adjacent to a native Section/CG) email the NFI contract Manager with SQUID (sample square unique ID).

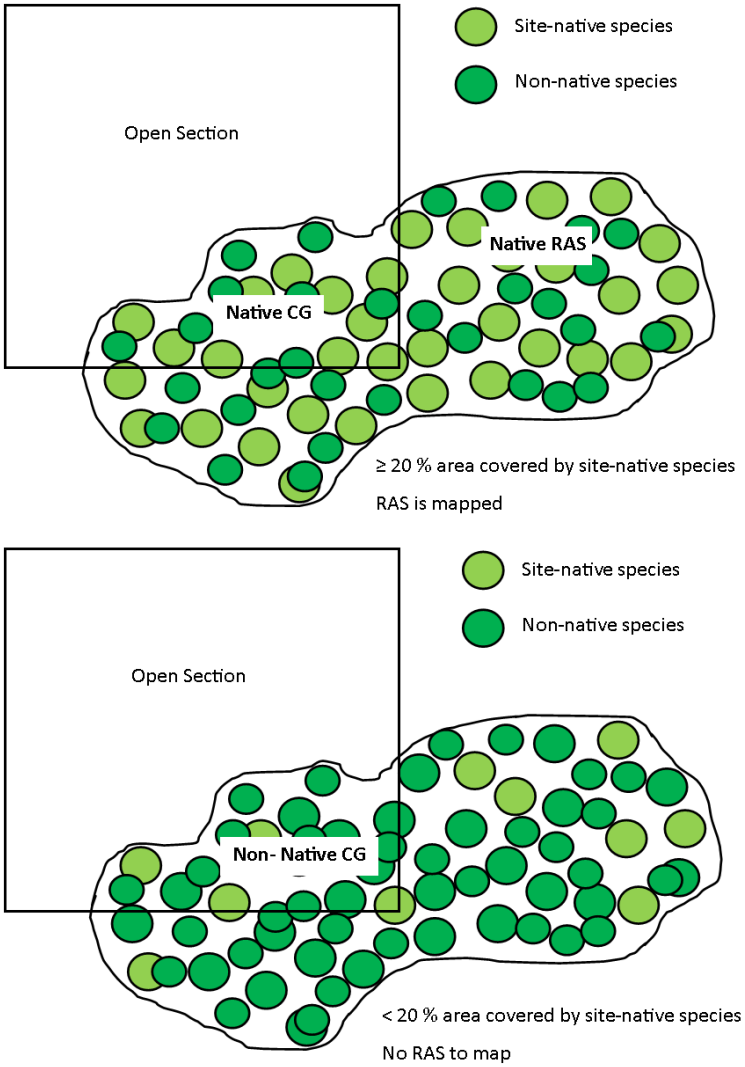
Mapping can be carried out by *via* field surveys and/or desk-based aerial photo interpretation. However, surveyors are not expected to walk more than 50 m from the sample square boundary and, if the sample square lies at the edge of the Lot, the surveyor is not expected to acquire aerial photography for the adjacent Lot. Where possible the entire area of the RAS should be mapped but under circumstances where this is not possible (i.e. >50 m walk or the square is on the edge of a Lot), then the minimum allowable area of RAS to should be mapped. The minimum allowable area of RAS should be enough to indicate that the total native area is ≥0.5 ha (i.e. total native area = the native section/CG within the square boundary combined with that in adjacent areas).

12.6 How to assess whether a section or component group is native

12.6.1 Canopy cover

To classify the section or component as native, the area of uppermost storey of the section or component must be composed of ≥20 % of site-native species (see Figure 12.2).

Figure 12.2 An example of a sample square where a RAS should be mapped and where a RAS should not be mapped



This example shows an aerial view of a sample square with two different scenarios. Each circle represents a tree, either site-native or non-native, in the uppermost storey of the canopy. In the top example, the area of the upper storey of the component group is ≥20% site native species, therefore the surveyor is required to map the RAS. In the bottom example, the area of the uppermost storey of the component group is <20% site-native species and therefore not classified as native and therefore no RAS to map.

The % area covered by site-native or non-native trees to decide if a component group or section is native, may be different from the from the % area field filled in for the component/s. The reason they may be different is because the % area in the RAS example above considers the physical area of the entire upper canopy, while the % area of component/s only takes into account the area covered by the component. For example, if a section or CG has a single component within the upper storey, the % area of this component is 100%. However, the actual canopy cover of the component may be <100%, for example, a sparse cover of oak.

If a section has multiple component groups, then the % area should consider total canopy cover of all native species (from all component groups) in the uppermost storey. If this is greater than or equal to 20% then the section is considered native and any RAS should be mapped. For example, if a Section has 3 Component Groups: CG1 (50% of the Section) has an Upper storey of oak with a canopy cover of 10% with a Lower storey of spruce, CG2 (20% of the Section) has an uppermost Lower storey of spruce with a canopy cover of 100%, and CG3 (30% of the Section) has an Upper storey of oak and spruce with 50% canopy cover each across the CG. Canopy cover of the oak across the section is therefore: 10% of 50% + 0% of 20% +50% of 30% = 5% + 0% + 15% = 20% therefore the Section is considered native.

Spatially explicit component groups are considered separately from the section with respect to nativeness where the CG crosses the square boundary (see Figure 12.4 below).

12.6.2 Basal Area or Stems per Hectare

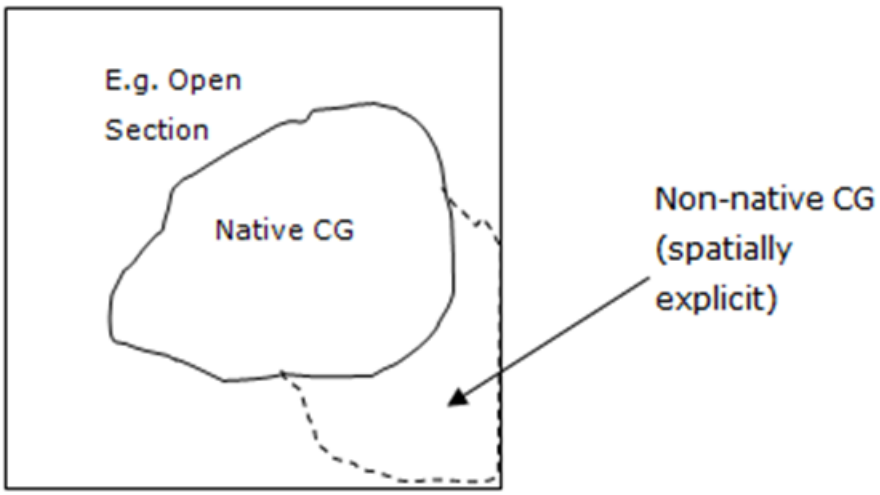
If upper canopy cover, or upper and lower canopy cover cannot be used to assess the nativeness of a section or component group, then basal area (BA) can be used as a proxy of canopy cover. As a last resort, then stems per hectare may be used but the following should be taken into account:

- Upper canopy trees should be used to determine both habitat and native-ness
- BA is a better measure as it inherently weights the assessment
- Seedling and Sapling storeys have little or no basal area (i.e. the trees are below 1.3 m in height)
- The younger the stand of trees then generally the more stems there are.

12.6.3 Exceptions

If a section contains a Component Group of native species, which is situated wholly within a square but has a second component group of non-native species which crosses the square boundary then the RAS is not created as the only species outside the square is non-native (see Figure 12.3).

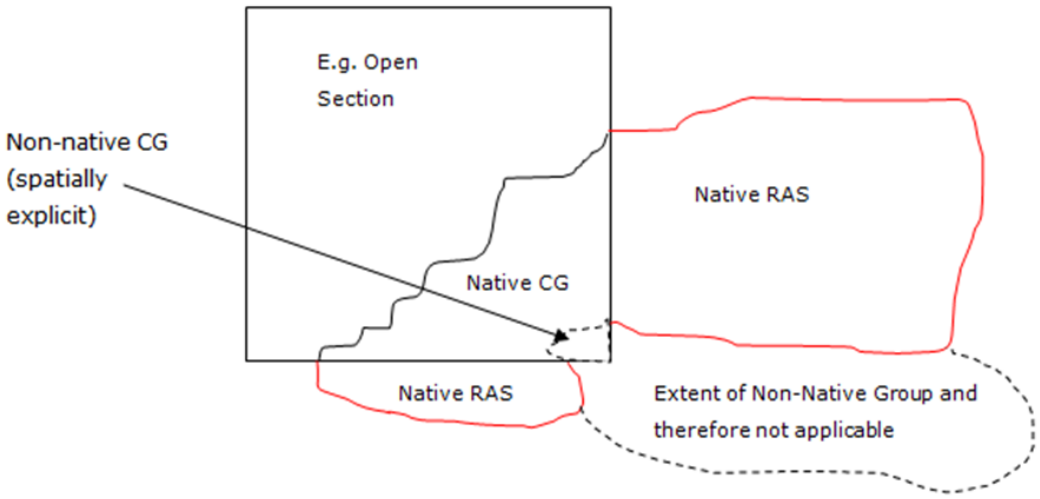
Figure 12.3 An example of a sample square where the non-native component group within a section does not extend beyond the square boundary.



In this example, although the native component group covers greater than 20% of the section (classifying the section as native), the native part of the section does not extend beyond the boundary of the square meaning that there is no RAS to map.

If a section contains a native component group and a non-native component group and they are spatially explicit (i.e. not intimately mixed) and one or both groups are too small to map out as a section. The RAS should encompass the native woodland outside the Square which is homogenous with the native component group but should not include the non-native spatially explicit Group's continuation outside the square.

Figure 12.4 An example mapping RAS where you have two or more spatially explicit component groups



13 Circular Plot Assessments

13.1 Introduction

Circular mensuration plots are assessed within all accessible NFI sections with trees once the section boundaries mapped. For each NFI section with trees that is deemed accessible, or visually assessable, the surveyor is required to carry out a full or abbreviated plot assessment, respectively (see Table 13.1).

An NFI circular mensuration plot is a circular plot with a 5.64 m horizontal radius (area 0.01 ha (100 m^2) planimetric area). The field software will randomly allocate 2-3 circular plots to each NFI section with trees within the sample square. For sections <0.6 ha two plots are generated by the software and for Sections ≥0.6 ha three plots are generated.

If a circular plot is inaccessible, but can be seen, the surveyor is expected to carry out a visual abbreviated mensuration assessment of the predominant storey e.g. the most abundant (or thicket storey if inaccessibility is due to thicket stage trees).

An inaccessible circular mensuration plot is a plot that has more than 10% of its measurable stems inaccessible due to thicket restrictions or less than 10% for other health and safety considerations such as a mineshaft. Thus, the plot may be partially accessible, where less than 10% of the measurable stems are inaccessible, the mensuration assessments for those trees may be estimated.

Mensuration data is important as it is used by the NFI to make estimations that are important to industry, for example tree size can be used to estimate standing volume.

The length of time required to assess a plot varies enormously depending on the terrain, the size and stocking of trees to be assessed, the level of vegetation within the plot, the quantity of type of young trees, the number of stumps and the amount of deadwood.

Table 13.1 Measurements included in both a full and abbreviated (visual) circular plot assessment

Assessment Type	Elements included in the assessment	Specific Measurement/ Observation
Full Plot	Tree Assessment (Chapter 14)	Species assessment
		Diameter at Breast Height (DBH) – see Diameter (DBH) Assessments V2.doc in Mensuration sub-folder of Additional Documents folder
		Tree heights and crown diameters – see Height and Crown Diameter Assessments V2.doc in Mensuration sub-folder of Additional Documents folder

		Live/Dead (Reason, Decay Class and Total Height (visual estimate) if dead)
		Storey assessment
		Conifer Straightness (if Conifer ≥14 cm DBH) – see the Additional Documents folder
		Component Group
		Excessive Lean
		Wind snap
		Re-survey status
	Stump Assessment (Chapter 15)	Number of stumps
		Size of sample stumps
		Decay class
		Species category
		Re-survey status
		Good felling practice
	Young Tree Assessment (Chapter 16)	Pre-mensuration, Seedling and Sapling assessments
		Species
		Number
		Mammal damage
	Lying Deadwood Assessment (chapter 17)	Deadwood type
		Diameter
		Decay class
		Decay features
Abbreviated/ visual	Tree Assessment	Height estimation
		Tree count estimation
		Estimated average diameter breast height (DBH)

13.2 Aim

The aim of this chapter is to provide an overview of the circular plot assessments and a description of how to use the software to generate a plot or locate a plot in a remeasure square.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

13.3 Circular plot assessment: new square

During the first visit to a square the field software will randomly allocate 2-3 circular plots to each NFI section with trees within the sample square (sections <0.6 ha two plots are generated by the software and for Sections ≥0.6 ha three plots are generated). The plots should be assessed only after the section boundaries and types have been assessed and recorded. This is particularly important for new square assessments to ensure that section boundaries will not change after plots have been allocated and assessed. Any change to the section boundaries will mean a deletion of new plots within any section affected by the boundary change. A peg and a wand should be placed at the centre point of a new circular plot to assist locating the circular plot in future surveys

13.4 Circular plot assessment: remeasure square

The general rule when assessing remeasure squares is to maintain continuity between previous assessments and the current survey. A key aim for the NFI is quantify change over time, therefore the current surveyor is expected to locate the existing plot locations and carry out either a full or abbreviated plot assessment.

13.4.1 Locating circular plots in a remeasure sample square

Field navigation techniques can be used to locate the location of the circular plots if they are being located for the first time (e.g. using features, maps and compass, GPS). There are additional tools available for locating circular plots in a remeasure square; use the information recorded by the previous surveyor (i.e. notable features, the presence of a particular vegetation), there should have been a peg and a wand left by the previous surveyor at the plot centre and a description of the plot centre and the surveyor can use a metal detector to locate the metal peg.

If the surveyor is unable to locate the circular plot or, if there is a difference between what the current surveyor thinks is the location of the plot and what the previous surveyor recorded, then best practice survey techniques should be employed, e.g. take the longitude/latitude of the plot centre from the GIS and compare this to your GPS reading to confirm location. Also, it is worth remembering that GPS readings can be inconsistent over time and can be out by ~10 m. Other tools to use include: information on the number and type of trees in the plot and their configuration, the surveyor is supplied with tree species, broad diameter classes and approximate tree heights that can be used to identify the plot location and details of any coppice stool, stump, or dead tree present in the plot.

13.4.1.1 Re-survey information

The surveyor is required to complete the re-survey information in the field software, including whether or not the peg was found; peg found, peg not found and plot centre certain, peg not found and plot centre approximate, peg not found and plot not located, inaccessible.

Peg found; the peg is found.

Peg not found and plot centre certain; this means the surveyor had a high level of proof that the centre of the plot was located to less than 0.5 m.

Peg not found and plot centre approximate: this means that the surveyor believes that the centre of the plot was located to within 0.5m to a maximum of 5 m. It is likely in this instance the surveyor found some or all of the plot trees identified in the previous survey, but the trees are located away from the plot centre and / or are too few. This means that without a lot of measuring and trigonometry the surveyor is unable to locate the plot location to less than 0.5 m, but the surveyor is certain the peg location is contained within the area they have identified as the plot.

Peg not found and plot not located: this means that the surveyor was not able to locate the plot area and could not reference any of the features recorded by the previous surveyor. In this instance the surveyor should generate a new plot to assess and the original plot will be 'frozen' and left to see if the QA team or the next surveyor can locate the plot. If it can be found it can be 'unfrozen' and brought back into use.

It is recommended that if you cannot find a plot easily that no more than 10 minutes are spent searching before it is declared 'peg not found'.

13.5 Whole section plots

In survey cycles one (2010-2015) and two (2015-2020) whole section plots were used when there are less than 40 measurable live trees (trees with DBH ≥7 cm) within the section. Whole section plots will not be used in the fourth cycle of the NFI field survey. In a remeasure square where a whole section plot assessment has been carried out by the previous surveyor, the current surveyor is required to change the 'points' (linked to the previous whole section plots) into circular plots and conduct plot assessments. Circular plots should be assessed in all sections classified as NFI land with trees.

13.6 Circular plots

Circular plots are used to gain a representative sample of the section. Circular plots within the NFI are 5.64 m horizontal radius (0.01 ha (100 m^2) planimetric area).

- For Sections <0.6 ha two plots are generated by the software.
- For Sections ≥0.6 ha the software generates three plots.

13.6.1 A circular plot with no measurable trees

Even in a section with more than 40 trees the software may occasionally allocate a circular plot that contains no measurable trees. If this happens then locate the plot

centre and peg the location and carry out the other assessments (i.e. deadwood, stump and young trees assessments). As described above, circular plots are randomly located by the software to provide a representative sample of GB woodland. Therefore, if a plot randomly contains no measurable trees this is a product of the probabilistic nature of the random sampling method and post survey statistical analysis will take this into account.

13.6.2 Gardens, Parks, Churchyards, and Cemeteries

These four land uses do not preclude woodland associated with them from qualifying as NFI woodland. If the NFI thresholds for area, width and canopy cover are met, then the woodland constitutes NFI woodland. As such it is subject to all the standard mapping and assessment regimes including mensuration assessments. Mensuration plots should be undertaken where required and permitted. If a surveyor has the permissions in place and the garden, park, churchyard, or cemetery features NFI Treed Sections then they must endeavour to carry out a mensuration assessment. In terms of access, the use of rods and pegs, and the timing of visits, a heightened degree of sensitivity surrounds NFI woodland associated with the four land uses. Surveyors should avoid surveying in churchyards or cemeteries during religious services, funerals, memorials, and commemorations or when it is evident that undertaking such survey work would disturb the solace of any persons present. If permission is granted for the use of pegs and rods, surveyors must consider the health and safety implications of their placement and the fact that their use may represent inappropriate intrusion.

13.6.3 Avoidable error and bias

It is important that the surveyor does what they can avoid introducing error or bias into the survey. The surveyor should ensure that their equipment is calibrated and in good working order. For example, a poorly calibrated hypsometer will measure trees incorrectly, therefore if that hypsometer is used in several sample squares, in several Lots across the same region, this will bias the data in that region in favour of the inaccurate hypsometer.

13.6.4 Circular plots that cross square or section boundaries

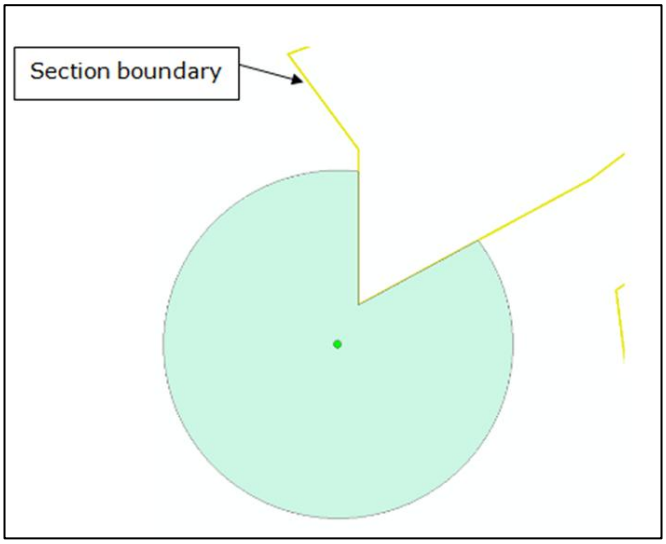
The software will not allocate the centre point of the circular plot across a section or square boundary. However, the area for trees, stumps/stools, seedlings, saplings and lying deadwood assessments may cross square and section boundaries.

13.6.4.1 Circular plots crossing a section boundary

The field software can be used to give a clear indication of how much of the plot crosses the section boundary. The surveyor should use this tool to make themselves aware of which elements to be assessed (e.g. stumps/stools) are inside the plot and section and which are not. This is important because anything across the boundary is not subject to

assessment (see Figure 13.1). Occasionally the software will not curtail the plot area crossing a section boundary if this happens the surveyor should assess only what is within the section within which the centre point of the circular plot is located.

Figure 13.1 A partial plot: where the plot area crosses a section boundary

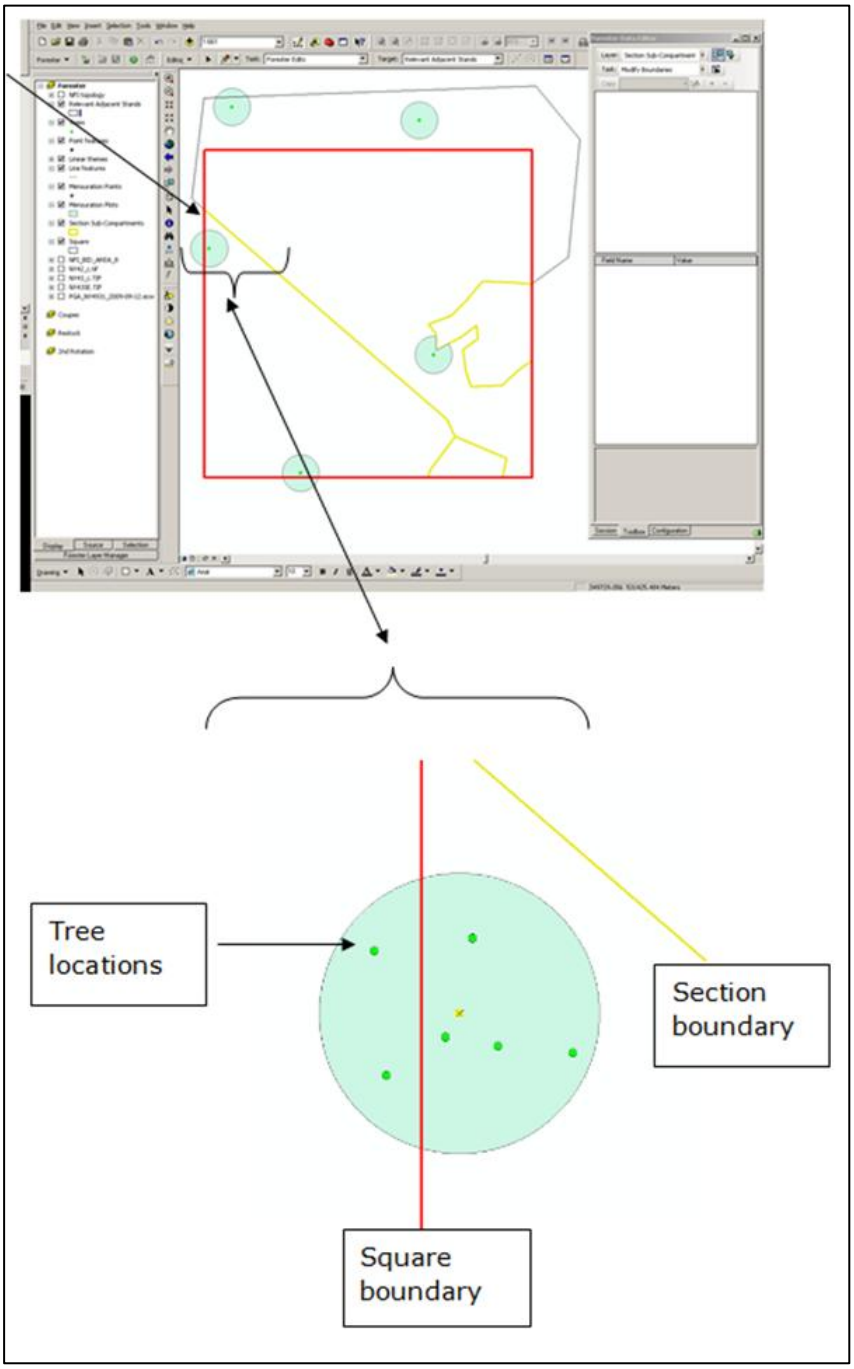


The shaded circular area represents the plot area with the centre of the plot indicated with a point. The lines represent the section boundary. In this example the field software automatically cuts the part of the plot that is across the section boundary. This means that only the plot area in the section within which centre point of the circular plot is located, is sampled.

13.6.4.2 Circular plots that cross a square boundary

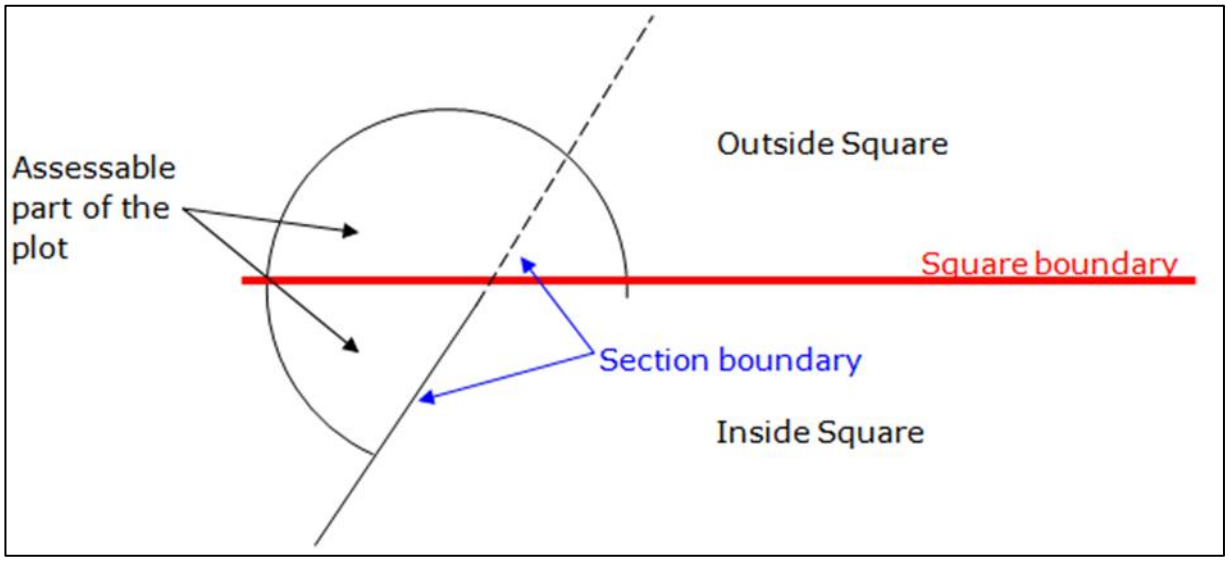
It is often the case that theoretically the section carries on beyond the boundary of the sample square. If this is the case and if the area of circular plot also crosses square boundary, then the entire plot area should be assessed including those parts that cross the square boundary (see Figure 13.2). The exception to this is where the circular plot also crosses a section boundary outside the square (see Figure 13.3).

Figure 13.2 An example of a circular plot that crosses a square boundary but does not cross a section boundary



The circular shaded area indicates the plot area. Theoretically the section can carry on beyond the boundary of the sample square. If this is the case and the area of circular plot also crosses square boundary, then the entire plot area should be assessed including those parts that cross the square boundary.

Figure 13.3 An example is a circular plot that crosses the square boundary and a section boundary.



The circular area indicates the plot area curtailed by the section boundary. Where the section could theoretically carry on beyond the boundary of the sample square and the area of circular plot also crosses square boundary, then the entire plot area should be assessed including those parts that cross the square boundary. The exception to this is where the plot area crosses a section boundary.

13.6.5 Circular plots that cross square or section boundaries: remeasure square

13.6.5.1 Section splits or boundary changes

If a section must be split or its boundaries changed to reflect differences observed in the current survey compared to what was previously recorded (e.g. felling or restocking), then the protocol is to maintain the existing circular plots. The circular plots will belong to the section within which their plot centre is located. This means if section boundaries are changed the plot may belong to the original section (parent section) or now belong to a different section (child section). The field software will manage this for the surveyor, all that is required to ensure the sectioning of the square is completed accurately.

If, as a result of changes to section boundaries in the current assessment, the plot ends up spanning two sections, the plot will be clipped to the boundary of their new (child) section. Any part of the circular plot area that is clipped off (i.e. it is located in another section different from that of the plot centre) will become a fraction plot. There is no requirement for the surveyor to carry out any assessment in a fraction plot.
Once the sections have split or their boundaries modified to reflect any changes between survey cycles, the surveyor is required to check the existing plots for each current section using the function in the software. If required, this function will freeze or delete

extra plots (e.g. where two or more NFI sections with trees have been merged) or add new plots where there are no longer enough.

13.6.5.2 Land use or stock changes

If section boundaries remain the same (i.e. there are no observed differences between those recorded in the previous assessment and the current survey) but some form of significant change has occurred within the section, such as clearfelling, then the original plot locations should be located and assessed.

13.6.5.3 Frozen plots

A frozen plot is one that no longer needs to be assessed. It may be frozen as a result of two sections being merged and there were then too many plots in the new section. A frozen plot appears on the software with the trees in grey. If required a plot may be unfrozen if it needs to be assessed in the current survey cycle.

13.6.5.4 Modified circular plot

A modified circular plot is a plot that has either increased/ decreased in area due to a section boundary change (i.e. a part of the circular plot has been clipped or gained as a result of a change to the section boundary). The modified circular plot includes the plot centre.

13.7 Inaccessible circular plots

If a circular plot is inaccessible, but can be seen, a visual abbreviated mensuration assessment of the predominant storey (or thicket storey if inaccessibility is due to thicket stage trees) should be conducted.

An abbreviated circular plot assessment includes an estimated average tree height, an estimation for the number of stems/ coppice stools within the plot and a estimated average diameter breast height (DBH). These estimations should be done for all the predominant stems within the plot or, if the thicket is the reason for the inaccessibility, then assess the thicket stems only.

If all the plots are inaccessible, then the section should be recorded as inaccessible but visual assessment possible.

If a visual assessment is not possible then no mensuration assessments are conducted.

Accessibility status is at the discretion of the surveyor.

Tables detailing the plot inaccessible data fields and plot visual assessment data fields is included in Annex UU and VV.

13.7.1 Remeasure square: change in accessibility status

Occasionally the surveyor may find that the plot is inaccessible where it was previously accessible. In this instance the surveyor should change the value in the access field (of the field software) and do an abbreviated/ visual assessment of the plot. Alternatively, a plot that was inaccessible may now be accessible. In this instance, change the access status and complete a full plot assessment.

13.8 Data Collection Procedure

The surveyors are expected to adhere to the following procedure when assessing circular plots. This will ensure that all data is collected and the data fields are filled out correctly. The procedure is as follows:

- Navigate to the chosen circular plot.
- Access status – determine accessibility of the Plot. Note that in residential areas with small gardens, a plot could easily cross an ownership boundary. In such cases, the surveyor must have permission from all the owners represented within any plot footprint before starting an assessment.
- Private gardens - Surveyors must have permission from the owner of a private garden via letter return (as supplied by the NFI) **or** after speaking to the owner, ideally, prior to the visit. Where access permission to a garden has been previously granted - even if this permission was granted only a day or so earlier - on the day of the visit the owner should be contacted again to ensure permission is still valid.
- Churchyards and Cemeteries - Surveyors should avoid surveying in churchyards or cemeteries during religious services, funerals, memorials, and commemorations or when it is evident that undertaking such survey work would disturb the solace of any persons present.
- Place metal peg and yellow rod/wand at the Plot centre and attach biotape. Where possible, additional biotape placed at eye level will aid return visits for QA and survey staff. In churchyards and cemeteries if permission is granted for the use of pegs and rods, surveyors must consider the health and safety implications of their placement and the fact that their use may represent inappropriate intrusion.
- Record the field GPS reading of peg on that day – do not record the coordinates from the ArcGIS software unless the Plot is Inaccessible in which case use the ArcGIS coordinates.
- Complete peg description field and take photo if possible to aid return visits up to 10 years in the future.
- Complete data collection for the plot.
- Once all data has been collected the Visit Status can be set to completed.

13.8.1 Circular plot level data

To enter circular plot level data into the software in the Forester Data Editor window click on 'point 1' for the plot to be assessed. The plot centre will be highlighted in yellow on the map. A table detailing point 1 data fields can be found in Annex WW.

13.9 Growing stock elements: surveyor quality assurance checks

The field software analyses the tree data that is collected as part of the circular plot assessment for use in the production forecast. Therefore, these results can be used to check the data that has been collected by the surveyor prior to checking in the sample square.

To start the analyses in the software click on the Forester button and the following options are available; 'Log off from Forester DB' and 'NFI'. Select NFI and then NFI Growing Stock Calculation. The software will the calculate the growing stock elements (species, storey, status, top height, stocking, mean DBH and basal area) for the elements that were captured within the circular mensuration plots. The growing stock calculator will not work on coppice.

To view the results in the software, go back into the Editor and select a Section. Click on Growing Stock Components and highlight a Growing Stock Component, the number of these varies depending upon the number of species and storeys found within the plots and whether they are dead or alive. The most important information lines for the surveyor are:

- **Species, Storey and Status** - ensure that the species, storey and Status combinations match the Components recorded within the Section.
- **Top height** – does this make sense for the Growing Stock Component
- **Stocking** – a useful check, how does this compare with the estimated Stems per ha in the Component, is there a good reason for the difference (e.g. were the plots in denser/sparser areas than for the rest of the Component within the Component Group?). Note that this is stocking per Section rather than stocking per ha within the Component Group so some maths will be required to do a comparison. To convert the Growing Stock stems per Section figure for a particular Component, divide this figure by the Section Area (in ha.) to give a comparable stems per hectare figure for that Component.
- **Mean DBH** – does this make sense for the Component? E.g. if the mean DBH is below 4cm then there is a problem. Likewise, if the mean DBH is very large has a large tree been cloned in the plots and the DBH's not edited?
- **Basal Area** (m^2/Section) – divide this figure by the Section area (in ha.) to get BA/ha. If the figure is above 50 m^2/ ha then the section should be densely

stocked. Note that basal area is the area of the stem at breast height and so depends both upon the number of trees AND the DBH’s of the trees. A few large diameter trees is the same as many small trees in terms of BA.

14 Circular Plot: Tree Assessment

14.1 Introduction

Mensuration plots are assessed within all accessible NFI sections with trees once the section boundaries mapped. For each NFI section with trees that is deemed accessible, or visually assessible, the surveyor is required to carry out full or abbreviated plot assessment (see Table 13.1). One element of the full plot assessment is the tree assessment including; species assessment, diameter at breast height (DBH), tree heights and crown diameters, live/dead, storey assessment, conifer Straightness (if Conifer ≥14 cm DBH), component group, excessive lean, wind snap and re-survey status. Other full plot assessments include the young tree assessment (Chapter 16), stump assessment (Chapter 15) and lying deadwood (Chapter 17).

14.2 Aim

The tree assessment is one element of the circular plot assessment (Chapter 13). The following chapter describes how to carry out a tree assessment as part of the NFI field survey.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

14.3 New square: tree assessment

If the circular plot is accessible then the surveyor is expected to conduct a full plot assessment including the tree assessment. Refer to section 13.7 for details on how to assess an inaccessible plot.

14.4 Remeasure: tree assessment

The general rule when assessing remeasure squares is to maintain continuity between previous assessments and the current survey. A key aim for the NFI is quantify change over time, therefore the current surveyor is expected to locate the existing plot locations. Providing the plot is still accessible a tree assessment is conducted as part of the full plot assessment on the same trees that were assessed in the previous survey. Refer to section 13.7 for details on how to assess an inaccessible plot.

14.5 Mapping and locating trees

Once the plot centre has been located (and pegged if a new square), the plot boundary should be located (i.e. 5.64 m radius horizontal distance from plot centre) and all measurable stems (≥7 cm DBH) within the plot identified (and mapped if a new square), whether alive or dead.

14.5.1 Mapping the tree positions: new square

When mapping the trees within the plot for the first time the surveyor should ensure that the mapping is accurate enough to allow a surveyor to locate the trees at a later date (i.e. 5 years later during the next cycle of the survey). As a minimum, trees/ stumps/ stools should be mapped into the correct 'octant' of the plot target in the software. A table detailing the data fields for new tree records can be found in the Annex YY.

Once all measurable trees in the plot have been identified they are recorded in the software as tree type 'Normal' and a range of attribute data is collected; DBH, species, tree alive?, windsnapped?, excessive lean?, storey, component group and resurvey status. Refer to Annex XX for the tree data fields – normal trees). Once all the trees have been mapped, three sample trees per plot are selected and a tree type for each is recorded, either; dominant, 2nd sample tree or 3rd sample tree (see below for details).

When identifying and mapping the trees in the plot, it is recommended to use either the North bearing, or an easily identifiable object (e.g. a thinning rack, large rock, the nearest measurable tree), as a starting & finishing point and work clockwise around the plot.

14.5.2 locating the tree positions: remeasure square

The data and observations recorded by the previous surveyor should be enough to relocate the previously assessed trees once the plot has been located. However, the following good practice can be used where trees are difficult to locate:

- Use 4-8 sticks to show the cardinal compass points on the ground within the plot.
- Use the vertex to get the distance between the plot centre and the tree.
- Take a compass bearing
- Locate the tree within the correct 'Octant' of the plot target

Also supplied to the surveyor to aid orientation and locating the trees are approximate DBH and tree height bands based of data recorded from the previous cycle. The exact value previously recorded will sit somewhere within the ranges that are given and therefore, should not be used for comparison or to estimate the current DBH or height. The surveyor will need to take their own measurements. In some circumstances the

previous surveyor may have recorded the data incorrectly. The main objective of the current surveyor is to make an independent assessment of the same tree. NFI analysts will compare current measurements to the values recorded by the previous surveyor to check if credible growth has been recorded. The same approach applies to crown diameter remeasurements.

14.5.3 Locating trees using the data editor

The software allows the surveyor to highlight trees either directly in the data editor window or by clicking on them within a plot.

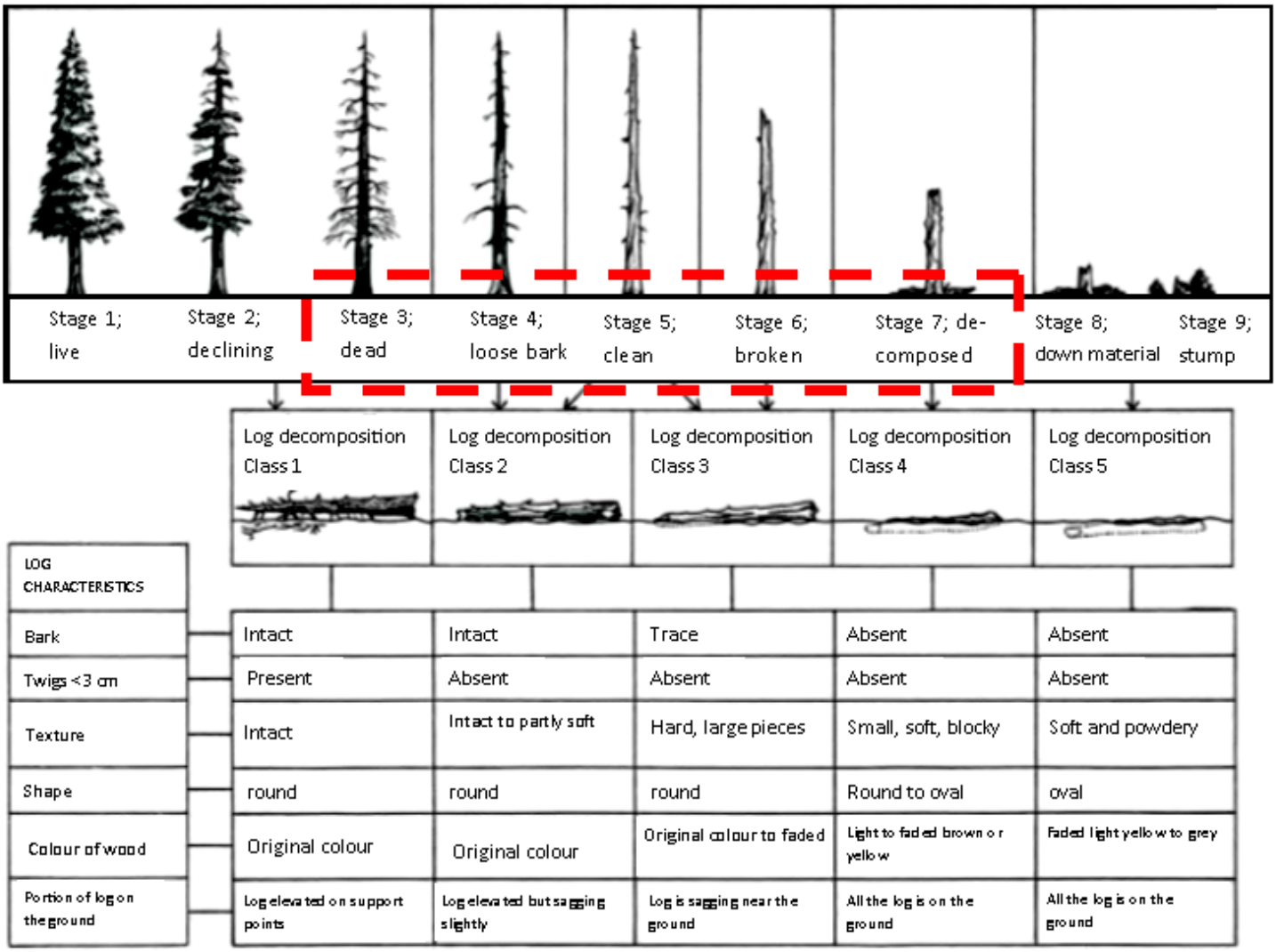
14.6 Standing deadwood

During the assessments of mensuration plots all trees are recorded as either alive or dead (see Annex WW for all data fields). If the tree is dead then additional fields are required. The decay class for dead stems ≥4 cm DBH is recorded (see Figure 14.1) and the option which best describes the cause of death (see Annex WW).

14.6.1 Standing deadwood height

The surveyor should estimate the height of any dead tree to its actual top (whether snapped or not) without adding any snapped tops to the height.

Figure 14.1 Decay classes for standing, lying deadwood and stumps



The above diagram has been taken from Hunter (1990) Wildlife, Forests, And Forestry, Prentice Hall, New Jersey. Decay classes used to describe standing deadwood are indicated by the red dashed box.

14.7 Sample trees

Once all the trees in the plot have been mapped, a maximum of three stems (where available) for each storey present within the plot are designated as sample trees. The largest DBH tree per storey is designated as the Dominant sample tree and is manually selected. The 2nd and 3rd sample trees are randomly selected by the software on command. Data collected for sample trees is: height, DBH, crown diameter, conifer stem straightness (for conifer stems at least 14 cm DBH) and broadleaf timber height (for stems at least 20 cm DBH).

14.7.1 Dominant height trees

A Dominant height tree is the largest DBH tree within its storey within the plot and, preferably, non-leaning. If there is more than one candidate dominant tree per storey, select the one closest to the plot centre. For each dominant height tree total height, timber height (if a broadleaf ≥20 cm DBH), conifer straightness (for conifers ≥14 cm DBH) and crown width is assessed.

14.7.1.1 Remeasure square: dominant height tree

In remeasure plots the dominant height tree can change from cycle to cycle as the diameters of the trees within the plots change. Where the DBH of a dominant height tree from the previous cycle is now less than another tree within the plot of the same storey the Dominant height tree must be changed (the original Dominant may become a new 2nd or 3rd sample tree if one of these has become the new Dominant tree) and the new largest DBH (in that storey) tree becomes the Dominant height tree.

14.7.1.2 Windsnapped and dead trees

Windsnapped and dead trees should never be used as the dominant height tree.

14.7.1.3 Leaning trees

If the dominant height tree is excessively leaning then a non-leaning replacement tree, within the same storey, with an equal, or next smallest DBH should be selected as the dominant height tree in the plot. The software will not validate if a leaning tree is chosen as the dominant height tree and there is a non-leaning tree available within that storey within the plot. If the only tree available to use as the dominant tree height sample is leaning, then the largest DBH tree within that storey is selected even though it is leaning. A warning sign will appear in the software to let the surveyor know that they have chosen a leaning tree as a dominant height tree. The 'Yes' box on the above warning pop-up should be clicked if there are no non-leaning trees available to be a dominant height tree. The 'Excessive Lean' box in the software for the dominant height tree should be set to 'Yes'. Height measurement is the vertical height of that tree. See the document on assessing height trees in the Mensuration Assessments sub-folder in the Additional Documents folder for how to assess leaning trees.

14.7.2 2nd & 3rd sample trees

Once the dominant height tree has been designated, the field software will auto-assign randomly, from the other trees that have been mapped in the plot, the 2nd and 3rd sample trees for each storey. For each of the sample tree, total height, timber height (if a broadleaf ≥20 cm DBH), conifer straightness (for conifers ≥14 cm DBH) and crown width is assessed.

Accept the software selection (or last cycle sample tree in a remeasure square), unless this places sample trees of the same storey within the same coppice stool or shared

rootstock. In this instance, change the 'non-permitted' Height Tree back to a Normal Tree and manually select a replacement from the remaining trees within the plot using the '3rd nearest' rule (see 3rd nearest neighbour). Do not look for height trees outside the plot. Sample trees of different storeys can be on the same coppice stool or shared rootstock.

If there are insufficient trees within a storey inside the plot to designate the 2nd and 3rd sample trees, then 2nd and 3rd sample trees are not assessed in that plot (i.e. the surveyor should NOT uses tree outside the plot). The surveyor should make a note that the 2nd and\or 3rd sample trees are not present under 'Note' at the circular plot level in the software.

14.7.2.1 Manually designating sample trees: 3rd nearest neighbour method

If the surveyor needs to manually assign a 2nd or 3rd sample tree or a sample stump (see stump assessment Chapter 15) then the 3rd nearest neighbour method should be used. This means for the 2nd sample tree, select a normal tree of the same storey that is the third nearest to the dominant height tree within the plot. For the 3rd sample tree, select a normal tree of the same storey that is the third nearest to the 2nd sample height tree within the plot.

14.7.2.2 Remeasure square: 2nd and 3rd sample trees

The surveyor should assess the 2nd and 3rd sample trees that were designated and assessed in the previous survey. If this is not possible (i.e. the tree has been felled) then the surveyor should use the software to assign designate tree.

14.7.2.3 Dead trees

Dead trees should never be used as the 2nd or 3rd sample height tree.

14.7.2.4 Leaning and windsnapped trees

Generally, a leaning or windsnapped tree should not be nominated as a 2nd or 3rd sample tree for mensuration purposes. The software will not auto-assign leaning or snapped trees but in rare circumstances the surveyor may choose to manually.

If the square is a remeasure the where possible leaning or snapped sample height trees should be replaced with non-leaning or unsnapped trees. In the software, convert the tree type to normal for the leaning or snapped sample trees and auto-assign new sample trees.

If the 2nd and\or 3rd sample height tree candidates are leaning or snapped within the circular plot and there are no non-leaning or unsnapped replacements present within the plot, then non-leaning or snapped replacements should not be sought from outside the plot.

If the surveyor has no other options (i.e. there are no non-leaning or unsnapped trees available) and a sample height tree is leaning or is snapped, then the appropriate 'Excessive Lean/ Windsnapped' box in the software should be set to 'Yes' and the tree assessed as normal. Height measurement is the vertical height of that tree. See the document on assessing height trees in the Mensuration Assessments sub-folder in the Additional Documents folder for how to assess leaning trees.

A table detailing the data fields for tree records (inc. normal trees and sample trees) can be found in the Annex YY and ZZ, respectively.

14.8 Coppice tree records

In the software the coppice stems need to be associated/ attached with the coppice stool. To assess a coppice stool diameter the surveyor should use a DBH tape at ground level to assess the diameter of the coppice stool. For more detail on how to assess a coppice refer to chapter 18. A table detailing the data fields for coppice tree records can be found in the Annex AAA.

14.9 Multi stem tree records

Multi-stem records are treated in the same way as coppice records in terms of recording the information in the software.

14.10 Burnt trees and circular plot assessment

If a burnt area, defined as where more than 80% of the trees have been destroyed by fire, is expected to revert to woodland within 10 years it is classed as NFI land where it forms part of an NFI Woodland polygon. Where a burnt area forms all or part of an NFI land with trees section, the field software creates a mensuration circular plot assessment. However, the software also treats the burnt area as land without trees. Sections without trees (NFI and non-NFI) do not require a mensuration assessment. Therefore, there is no requirement to collect mensuration data for any areas classified as burnt (PBU).

15 Circular plot: stump assessments

15.1 Introduction

Mensuration plots are assessed within all accessible NFI sections with trees once the section boundaries mapped. For each NFI section with trees that is deemed accessible, or visually assessible, the surveyor is required to carry out full or abbreviated plot assessment (see Table 13.1). One element of the full plot assessment is the stump assessment. Other full plot assessments include the young tree assessment (Chapter 16), tree assessment (Chapter 14) and lying deadwood (Chapter 17).

Stumps can occur in any woodland, but they are most commonly associated with areas of clearfell or thinning. Where stumps are present in the circular plot the surveyor is expected to count the total number of stumps that are present, map two stump locations and record attributes within the field software. Where coppice stools are present the surveyor should assess to the outside of the stool and not individual stems connected to it.

15.2 Aim

The aim of this chapter is to describe the stump assessment protocol.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

15.3 Stump assessment: new square

If the square is being assessed for the first time a stump count is undertaken for each circular plot within each section. The number of stumps within a plot is recorded in the software. Attribute data is collected for two stumps within the plot and their positions mapped. Attribute data includes; number of stumps, size of sample stumps, decay class, species category, observations on good felling practice. The first stump to be mapped and recorded should be the one nearest the plot centre. The second stump to be mapped and recorded is the 3rd nearest to the plot centre.

15.4 Stump assessment: remeasure square

The general rule when assessing remeasure squares is to maintain continuity between previous assessments and the current survey. A key aim for the NFI is quantify change over time, therefore the current surveyor is expected to locate the existing plot

locations. Providing the plot is still accessible the surveyor should count the number of stumps present in the plot and compare this to the number that were previously recorded. If the two counts are different the surveyor should remove or add sample stumps as appropriate. If a lone tree recorded in the previous survey has since been felled, keep the tree record and change the type to 'stump' in the software. Remeasure squares require the two sample stumps that were previously assessed and mapped to be reassessed in the current survey. The attribute assessment includes; number of stumps, size of sample stumps, decay class, species category, observations on good felling practice.

15.4.1 New clearfell

If clearfell sites have occurred since the previous cycle, the surveyor is required to map each tree that has been felled and is now a stump. To record this in the software the surveyor can either press the 'fell all' button or manually change the 'type' field to 'stump' against each tree. It is important to maintain continuity between the tree and stump records. To achieve this, the surveyor will need to convert the 'once' standing trees to felled stumps by changing tree type to 'stump'. To do this automatically, right click on the tree folder in the plot layer and choose the 'Convert all trees to stumps' option. At the circular plot level all trees will be converted to stumps and the 2 sample stumps auto-allocated.

The system will create stumps accordingly; setting most to 'normal' stump type (which have no attributes to measure or record) and the system will then select two sample stump locations within the plot. The surveyor will need to measure and attribute the sample stumps accordingly.

If a stump from the previous survey already exists (for example from a previous thinning) this will also be included as a candidate for selecting the sample stumps. If the sample stump from the previous survey has been removed on the ground or has decayed away, delete that from the plot, recording the reason for change and choose another stump and use that as a sample stump.

15.4.2 Thinning

Stumps from the previous survey will be recorded against the count at plot level (field will be called 'Previous Survey Stump Count' and will be non-editable). Where no trees have been thinned or felled since the last survey create and map one new stump and map its location so that two sample stumps exist – measure and attribute accordingly.

The surveyor should count the stumps and record their count against the 'Point Stump Count field' at the point level.

Where trees have been thinned / felled since the previous survey you need to observe and record this. It is important to maintain continuity between the tree and stump records. To achieve this, the surveyor should convert the 'once' standing trees to felled stumps by changing tree type to 'stump'.

The surveyor should not delete tree records then create new stump records, this will break continuity in assessment and will take you more time. The system will select two stump locations within the plot, measure and attribute these accordingly. Any 'old' stumps not recorded in the previous survey through surveyor error should be created now and mapped and the value of 'surveyor error' added against them.

15.5 Number of stumps

A stump is defined as a part of a tree stem that still has roots attached to the ground, is less than 1.3 m in height, and has no visible live shoots. Minimum diameter of the stool or stump is 4 cm. All stumps that meet these criteria should be included in the count. In the field if there is some ambiguity over whether a stump is still a stump (e.g. a moss-covered mound) surveyor discretion should be used.

15.6 Size of the sample stumps

The height and diameter of the two sample stumps from each circular plot should be recorded. The height is the average height of the stump (on a slope assess mid-way up the slope). The diameter should be the measured north to south and east to west on the stump. If there is vegetation obscuring the stump then the surveyor may estimate the diameter as it important not to disturb or remove the vegetation.

15.7 Felling practice

Where thinning or felling has occurred, observations on good felling practice should be recorded. The surveyor should assess the stumps to ascertain if good felling / silvicultural practice was applied at time of felling. This information will be used as an indicator of potential illegal felling by 'amateur' operators (i.e. signs of bad felling practice observed). Illegal felling who are generally after firewood. This is a recent phenomenon driven by the increase in fuel prices and many woods are being damaged by exploitative and unregulated felling, often by people who are not trained or schooled within the woodland management sector.

15.7.1 Signs of bad felling practice

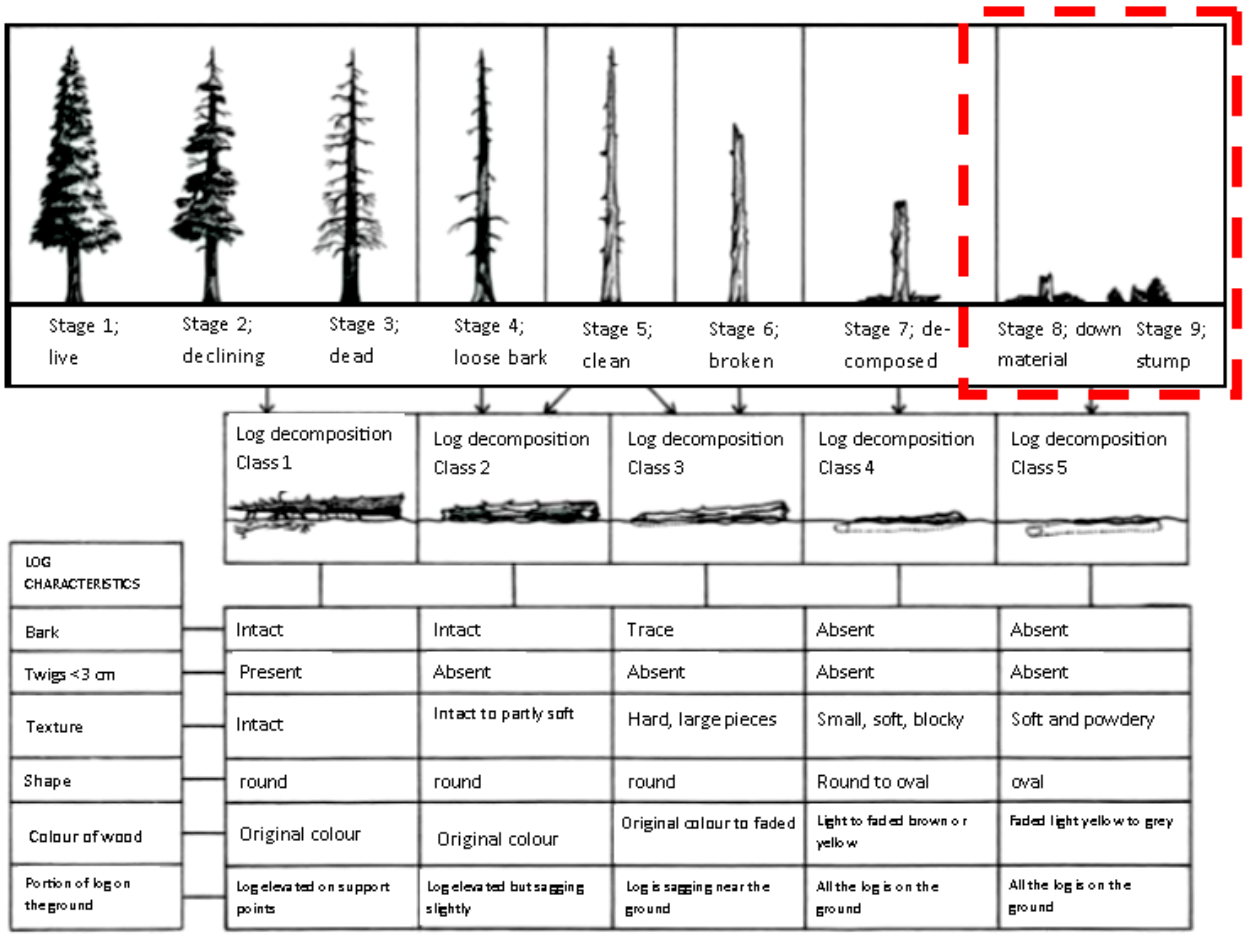
- Stumps without felling hinges or 'mouth' cuts.
- Felling hinges which have broken unevenly - with long or wide 'spikes' of timber protruding.
- High stumps (unless processor harvested).

- Several 'hacking' chainsaw cuts as opposed to one smooth back cut (or two even cuts in larger trees).
- Felling by axe or another blade.
- Removal of whole tree by pulling or pushing with an excavator or tractor.
- Contextual evidence should also be considered:
  - Excessive skimming of tree bark on remaining trees.
  - Erratic or poor choice of tree removal in terms of good silviculture.
  - Scale of operation (two or three trees taken within a stand leaving 'hacked' stumps, is unlikely to be a planned operation).

15.8 Decay class

The surveyor is required to record the decay class of the two sample stumps within each plot. The decay class for stumps is either 8-9 (see Figure 15.1).

Figure 15.1 Decay classes in standing, lying deadwood and stumps



The above diagram has been taken from Hunter (1990) Wildlife, Forests, And Forestry, Prentice Hall, New Jersey. Decay classes used to describe stumps are indicated by the red dashed box.

15.9 Species category

The surveyor s required to record the broad species category of the two sample stumps as either spruce, pine, broadleaved or other conifer.

15.10 Data entry

Details of the stump data fields can be found in Annex BBB.

16 Circular plots: Young Tree Assessment

16.1 Introduction

Mensuration plots are assessed within all accessible NFI sections with trees once the section boundaries are mapped. For each NFI section with trees that is deemed accessible, or visually assessible, the surveyor is required to carry out a full or abbreviated plot assessment (see Table 13.1). One element of the full plot assessment is the young tree assessment. Other full plot assessments include the stump assessment (Chapter 15), tree assessment (Chapter 14) and lying deadwood (Chapter 17).

Young trees are defined as all trees that are <4 cm DBH and are divided into one of three classes:

- [1] Pre-mensuration trees: any tree with a DBH of 4 cms to 6 cms inclusive.
- [2] Saplings: any tree >50 cm tall and <4 cm DBH.
- [3] Seedlings: any tree <50 cms tall.

The Young Tree Assessment involves separate assessments of Pre-mensuration trees, Saplings and Seedlings.

During the first cycle of the NFI survey young trees were assessed using transects in all mensuration plots. The methodology in the second cycle changed and young trees were assessed using transects in mensuration plots 1 (for continuity and comparison) and concentric circular plots in mensuration plots 2 and 3 (where present).

In summary, the present situation regarding transect and plot assessments is:

An original mensuration plot 1 in any section existing from the 1st cycle - All three types of Young Tree Assessment are done on a transect within the plot.

Mensuration plot 1 in a new square 2nd cycle onwards, or a new section in a remeasure square 2nd cycle onwards - All three types of Young Tree Assessment are done within smaller, concentric circular plots sharing the same plot centre as the mensuration plot

Mensuration plots 2 (and 3) in a new square 2nd cycle onwards, or a new section in a remeasure square 2nd cycle onwards, or original mensuration plots 2 (and 3) in an original section in a remeasure square 2nd cycle onwards – All three types of Young Tree Assessment are done within smaller, concentric circular plots sharing the same plot centre as the mensuration plot

If saplings or seedlings are recorded in a mensuration plot, then each species (along with any browsing or fraying activity) should also have a corresponding component of saplings or seedlings at component level within the section.

If Pre-mensuration trees are recorded in a mensuration plot, then these must be accounted for (along with any browsing or fraying activity) within a storey other than a sapling or seedling storey as appropriate. For example, upper, middle, lower, or complex storeys.

16.2 Aim

The aim of this chapter is to describe the methodology used for the young tree assessments and how to record data and observations in the field software.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

16.3 Young tree assessment: new square

If the circular plot is accessible, then the surveyor is expected to conduct a full plot assessment including the young tree assessments.

16.4 Young tree assessment: remeasure square

The general rule when assessing remeasure squares is to maintain continuity between previous assessments and the current survey. A key aim for the NFI is quantify change over time, therefore the current surveyor is expected to locate the existing plot locations. Providing the plot is still accessible a young tree assessment is conducted as part of the full plot assessment.

16.5 Young tree transects and plots

The Young Tree Transect is a 10 metre long transect in a north\south orientation that runs through the plot centre. Five metres of the transect are north of the plot centre, five metres are south (see fig 16.1) **The assessment is always done starting from the north and moving southwards.**

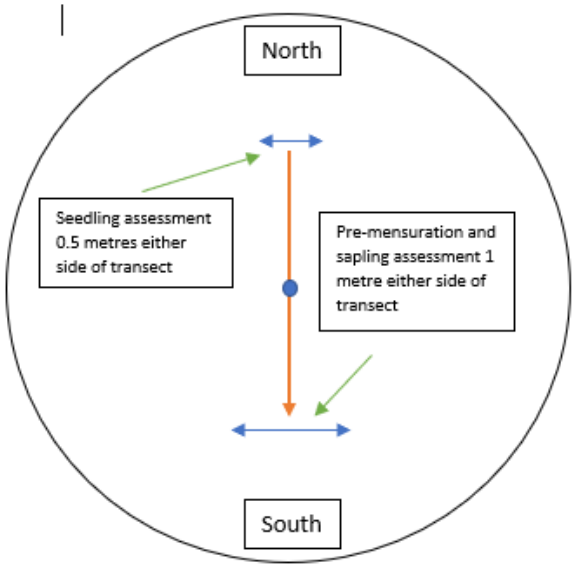
To determine the position of the transect start point 5 metres north of the plot centre, the surveyor should use either the transponder and Vertex to measure the distance or a loggers' tape attached to a pole in the centre of the plot. A compass should be used to determine the position due north of the pole by sighting 180 degrees south in line with the pole. In order to maintain the correct bearing moving southwards the surveyor should identify a feature beyond the plot that is in line with the start point and the pole in the centre.

Pre-mensuraton trees 1 metre either side of the transect are assessed and recorded as appropriate. Saplings are also measured 1 metre either side of the transect and recorded in their appropriate category. Seedlings are assessed 0.5 metres either side of the transect. Due to the need to maintain the correct bearing, observe the actual transect any trees occur within and count three categories of trees, it is good practice to use a notebook to record data whilst walking the transect rather than attempt to enter the data onto the Toughbook whilst doing the assessment. With practice, or where few trees are present, a surveyor may undertake all three assessments together in one walk of the transect.

The Young tree plots are smaller, concentric circular plots inside the circular plots used to collect the other mensuration data (see Figure 16.1). Young tree plots are divided into two sizes; 1.78 m radius to assess seedlings and 2.52 m radius to assess saplings and pre-mensuration trees (see Figure 16.1).

Within the software a new record should be created for each species. A full list of the data entry fields are in Annex CCC & DDD.

Figure 16.1 Schematics of transects and circular young tree plots within a circular mensuration plot.



The Young Tree Transect is 10 metres in length and runs through the mensuration plot centre at its mid-point of 5 metres.

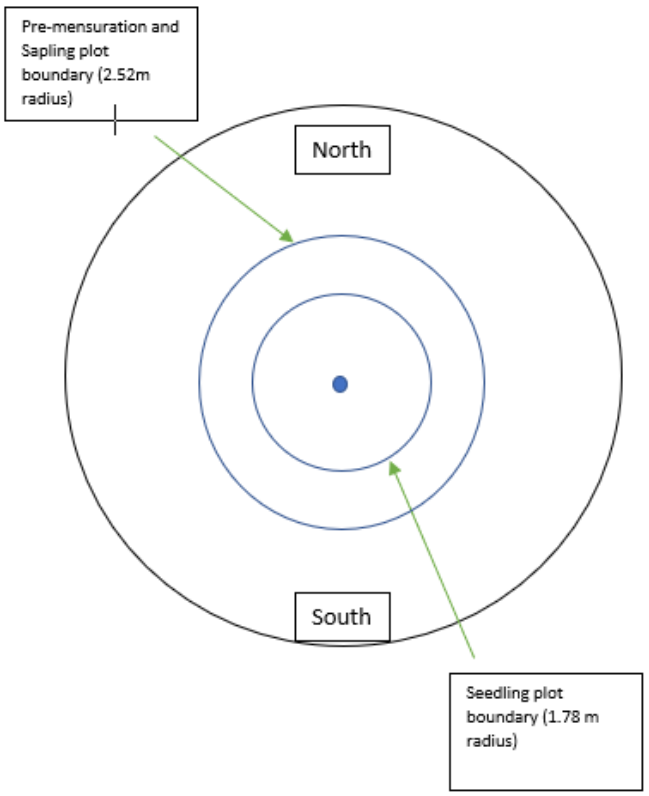
Assessment is always in a north to south direction.

The pre-mensuration, sapling and seedling assessments record tree species along the transect length with the different categories recorded within the segment they occur (e.g., 0-1 m, 1-2 m, 2-3 m, etc.)

The pre-mensuration assessment records trees within a strip 1 metre either side of the transect.

The sapling assessment records trees within a strip 1 metre either side of the transect.

The seedling assessment records trees within a strip 0.5 metres either side of the transect



The Pre-mensuration plot is a circular plot of 2.52 m radius

The Sapling plot is the same size as the Pre-mensuration plot - 2.52 m radius

The Seedling plot has a radius of 1.78m

16.5.1 How to set out the Young Tree Circular Plots

A quick and accurate way to set out the young trees circular plots is to use a pre-marked (at 1.78 m and 2.52 m) piece of non-elastic cord attached to the transponder pole as a pivot in the centre of the plot. Mark the start point (i.e. with a peg) and then, walking clockwise around the pole while keeping the string level and taught, count all the young trees as they fall under the string and record estimated planting year, species, browse class as apprppriate, and record any evidence of fraying.

16.5.2 Leaning trees

Leaning young trees are not counted if the location of the tree (i.e. centre of the base of the tree) is outside the plot area.

16.5.3 Coppice trees

The centre of the coppice stool (i.e. where the original seedling was deemed to be) must be within the plot to be included in the assessment. Provided the centre of the stool is inside the plot then all the stems on the stool should be included in the assessment. If the centre of the stool is outside the plot then all stems on the stool are deemed to be outside the plot and do not require assessment. Coppice stems are assessed individually and are counted if the root collar junction lies within the plot. Side branches on coppice stool stems are not counted as young trees. Low side branches on maiden-form trees stems are also not counted as young trees. Refer to Chapter 18 for more information on coppice trees and what is recorded as part of the field survey.

17 Circular plot assessment: lying deadwood

17.1 Introduction

Mensuration plots are assessed within all accessible NFI sections with trees once the section boundaries mapped. For each NFI section with trees that is deemed accessible, or visually assessable, the surveyor is required to carry out full or abbreviated plot assessment (see Table 13.1). One element of the full plot assessment is the lying deadwood assessment. Other full plot assessments include the stump assessment (Chapter 15), tree assessment (Chapter 14) and young trees (Chapter 16).

Deadwood is an important ecological feature of the forest environment. It provides food and habitat for a variety of flora and fauna as well as nutrients for the soil. It is also an important part of the carbon cycle. Assessing the decay classes of deadwood over a series of survey cycles means that the NFI can gain a greater understanding of decay rates for different types of tree species in differing climates and forest habitat. Data and observations on deadwood contribute to analyses of decay rates and inform carbon accounting.

The lying deadwood assessment consists of a single 10 m transect per circular mensuration plot.

Lying Deadwood is dead, woody material from trees that has not been processed (e.g. branches or stem-wood) that are ≥7 cm diameter where the transect line crosses it (Coarse Woody Debris, CWD). Fencing posts etc. are not counted as lying deadwood.

17.2 Aim

The aim of this chapter is to describe the methodology for the lying deadwood assessment and how to record data and observations in the software.

Details of how to use the field software is provided in a separate series of videos that are available on request and can be used alongside this document to understand how to input the field and data observations. Where the text refers to 'data fields' these are referring to the data fields options in the software and are useful to understand what is being recorded.

17.3 Lying deadwood assessment: new square

If the circular plot is accessible, then the surveyor is expected to conduct a full plot assessment including the lying deadwood assessment.

17.4 Lying deadwood assessment: remeasure square

The general rule when assessing remeasure squares is to maintain continuity between previous assessments and the current survey. A key aim for the NFI is quantify change over time, therefore the current surveyor is expected to locate the existing plot locations. Providing the plot is still accessible a lying deadwood assessment is conducted as part of the full plot assessment. A deadwood assessment in remeasure squares carried out in the same way as for a new square.

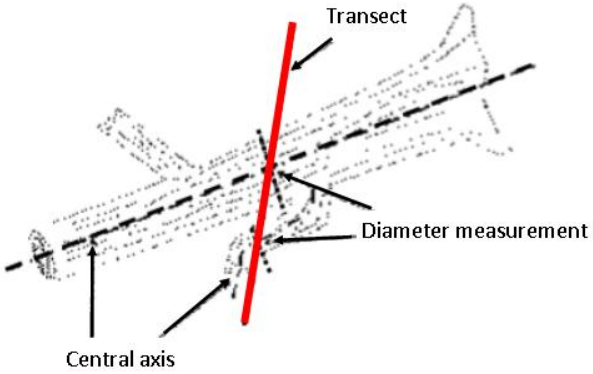
17.5 How to set out the transects and carry out the lying deadwood assessment

At each circular plot a lying Deadwood transect should be conducted. Deadwood transects are assessed along a 10 m line running 5 m north of the plot centre and 5 m south of the plot centre. The following observations should be recorded in the software; presence of deadwood, type of deadwood, percentage of the transect that falls outside the section, diameter and decay class. A table detailing the data fields recorded in the software can be found in Annex DDD.

17.5.1 Forked or stack/ piles of deadwood

Where forked deadwood intersects the transect line at more than 1 point, measure all diameters where they intersect the transect line (see Figure 17.1). Only assess deadwood within the section. Where there is a stack/pile of deadwood, measure those pieces that the transect crosses which are safe to assess and estimate any remaining pieces of deadwood. Do not dismantle the stack/pile. Where a transect line runs along a length of deadwood assess the diameter mid-way along that part of the transect that coincides with the deadwood length.

Figure 17.1 Deadwood transect crossing a forked log



Where forked deadwood intersects the transect line at more than 1 point, measure all diameters where they intersect the transect line

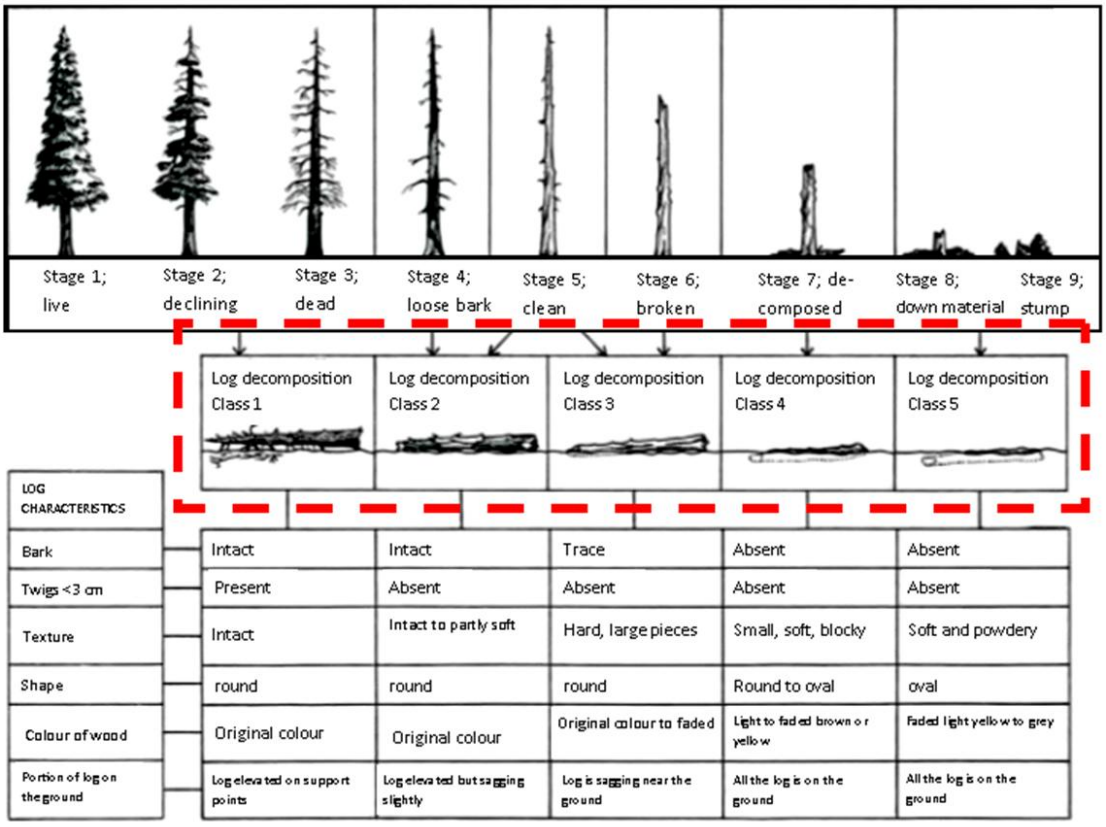
17.6 Deadwood type

Each piece of deadwood is required to be attributed a type or cause. Three broad categories are offered in the field software: fallen, windblow and harvesting debris. Fallen is generally associated with trees or branches than have died at some point and that have eventually fallen to the ground. Windblow includes material such as branches, tops, or whole trees that appear to have been dislodged by wind. Harvesting debris will include branches, tops and stem material that appear to have arisen from harvesting operations.

17.7 Decay class

The surveyor should record the decay class for each piece of lying deadwood (coarse woody debris; CWD), see Figure 17.2.

Figure 17.2 Decay classes for standing, lying and stumps



The above diagram has been taken from Hunter (1990) Wildlife, Forests, And Forestry, Prentice Hall, New Jersey. Decay classes used to describe lying deadwood are indicated by the red dashed box. Decay classes for log decomposition 1 = bark intact, 2 = bark loose or sloughing off, no sapwood degradation, 3 = no bark, some sapwood degradation, 4 = no bark, considerable sapwood degradation, 5 = sapwood and heartwood degradation.

18 Coppice

18.1 Introduction

Coppicing is probably the earliest form of structured silvicultural management and relies on the ability of many species of tree to regenerate from cut stumps or 'stools'. It primarily involves cutting either a tree or existing coppice stool to encourage re-growth from the freshly cut stumps to produce many small stems per tree or coppice stool. The many stems are in turn harvested on regular short rotations to produce timber material in smaller, shorter and narrower dimensions than standard even aged silviculture. These smaller materials are for uses such as hurdling, wicker work, firewood, wattle and daub, etc. This silvicultural technique produces many smaller wood products than the equivalent high forest silviculture an it also produces these wood products faster than high forest silviculture.

Historically, due to the small dimensions of the material harvested it was easy to harvest. Furthermore, in the ages without metal cutting tools or machinery, harvesting small wood products overcame the challenge of felling and processing large trees as coppice products were already the required size for use without the need for any processing. Therefore, a coppice stand will evident by the presence of many multi-stemmed trees, growing from an older larger stump, without a single dominant bole or stem. They will also have a lower canopy height than average. This tree form may be for all or a high proportion of the trees on the site.

Most of our native broadleaves, plus a few exotic conifers such as Coast Redwood, will coppice. The length of the period between cuts varies depending upon species, the site and the produce required. Common species used for coppice are hazel (especially so on chalk), ash (on calcareous and clay soils), hornbeam (on the heavier more acidic soils of the south east), sweet chestnut on the more freely drained of the latter soils and oak on more acid soils. A variety of other species, such as birch can occur in mixtures throughout Britain.

Another characteristic of coppice sites is that coppice was often practiced on a smaller scale than traditional high forest felling silviculture, with many small felling and re growth coupes (less than 0.5 ha) in close proximity to one another. The smaller coupes helped to supply relatively small amounts of the smaller materials in a continuous fashion. This was advantageous as many of the products used were necessary for day to day life in the communities of the past and with such were often situated close to where people lived. Such sites are often associated with wood banks, charcoal platforms and tracks. In the more recent past of the industrial revolution coppice was used to supply early industry and can often be found associated with industrial archaeology.

With the advent of metal tools and machinery there is less effort involved in processing small dimension products from large dimension timbers. Also with the advent of new materials such as plastics there is a lower demand for small dimension woody materials from society. These factors combined have played a large part in the decline of coppice as a silviculture system and has left most of our coppice stands in neglect or decline and in the process of evolving into high forest. This background is a highly relevant factor when assessing the nature and condition of the coppice areas.

There are two main types of coppice silvicultural practice:

- Simple
- Coppice with Standards

18.1.1 Simple Coppice

An even-aged, single-storey crop generally grown for fuelwood and/or medium or small sized produce.

18.1.2 Coppice with Standards

In many coppice woodlands a proportion of trees are grown to timber size with the coppice as an understory. Or, alternatively a different species to the coppice crop is planted which is encouraged to be grown to a high forest tree. Such trees are called 'standards' and can occupy a small or large amount of the stand, but often occupy around 30-40% of the area. The standards are widely spaced so that their crowns are not touching, allowing plenty of light to the coppice crop below. The standards can be of various ages and in traditional 'textbook' systems should consist of three to six different age classes. As noted they may be of a different species, e.g. a coppice storey of hazel, with standards of oak.

18.2 How to tell if a Multi-stemmed Tree has been Coppiced

Coppicing follows a cycle, see Figure 18.1. Stems are cut close to the ground and new shoots are grown from the resulting stump. These are, in turn, harvested for specific products and the stump regenerates another crop of shoots.

Figure 18.1 The Coppice Cycle

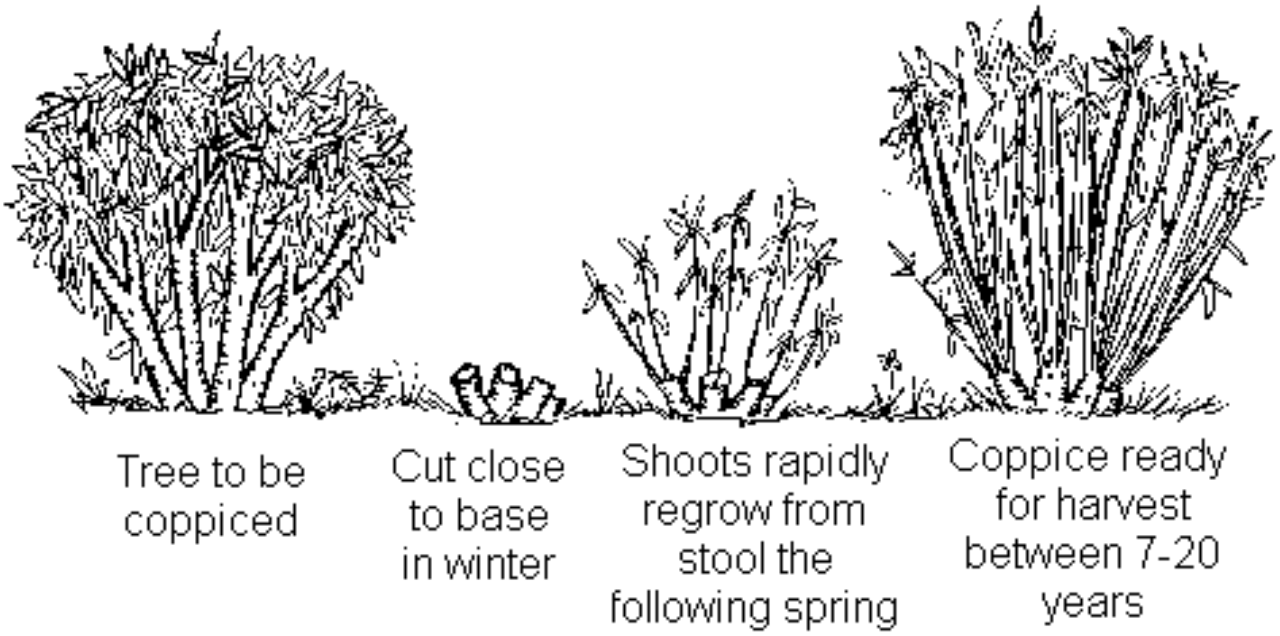


Diagram was taken from https://en.wikipedia.org/wiki/Coppicing

18.3 Distinguishing Between Worked and Stored Coppice

Maximum rotation length for coppice is considered to be 40 years but is generally less than this for most species. The exception to this is hazel, coppice can successfully be resumed even after a period of 60 years neglect.

Many coppice woodlands in Britain are well past their normal cutting cycle and have become 'overstood', neglected and are becoming a form of high forest. This process can be aided by the removal of all but the best stem (straightest and vigorous) from each stool. This operation is known as 'singling' and the stems grown on to form large trees are known as 'stored coppice'. The stand can then be treated as a normal forest for thinning, felling and other operations.

18.4 Recording Coppice within the NFI

Coppice is recorded at different levels within the sample square:

- As a landuse (component level)
- As a silviculture system (component level)
- As an observed operation (Management intervention – sub component level)
- And at the coppice stool level (in circular plots)

18.4.1 Landuse

As with all stratification of stands and allocation to a landuse (or use of land), the surveyor should identify the predominant use of that land. When classifying an area as coppice the surveyor should be looking to see if the area in question was established as coppice and was worked enough as coppice for that to have determined the stands overall character and structure. If there is evidence that the coppice past activity dominates the nature of the area, classify the area as coppice. Consideration of past activity is important because around 90% of coppice stands have now been abandoned or converted and past activity plays a large part in understanding a stands history and classification.

The surveyor is required to assess whether there is evidence that the coppice is a 'worked coppice' or an 'abandoned coppice' land use. A key indicator is to look for evidence of when the coppice was last cut. This varies with species and the objectives of the coppicing, but a general rule would be if it has not been cut for 6 to 10 years the surveyor should start to consider if it has been abandoned. How much 'beyond' ten years a crop has to go without cutting until it is a definite abandonment varies and some planned coppice techniques can involve coppice being grown for up to 40 years. A few broad guidelines would be if the following species are not cut within the following periods, it is becoming increasingly likely that the coppice is abandoned:

- Hazel 6-12 years
- Sweet Chestnut 12-16 years
- Oak 20 plus years (and less than 40)

There were around 230,000 ha of coppice in Britain in 1905; by 1997 it had fallen to less than 30,000 ha. If you find a stand with no signs of fencing, no operations of any form and is composed of hazel that has not been cut for 30 years it is most probably an abandoned coppice. However, an oak coppice stand grown to 20 years in a well-maintained wood, with evidence of other coppice cut at 20 plus years, is likely to be on a long rotation and is a worked coppice. The final classification is at the discretion of the surveyor.

18.4.2 Silviculture System

In addition to a landuse classification (i.e. worked or abandoned coppice), the surveyor is required to classify the type of coppice silvicultural practice that form the predominant silvicultural features of the site. For example, even if a coppice site has remained un-worked for 20, 30 or 40 years, the features that distinguish simple coppice from coppice with standards are likely still to be evident.

18.4.2.1 Coppice silviculture types

The following are coppice silviculture types:

- Coppice (or simple coppice) – all stools and stems broadly the same age

- Coppice with standards – coppice stools and stems forming an understory to high forest
- Short Rotation Coppice – energy crops, establish within the last few decades, cut on very short cycles (less than 7 years) and often composed of willows or hazel.

18.4.3 Management Intervention and observed operations

Once the landuse and the silviculture system have been identified, the surveyor will need to identify what, if any management operations are evident, ascertain their age and create a series of management intervention records to reflect the evident activity. For example, an abandoned coppice site, of simple coppice, may have been fenced and had game bird pens established within the last 3 years. Here you would need to create management interventions; one of 'fencing' and one of 'game birds' and classify each as 'less than 3 years'. Another example may be, a worked coppice, of simple coppice, may have been seen 'coppicing' in the last 3 – 10 years. Here create one manual intervention of 'coppicing' and classify that as Approx 3-10 years.

18.5 Component level data

18.5.1 Landuse

All coppice sites should be assigned either a 'worked coppice' or 'abandoned coppice' landuse (see above). Only when abandoned coppice sites have been abandoned or managed under a non-coppice regime for so long that their coppice origins do not dominate the character of the site should the site be classified as high forest.

18.5.2 Timber Potential

Worked coppice by its very nature is being managed to produce small roundwood; consequently timber potential will be short roundwood or fuelwood. Coppice which has become overstood or stored has the potential to produce timber in which case the normal rules based on the number of stems per hectare will apply.

18.5.3 Age of stem or age of stump or stool?

The age of stool should be assessed, not the age of stems.

18.5.4 Storeys

In a well-managed, simple coppice, a single stool will generally fall into one storey. In coppice with standards the standards will fall into one or more storeys. There are situations, especially in abandoned coppice where measurable stems within the same stool need to be assigned to different storeys, if they are sufficiently different in terms of canopy height.

For stools containing a mix of measurable and non-measurable stems, the measurable stems are assigned to upper/middle/lower/complex storeys, and non-measurable stems are assigned to the sapling or seedling tree storeys, even though they may be same height as measurable stems.

Stools/Ha (not stems/Ha). For stools containing a mix of lower storey and young tree storey stems, the stool is counted twice - once for the lower storey Component and once for the young tree storey Component.

18.5.5 Plot level

Coppice stools are mapped and coppice stems are recorded against each relevant 'parent' stool under the stool record. Multiple stems can be cloned and attached to a single stool.

Individual measurable stems are included in the count for deciding between circular plots or points. If the centre of the stool is within the plot perimeter then all stems are included in the plot, even those that lean outside. The same applies to the Young Tree Transect and plots.

Only one Height Tree of the same storey can be selected per stool. If the software auto-assign function selects two within the same stool, change one of the stems back to a Normal Tree and manually select a replacement using 3rd Nearest rule.

If a coppice stem is selected as a sample tree, it should be tagged with biotape if there are several of the same DBH (for QA purposes).

When doing crown heights and widths, measure just the foliage belonging to the selected Height stem.

18.6 Remeasure square: coppice

The surveyor is required to make an assessment of the presence and nature of coppice at the square. The current surveyor will be supplied with the landuse, silviculture systems and operations that the previous surveyor observed at the site.

The chapters on sectioning, storeys and component group allocation describe what to do if the current assessment is different to the previous surveyors' observations and there is evidence to suggest that the difference it is not due to real change. Points to consider:

- There is little ambiguity or subjectivity in interpreting a worked coppice site if it is operated under shorter rotations.
- Where rotations are longer discerning between abandoned coppice and worked coppice on longer rotation, becomes more of an art and there is some subtlety and subjectivity to discerning this. As a result, the surveyor may find

they disagree with the previous surveyor's assessment. In such instances, the current surveyor should exercise their discretion and record their observations even if they are different to the previous surveyors. In general, an abandoned coppice would have to have been not coppiced for over 20 to 30 years, singled, converted to stored coppice and been left to 'grow on' into high forest before a high forest classification should be applied. Crown closure would clearly signify completion of this conversion.

- Some surveyors can mistake naturally occurring multiple stemmed trees for coppice. A close observation of the stump for evidence of cutting should clarify this. If a mistake has occurred, then the current surveyor should correct as appropriate.

18.6.1 A cluster of stems not associated with their coppice stool

Occasionally the previous surveyor may have mapped a cluster of trees in the same area where a coppice stool sits, but the record has no coppice stool. This may occur because in the first year of the first cycle of the field survey the field software did not allow the surveyor to a coppice stool and associate coppice stems to the stool. In subsequent cycles of the survey provision has been made within the software to enable the surveyor to correct this. If a cluster of these 'orphan' stems is found, the surveyor should create a coppice stool at the centre of the tree cluster and assess the stool and attribute as normal within the software. Then right click on the coppice stool record and choose 'Attach existing trees as coppice stems'. The software will search for trees of the same species within 2 m of the stool and attach these to the stool as coppice stems. If the software misses some stems that should have been attached to the stool, the surveyor should go to each tree (in the software) and move its location to within two metres of the stool and re-run the attached utility.

19 Glossary

Word/phrase	Definition
Age class	A grouping of trees into specific age ranges for classification purposes. For the purposes of the "age distribution of trees" NFI WEC indicator, trees are grouped into three age classes: 0 – 20 years (Young); 21 - 150 years (Intermediate); >150 years (Old). For birch, cherry or Sorbus species: 0 - 20 years (Young); 21 - 60 years (Intermediate) >60 years (Old). Not applicable is used for stands without trees.
Ancient semi-natural woodland (ASNW)	Woodland which has been in continuous existence since 1600 (1750 in Scotland).
Area (forest/woodland)	Forest and woodland area can be defined in net or gross terms. Net area is the land actually covered by trees (in the National Forest Inventory that is to the drip line of the canopy). Gross area includes both the area covered by trees and the open spaces (<0.5 hectare) within (e.g. rides, glades, ponds).
Bark stripping	The removal of bark from trees by herbivores.
Biodiversity	Biodiversity represents 'all heritability-based variation at all levels of organisation, from the genes within a single local population, to the species composing all or part of a local community, and finally to the communities themselves that compose the living parts of the multifarious ecosystems of the world' (Wilson, 1997, p.1)
Broadleaves	Trees and shrubs that belong to the angiosperms (flowering plants) (as distinct from the gymnosperms that includes conifers). Most in the UK are deciduous and have laminar leaves (they do not have needles or cones) and a few, such as alder, have cone-like structures for their seeds which are not true cones. Sometimes referred to as 'hardwoods'.
Browsing	Herbivores feeding on tree buds, shoots and foliage.
Canopy	The mass of foliage and branches formed collectively by the crowns of trees.
Canopy cover	The percentage cover of the canopy across a defined area (e.g. NFI survey section or square).
Clear-felling	Cutting down of an area of woodland (if it is within a larger area of woodland it is typically a felling greater than 0.25 hectare). Sometimes a scatter or small clumps of trees may be left standing within the felled area.
Common Standards Monitoring (CSM)	The CSM approach was established during the 1990s by UK conservation agencies to describe the condition of protected sites, such as Sites of Special Scientific Interest (SSSI), in order to assess the effectiveness of conservation policies and practice.
Component (or sub-component)	Individual elements of the NFI survey component group. For example, each tree species will be recorded under a separate component, as will each habitat type if two habitats are intimately mixed (such as upland birchwood and wet woodland).
Component group	Homogeneous areas of the NFI survey that are too small (<0.05 ha) to practically map using Geographic Information System (GIS) software in the field, but with most of the same defining characteristics as a section. Component groups can be subdivided into components.
Condition	Shorthand for Woodland Ecological Condition.

Word/phrase	Definition
Conifers	Trees and shrubs that belong to the gymnosperms, as distinct from the angiosperms that include broadleaves). Conifers mostly have needles or scale-like leaves and are usually evergreen. Sometimes referred to as 'softwoods'.
Convention on Biological Diversity (CBD)	A multilateral treaty to develop national strategies for the conservation and sustainable use of biological diversity.
Crown dieback	The death of branches within a tree's crown.
Deadwood	Non-living woody biomass not contained in the litter, either standing or lying on the ground (the NFI 'volume of deadwood' indicator does not include data on stumps).
Diameter at breast height (DBH)	The diameter on the stem of a tree at 'breast height', defined as 1.3 m from ground level.
Drip line	The drip line is the furthest tip of the widest branch in the crown; the last point from which the tree can drip if wet. If two treed sections have drip lines that cross over each other use the centre line of the cross over.
Earth observation	The collection of information about the physical, chemical, and biological systems of the planet via remote-sensing technologies.
Ecology	The relations of organisms to one another and to their physical surroundings.
Establishment	The formative period that ends once young trees are of sufficient size that, given adequate protection, they are likely to survive at the required stocking. This varies for species and according to environmental condition, but is typically from around five to twenty years.
EU Habitats Directive	The EU Habitats Directive (Directive 92/43/EEC) aims to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on its Annexes to a favourable conservation status (JNCC, 2018).
(Vegetation) field layer	Vegetation 10 cm to 2 m tall measured as part of the NFI vegetation assessment.
Flora	The plants of a particular region, habitat, or geological period.
Forest (or woodland)	See woodland
Forestry Commission (FC)	The government department responsible for regulating forestry, implementing forestry policy and managing state forests in England. It was formerly also responsible for Forestry in Wales and Scotland, however on 1 April 2013 the Forestry Commission's functions in Wales transferred to a new organisation, Natural Resources Wales. From 1 April 2019, forestry was fully devolved, except for common issues addressed on a GB or UK basis, such as international forestry, plant health and forestry standards. Following devolution, two new Scottish Government agencies were created, Scottish Forestry and Forest & Land Scotland.
Forestry and Land Scotland (FLS)	The Scottish Government agency responsible for managing Scotland's national forests and land.
Fragments	Small areas of woodland with 50% or more native tree species occupancy in the upper canopy, but that fall in the size range 0.05 ha to 0.099 ha.

Word/phrase	Definition
Geographic Information System (GIS)	A system designed to capture, store, manipulate, analyse, manage, and present spatial or geographic data.
Global Positioning System (GPS)	A satellite-based global navigation satellite system that provides geolocation and time information to a GPS receiver.
Great Britain (GB)	England, Scotland and Wales.
(Vegetation) ground layer	Vegetation 0 – 10 cm tall measured as part of the NFI vegetation assessment.
Habitat Action Plan (HAP)	For all UK BAP priority habitats classified between 1995 and 1999, a Habitat Action Plan (HAP) was created (45 in total). For the habitats added to the priority habitats list in 2007, no UK action plans have been, or will be, produced, as conservation action is now primarily carried out at a country-level, rather than a UK-level, in response to the generation of country-level biodiversity strategies and aims (JNCC, 2019a).
Herbivore	An animal that is adapted to eating plant material for the main component of its diet.
Hectare (ha)	Unit of area defined as 10,000 square metres (100 m by 100 m), approximately equivalent to 2.47 acres.
Indicator	A quantitative or qualitative parameter that synthesises complex information and can be periodically measured to assess trends over time. 15 stand level indicators were selected to assess the condition of woodlands as part of the NFI WEC approach.
Invasive species	A species that is not native to a location, where it is likely to cause ecological or economic harm.
Invertebrate	A cold-blooded animal that does not have a backbone.
Lichen	A composite organism that arises from algae or cyanobacteria living among filaments of multiple fungi species in a mutualistic relationship.
National Forest Inventory (NFI)	National forest inventories are carried out in GB by the FC to provide accurate, up-to-date information about the size, distribution, composition and condition of the forests and woodlands. The current NFI, which began in 2009, is a multi-purpose operation that has involved the production of a forest and woodland map for GB and a continuing programme of field surveys of the mapped forest and woodland areas.
National Forest Inventory map	An earth observation-based programme that monitors and maps the extent and location of woodlands across GB on an annual basis.
National Forest Inventory field survey	A field survey of a large, stratified-random sample (15,100 sites) of woodlands across GB on a 5-year rolling cycle using a standardised protocol.
Native species	Species that have arrived and inhabited an area naturally, without deliberate assistance by man. For trees and shrubs in the United Kingdom usually taken to mean those present after post-glacial re-colonisation (around 11,000 years ago) and before historic times. Some species are only native in particular regions - hence locally native.
Natural England (NE)	The government's adviser for the natural environment in England. Natural England is an executive non-departmental public body, sponsored by Defra.
Naturalised species	A species that, once it is introduced outside its native distributional range, establishes self-sustaining populations.

Word/phrase	Definition
Natural Resources Wales (NRW)	The organisation responsible for advising the Welsh Government on the environment, created on 1 April 2013. NRW is responsible for the functions previously carried out by the Environment Agency in Wales, the Countryside Council for Wales and Forestry Commission Wales.
National Vegetation Classification (NVC)	Vegetation classification system commonly used in Great Britain.
Native woodland	Woodland with 50% or more native tree species occupancy in the upper canopy that either: - Forms a discrete woodland parcel with a minimum area of 0.5 ha. - Forms a woodland stand with a minimum area of 0.1 ha that is part of a woodland that is 0.5 ha or larger.
Native Woodland Survey of Scotland (NWSS)	A survey of all native woodlands, nearly native woodlands and non-native plantations on ancient woodland sites in Scotland.
Near native woodland	'Nearly' native woodland with 40% to 49% native species canopy cover.
NFI Condition Calculator	An analytical GIS tool developed to automatically produces the component group-level NFI WEC indicator results per woodland type and aggregated statistics for the reporting area.
NFI WEC working group	The expert committee that was established to develop the NFI WEC indicator approach. This group consists of representatives from (former) FC England and Scotland, Scottish Natural Heritage, Natural England, Natural Resources Wales and the Welsh Government.
Non-native woodland	Woodland with less than 40% native species occupancy.
(Woodland) parcel	Discrete blocks of woodland that are separated from other woodland parcels by gaps of at least 20 m in length.
Private sector estate	Forests and woodlands in the UK not managed by the Forestry Commission, Natural Resources Wales or Forest Service. In the context of the National Forest Inventory, 'Private sector' is used for convenience although it includes land owned or managed by bodies such as local authorities and charities.
(Natural) Regeneration	The regeneration of existing woodland by natural means, i.e. without sowing or planting.
(Ecological) resilience	The ecological resilience of woodland ecosystems refers to their ability to absorb disturbance while maintaining the major habitat-forming species that define their structure and ecosystem functioning. Resilience incorporates both the woodland ecosystem's ability to resist changes in response to disturbance or, failing this, its capacity to recover functioning via adaptation.
(NFI) sample square	The one-hectare (100 m by 100 m) square plots, which may be entirely within woodland or may overlap the woodland edge, used for the NFI field survey.
Sapling	Young tree ≥50 cm tall and <4 cm in diameter.
Saproxylic	Dependent on deadwood.
(NFI WEC) score	An ordinal score is assigned to the individual indicator classes of 'unfavourable' (1), 'intermediate' (2) and 'favourable' (3). The scores are summed for all 15 indicators to provide each stand's overall ecological condition score, which has a maximum value of 45.
Scottish Natural Heritage (SNH)	The public body responsible for protecting and promoting Scotland's natural heritage, especially its natural, genetic and scenic diversity. To be renamed 'NatureScot' from May 2020.

Word/phrase	Definition
Section	Within each NFI sample square, the forest was stratified into different woodland 'sections'. Sections are defined by individual strata at least 0.05 ha in size that are differentiated on basis of forest type, habitat, land use, silviculture system, tree and shrub composition, age and structure.
Seedling	Young tree <50 cm tall.
Shrub	Woody plants often (but not always) branching abundantly from the base that are between 2-5 m tall.
(Vegetation) shrub layer	Vegetation 2-5 m tall measured as part of the NFI vegetation assessment.
Site of Special Scientific Interest (SSSI)	A formal conservation designation that is applied to areas of particular interest to science because of the geology/geomorphology features or species it contains or supports.
(Woodland) Stand	A distinct area of woodland (from either planting or natural regeneration), generally composed of a uniform group of trees in terms of species composition and spatial distribution, and age and size class distribution.
Standard error (SE)	The measure of the margin of error associated with an estimate as a result of sampling from a population with statistical variability. Larger standard errors indicate less precision in the estimate. Standard errors in this report are quoted in relative terms (i.e. as percentages of the value of the estimate). In this report, any standard error greater than 25% is reported in amber italics and represents a lower degree of assurance in the estimates.
Stocking	The density of trees within a woodland.
Stump	The above-ground base part of a tree that would usually remain after felling.
Transect	A path along which a survey is carried out.
Transition woodland	Land classified as woodland area that is in transition between no tree cover and tree cover. Examples include clear-fell sites, restock sites, new planting sites and land with natural regeneration.
UK Biodiversity Action Plan (UK BAP)	The UK government's national biodiversity action plan that was developed in response to the Convention on Biological Diversity and replaced by the 'UK Post-2010 Biodiversity Framework' in 2012 following new international targets. It described the biological resources of the UK and provided detailed plans for conservation of these resources (JNCC, 2019a). The UK BAP priority habitats were identified as the most threatened habitats requiring conservation action under the UK BAP.
UK Forestry Standard (UKFS)	The reference standard for sustainable forest management across the UK that applies to all woodland to ensure that international agreements and conventions on areas such as sustainable forest management, climate change, biodiversity and the protection of water resources are applied in the UK.
United Kingdom (UK)	Great Britain and Northern Ireland.
Woodland (or forest)	Land predominately covered in trees (defined as land under stands of trees with a canopy cover of at least 20%, or the ability to achieve this, and with a minimum area of 0.5 hectare and minimum width of 20 m), whether in large tracts (generally called forests) or smaller areas known by a variety of terms (including woods, copses, spinneys or shelterbelts).

Word/phrase	Definition
(NFI) Woodland Ecological Condition (WEC)	The approach used by the NFI to assess the ecological condition of woodlands in GB in terms of their likely biodiversity value.
(Woodland) storey	A woodland's trees and shrubs can often be stratified into distinct layers, or storeys, according to their height.
Vertical (woodland) structure	The number of canopy storeys present.
Veteran trees	A tree that is of interest biologically, culturally or aesthetically because of its age, size or condition (Read, 2000)

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