Survey protocol for Woodland Carbon Code projects
Version 3.0
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Contents

Version Control

Version	Date	Amendment	Author
1.0	March 2016	--	Vicky West
2.0	March 2018	Minor clarifications	Vicky West
2.2.1	April 2024	Incorporating year 15 surveys and clarifying how to stratify your site. Adding screenshots and examples.	Vicky West
3.0	August 2025	Further clarifications on stratifying your site and calculating plot size on sloped ground.	Vicky West, Anna Brand, Phoebe Golden

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Introduction

This document sets out the survey protocol for most Woodland Carbon Code projects.

It summarises a subset of methods from the carbon assessment protocol and annex. Very large, small or hard-to-access projects may need to refer to the carbon assessment protocol for a more appropriate methodology.

For this survey, trees are divided into three categories which are treated differently:

Tree size category	Definition
Seedling	A living stem less than 50 centimetres tall.
Sapling	A living stem 50 centimetres or more tall and with a diameter at breast height (dbh) less than 7 centimetres.
Tree	A living stem with diameter at breast height of 7 centimetres or more.

Year 5 survey: The year 5 survey confirms the stocking density and health of seedlings and saplings in Woodland Carbon Code projects at approximately five years after planting.

Year 15+ survey: The year 15+ survey confirms the carbon stock in the tree biomass at a point in time, as well as tree health.

Year 10 survey where required: Where a project is classified as 'red' status at the year 5 verification and a year 10 assessment is required, the year 5 'stocking density' methodology should be used.

If projects choose to do a year 10 assessment as part of the Woodland Carbon Guarantee, the project developer may use either:

- The year 5 'stocking density' methodology if most stems are less than 7cm dbh or
- The year 15 'mensuration' methodology if most stems are 7cm dbh or greater.

Survey work can be summarised in three steps:

1. **Plan your survey**
    a. **Stratify:** Divide your site into sub-areas which are of similar makeup.
    b. Plot size: Decide how big your plots will be, based on planting density.

   c. **Plot number and location:** Decide how many plots you need, based on the size and variation of your strata, and decide where the plots should be located.
   d. **Get your survey plan checked by your chosen verification body.**
2. **Survey:** Go to the site and count/measure trees.
3. **Calculate:** Enter data into spreadsheet to work out planting density (year 5) or carbon stock (year 15+) and overall tree health.

You should carry out survey work during the growing season where possible to assess tree health more accurately.

The project developer should submit a project progress report and other verification documents to your chosen verification body once you have completed your survey work. See guidance on preparing and submitting documents.

1. Survey planning

1.1 Stratify

1. Locate your Woodland Carbon Code project map from validation. Ensure that the gross project boundary, planted or regenerating areas, open ground and existing woodland are clearly mapped. See mapping rules.

2. If your validation map did not include open ground, you should map and identify open areas greater than 0.25ha and exclude these from your strata. Where this is not possible, a greater number of sample plots will be required (see 1.3. Plot number and location) to compensate for the probability some plots will be located in areas of open ground.

3. Sub-divide the site into relatively uniform strata. This can be based on planting year, species, growth rates or stocking density. The variation within a stratum should be less than the variation between strata. Your stratification should divide the woodland into fairly uniform areas. The stratification at year 5 could differ from the stratification at year 15 or subsequent years.
   See an example in Figure 1.

   a. Natural regeneration should be separate from planted areas
   b. Mixed species stands may be considered as one stratum. Mixed species stands include those planted in an intimate mixture, or a row, line, group or mosaic mixture.
   c. Areas with variable planting density, for example native planting, may be considered as one stratum.
   d. Areas planted across a maximum of three planting seasons may be considered as one stratum.
   e. At year 15, conifers and broadleaves should be kept separate unless planted in a mixed species stand. At year 5, areas of conifers and

broadleaves may be combined with each other or with a mixed conifer-broadleaf stand if planted at the same density.

f. Areas of similar planting density (i.e. densities within 600 stems per hectare of each other) may be combined, except where conifers and broadleaves are already combined under e). Work out the average spacing and planting density using the calculator in the survey plan template. For example:
    a. You may combine broadleaved areas planted at 1,111 and 1,600 stems per hectare, but you should not combine broadleaved areas planted at 1,600 and 2,500 stems per hectare.
    b. You may combine a mixed conifer stand planted at 2,000 stems per hectare with a conifer area planted at 2,200 stems per hectare, but you should not combine a mixed broadleaved and conifer stand planted at 2,000 stems per hectare with with a conifer area planted at 2,200 stems per hectare.
    c. If you combine conifers and broadleaves at the same density under e), you should not subsequently combine this merged stratum with any area of a different density.

g. Regardless of guidelines a-f, any area that is up to two hectares and less than 5% of the project net area may be combined with the next most similar planting area.

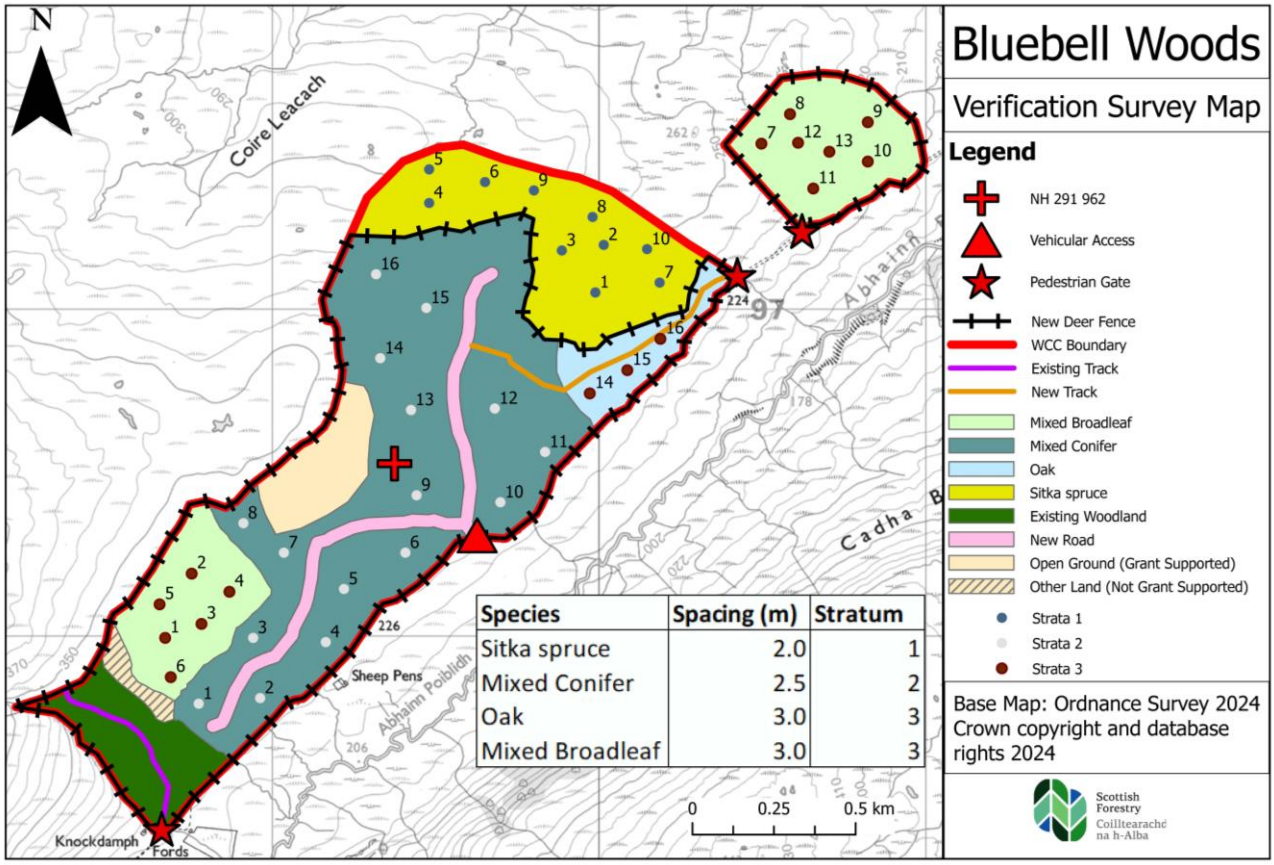
4. Decide whether the strata you have selected are ‘uniform’ or ‘variable.’ Strata with greater variability require more plots to obtain a precise survey result. A stratum would be considered uniform if trees were:

    a. Planted within three years and were of similar height (i.e. no more than 4m height difference) AND
    b. Single species AND
    c. Planting positions were evenly distributed (not clumped) AND
    d. (from year 15 onwards) dbh range is ‘normal’.

A stratum should be considered ‘variable’ if any of these criteria are not met. For example, native species planted in an intimate mixture should be considered ‘variable’.

Please refer to carbon assessment protocol and annex for further clarification.

Figure 1: Map of Bluebell Woods showing stratification into three strata, with oak and mixed broadleaves combined. They are similar yield class, the same spacing and less than 5% of the net woodland creation area.



Species	Spacing (m)	Stratum
Sitka spruce	2.0	1
Mixed Conifer	2.5	2
Oak	3.0	3
Mixed Broadleaf	3.0	3

Table 1: Stratification of Bluebell Woods

	Stratum 1	Stratum 2	Stratum 3	Stratum 4	Stratum 5	Total
Net area of each stratum (ha)	30.30	78.76	42.16			151.22
Unmapped open ground or unmapped existing woodland of each stratum (ha)			10.00			10.00
Gross area of each stratum (ha)	30.30	78.76	52.16	0.00	0.00	161.22
Percentage of unmapped open ground or unmapped existing woodland in stratum	0.00	0.00	19.17	#DIV/0!	#DIV/0!	
Uniform or variable?	Uniform	Variable	Variable	Select one	Select one	
Species	Sitka spruce	Mixed conifers (Douglas fir and larch)	Oak and mixed broadleaves			
Planned spacing (m)	2.0	2.5	3.0			
Planned stocking density (trees per ha)	2500	1600	1111			
Plot radius (m) if circular or length (m) if square	10.0	8.0	8.0			
Plot shape	Square	Circular	Circular	Select One	Select One	
Number of plots	10	16	19			

1.2. Plot size and shape

1. Table 2 shows the minimum plot size for a range of planting densities/spacing. Use the planned spacing to select the plot size for each stratum. Your plot should be large enough to include:

    a. At year 5: at least 20 live stems (seedling/sapling) or
    b. At year 15+: 7 to 20 trees greater than or equal to 7cm diameter at breast height

2. The **plot size and shape should not vary across a stratum**. When you get to site, the surveyor should ensure that the plot size chosen for a stratum will pick up 20 stems for the majority of the plots. If in doubt or you think the stocking density could be less in other areas of the stratum, choose a larger plot size which will be suitable across the whole stratum.
3. If your plot will not fit in your stratum boundary (e.g. your stratum is too thin for your plot) please contact the Woodland Carbon Code team for advice (info@woodlandcarboncode.org.uk).
4. In most circumstances circular plots should be used, as these are less likely to introduce bias. However, if you can clearly see the plant rows, you can use square plots. Plot shape should remain the same within a stratum but can differ between strata. For example, you might choose to use a circular plot for a native woodland stratum and a square plot for a regularly spaced Sitka spruce stratum.
5. Plot size and shape can vary between stratum if strata have different planting densities.
6. If the ground to be surveyed is on a significant slope (e.g. over 25 degrees), you may need to increase the plot size to account for the slope. Please see Annex 1 for advice on how to do this.
7. The seedling plot radius should remain the same for the whole stratum. If the density of regeneration varies within the stratum, choose a plot size suitable for the majority of the stratum. Where there are more than 60 seedlings in a stratum, stop counting after 60 and provide an estimate of the total number in the comment box.

Table 2: Alternative plot size and area

Planting density (trees per ha)	Greater than or equal to 3967	2000 to 3966	1006 to 1999	399 to 1005	200 to 398
Spacing (m)	Less than or equal to 1.59	1.60 to 2.24	2.25 to 3.15	3.16 to 5.01	5.02 to 7.07
Plot area (ha) which gives at least 20 locations per plot	**0.005**	**0.01**	**0.02**	**0.05**	**0.10**
Circular plot radius (m) which gives at least 20 locations per plot	4.0	5.6	8.0	12.6	17.8
Square plot length (m) which gives at least 20 locations per plot	7.1	10.0	14.1	22.4	31.6

1.3. Plot number and location

1. Decide how many plots should be assessed, based on:

    a. the area of the stratum.
    b. the variability of the stratum (see table 3).
    c. The extent of open ground or existing woodland and whether it is mapped or not.

Table 3: The minimum number of sample plots for uniform and variable strata, based on the size of each stratum and whether open ground or existing woodland is clearly mapped.

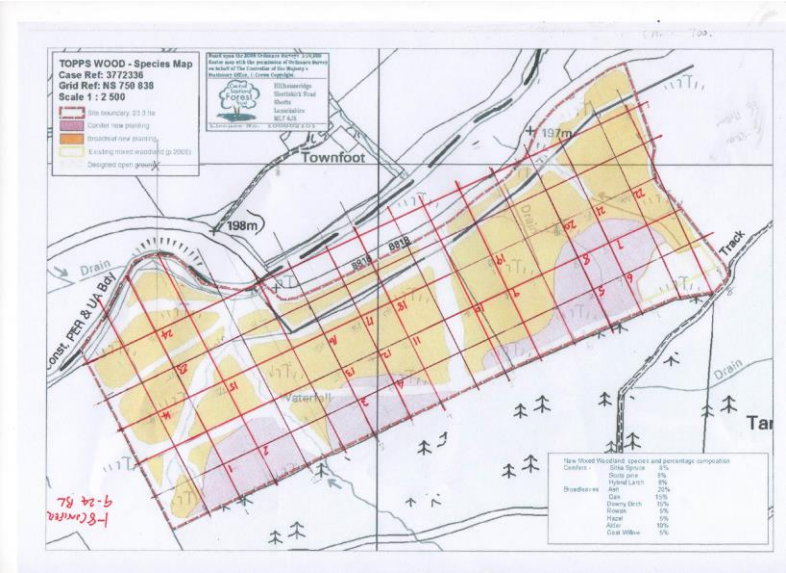
Net area of stratum	Uniform stratum	Variable stratum – open ground and existing woodland mapped	Variable stratum – open ground or existing woodland is less than 20% and not mapped	Variable stratum – open ground or existing woodland is over 20% and not mapped
Less than 0.5 hectares	4	6	7	8
0.5 to 2.0 hectares	6	8	9	10
2.0 to 10.0 hectares	8	12	14	16
Over 10.0 hectares	10	16	19	21

2. If your project has unmapped open ground or existing woodland, adding more plots (see table 3 above) should ensure enough trees are measured, even if some plots fall in unplanted or low-density areas.
3. This is the minimum number of plots you are required to complete. If the variation within your stratum is high, increasing the number of plots (up to 30 per stratum) improves the accuracy and reduces the level of uncertainty in your results.
4. Plots should be randomly located across the relevant area. Plots could be selected by:
    a. placing a regular grid across the project area and selecting 'nodes' within the stratum (systematic random sampling, see figure 2) or
    b. by randomly selecting points throughout the stratum (figure 1).
5. When locating plots, remember:
    a. Plots should not be within 5m of the edge of a stand/the woodland.
    b. If you have combined two areas of different species or spacing, allocate the plots proportionally to make sure both areas are well represented (e.g. if you have a stratum made up of 5 hectares at 2.5m spacing and 10 hectares at 3.0m spacing, ensure that one third of the plots are in the 2.5m spacing and two thirds of the plots are in the 3.0m spacing).

c. You should record the locations/grid references of each plot location before going to the site.

6. You should not change the location of your plots when you get on site.
7. Complete your 'Survey plan' (template available).

Figure 2: Example of plot selection for the Topps Wood project, which was made up of two strata – a conifer 'uniform' stratum (2 to 10ha) with eight plots and a broadleaved 'variable' stratum (10ha+) with 16 plots. In this case, the open ground within the project was clearly mapped.



1.4. Survey plan check

The survey plan must be checked by your chosen verification body before undertaking the survey. You should submit the following documents to your chosen verification body:

1. Your survey plan (template available).
2. Woodland Carbon Code map from validation, plus any update. For example, if you are able to update your map to show areas of open ground you can submit this in place of the validated map.
3. Carbon calculation from validation.
4. A plot map which clearly shows how the site is stratified and the location of plots within each stratum.

The verification body could ask you to re-survey if:

- You do not get your survey plan checked before you survey.
- Your survey plan was checked, but it was based on incorrect information.
- Your survey was not implemented according to the plan (allowing for practical adjustments made once onsite, e.g. it would be acceptable to choose to use a larger plot size if stocking density is not as good as planned).

2. Onsite: Setting up plots and photography

Use the template monitoring reports (see template documents). These contain:

- Template data collection sheets (which can be printed or completed using a suitable device)
- Plot sheets (year 5 survey)
- Summary sheet for stocking density, growth and health (year 5 survey)
- Seedling, sapling, and tree sheets (year 15 survey)
- Summary sheets for carbon stock and health (year 15 survey)

Before you head out to survey, make sure your survey plan has been checked by your chosen verification body.

2.0 Equipment you will need:

For all surveys, you will need:

- Map of the site with plot locations for each stratum indicated
- Sufficient blank template plot sheets (for year 5) or seedling/sapling/tree sheets (for year 15+), possibly printed on weather-resistant paper or loaded on a device suitable for outdoor use e.g. Toughbook.
- A Weather Writer or other waterproof clipboard if using paper sheets.
- A pencil or pen with waterproof ink.
- A tape or a cane marked at 0.1m intervals to assess tree height (including 1.3m for diameter at breast height measurements).
- A length tape (such as a 20 or 30 m logger's tape) suitable for laying out sample plots and measuring other horizontal distances.
- Rope to use to indicate plot radius.
- Spray paint or tape to mark central trees or plots.
- Compass and/or GPS device (Garmin, other GPS or smartphone) to help navigate to each plot.
- Camera/smartphone/smartwatch or GPS device which can record the location/eight figure grid reference of the plot. Smartphone apps such as 'OS Locate' or 'Grid Reference' will give the current location as 6, 8 or 10-figure grid reference
- A camera or smartphone camera with location-tagging capability. Most smartphone cameras and newer cameras have location-tagging capability and can tag a photo with its latitude and longitude.
- Painted stakes, canes or pegs to mark the location of plots (royal blue or white are effective).

For survey from year 15 onwards, you will also need:

- A rounded-down girth tape or tree callipers (for measuring tree diameters at breast height).
- A hypsometer or clinometer (for measuring tree height).

- Personal protective equipment: helmet with a visor or safety glasses if you are likely to be surveying in dense conifers.

2.1 Boundary and planting maps and 'whole site' site photographs

Before you go to site, if there are any changes to your project net area or the species planted, create a new map to confirm the actual planted/regenerating area. This should show any changes to the boundary, planted, regenerating or open areas and needs to be submitted as part of your verification documentation. Refer to the latest mapping rules.

From year 15 onwards, access the latest aerial photography (or other remotely sensed data) and overlay your original project boundaries to help you decide if the boundaries of the planted or regenerating areas should be updated.

There are a number of tools available to help with this task, which allow you to access aerial photography, including:

- England's Map Browser and Land Information Search
- Scotland's Land Information Search in Scotland's Environment Web
- Natural Resources Wales Interactive Mapper
- My Forest (you can upload an existing shapefile and overlay it on aerial photography)
- The Land App (access Bing imagery or Mapbox imagery)
- MAGIC
- Scotland's Environment Web
- Google Maps or Bing Maps (although aerial photography can be older).

When you are onsite: Where it is feasible, check that the boundaries on the ground agree with the mapped boundaries shown at validation or the most recent verification. Annotate any areas known to be left unplanted or which are now open/without trees for any reason.

Onsite photos: While onsite, take two or three photos across the whole site which are representative of the general site condition. Ensure location tagging is enabled and note which direction the photo faces.

2.2 Locating plots and plot photographs

1. Navigate to each plot location in turn, using GPS device/smartphone app or map and compass.
2. Do not move plots, as this will bias results. You should still complete a plot sheet even if there are no trees in the plot location.
3. Mark with a stake or peg the centre of a circular plot or south-west corner of a square plot, even if it does not contain any trees. It is also possible to mark the closest tree to the centre with spray paint/tape. If you do this, you should note on the survey sheet the distance and direction of the plot centre from the marked tree.

4. For each plot, stand at the stake/peg (centre of a circular plot or south-west corner of a square plot) and take a photograph.
    a. Ensure location-tagging is enabled.
    b. Record the time (to help with photo-to-plot matching) and the direction which the photo faces.
    c. It may be feasible to take all photos facing the same direction (e.g. all to the north). Also consider making the plot sheet visible in the very corner of the image so there is a record of the plot number on the photo.
5. If you have not recorded the location of the plot via photo location-tag, record at least an eight-figure grid reference using a GPS device or suitable app on your phone (e.g. OS Maps).
6. Use measuring tape or rope marked with common plot radius options as a ‘spoke’ to identify the edge of your plot. You could also use spray paint to mark the boundary of the plot.

3. Year 5 survey: measurement

Before you go to site, add basic information about each stratum to the relevant 'stratum summary sheet' (e.g. project name, stratum number, species to be surveyed). This will update all the 'plot sheets' for the information that is the same across the stratum (see the year 5 monitoring report).

3.1 Stocking density

1. Within each sample plot, count and record the number of live seedlings/ saplings of each species, estimating the height as follows:
    a. to the nearest 0.1m below 1m (e.g. 0.6m, 0.7m…) and
    b. to the nearest 0.5m above 1.0m (e.g. 1.5, 2.0…).
2. Note the number of live trees which are damaged, and the number of dead trees (confirm zero in the plot sheet if no dead trees).
3. Specify the main reasons for damaged or dead trees in the plot.

3.2 Tree growth and health

Tree growth

1. Note the seedlings/saplings with:
    - Poor leader growth (last year's leader growth is less than the average to date)
    - Multiple stems
    - Poor leaf/needle size
    - Poor lead/needle retention

3. Add any observations or reasons for poor growth in the 'general comments' box at the bottom of the plot sheet.

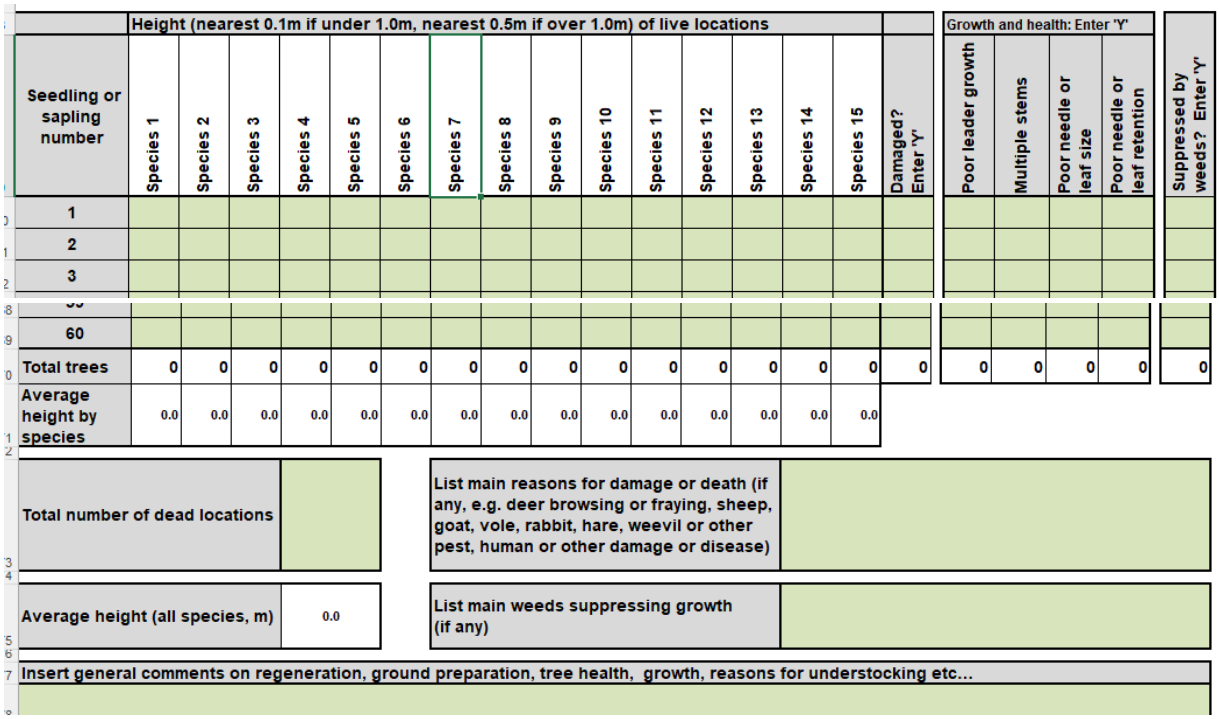
Tree health

Assess the overall health of the seedlings/saplings by assessing within each plot:

1. Number of damaged saplings
2. Number of seedlings/saplings with:
    - Poor leader growth
    - Multiple stems
    - Poor foliage colour or needle/leaf size
    - Poor needle or leaf retention

3. Number of seedlings/saplings suppressed by weeds, and the main species of weeds
4. Specify the main reasons for damage or death within the plot
5. Add any other general comments on the health, growth or reasons for poor performance.

Example 1: Recording tree growth and health



Seedling or sapling number	Height (nearest 0.1m if under 1.0m, nearest 0.5m if over 1.0m) of live locations															Damaged? Enter 'Y'	Growth and health: Enter 'Y'				Suppressed by weeds? Enter 'Y'
	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Species 9	Species 10	Species 11	Species 12	Species 13	Species 14	Species 15		Poor leader growth	Multiple stems	Poor needle or leaf size	Poor needle or leaf retention	
1																					
2																					
3																					
60																					
Total trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average height by species	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						

Total number of dead locations		List main reasons for damage or death (if any, e.g. deer browsing or fraying, sheep, goat, vole, rabbit, hare, weevil or other pest, human or other damage or disease)	
Average height (all species, m)	0.0	List main weeds suppressing growth (if any)	

Insert general comments on regeneration, ground preparation, tree health, growth, reasons for understocking etc...

3.1 Tree protection

Note the presence and condition of fences and tree shelters in the stratum summary sheet.

Please add any other comments on the general health and growth of the site or reasons for poor health/growth.

Example 2: Recording tree shelter, fencing and other general comments for the stratum

Tree protection	Presence? (Y/N)	Condition	Comments
Tree shelters		Pick from list	
Fencing		Pick from list	

General comments: Insert comments on ground preparation, health of trees, reasons for understocking, lack of vigour, foliage colour etc...

4. Year 5 survey: results

Enter data into the plot tabs (Plot 1, Plot 2 etc.). If you have a suitable device, you can enter data into the excel plot tabs in the field. Do this back in the office if you take paper sheets to site.

- You will need one monitoring report per stratum.
- Basic information such as project name, ID, stratum number and net area, number of plots should be entered into the stratum summary sheet and will copy across to each plot sheet.

- The stratum summary sheet automatically calculates the stocking density and overall tree health/growth, once you enter the net area, number of plots, plot radius and planned average spacing.

4.1 Calculate stocking density and tree growth/health summary:

The stratum summary sheet of the year 5 monitoring report gives the following results:

- **Actual planting density compared to planned** is given in Cells AA2 to AE5 (top right). The metrics shown give an idea of how variable the stocking density across the site as well as giving the overall stocking density.

% plots at least 110% stocked	**85.0%**
% plots at least 100% stocked	**95.0%**
% plots at least 90% stocked	**100.0%**
Overall actual vs planned planting density	**95.0%**

- The **difference between the planned and actual species mix** is given in cells B46 to Q48. This should be completed to understand if the carbon prediction is representative of the actual mix.

Actual species mix (%)	55.0%	18.0%	17.0%	10.0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	100.0%
Planned species mix (%)	50.0%	20.0%	20.0%	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**100.0%**
Planned species area (ha)	10.0	4.0	4.0	2.0												**20.0**
Difference (% point)	5.0%	-2.0%	-3.0%	0.0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.0%

- **Growth and health:** Summary statistics for trees damaged or dead, tree growth and health metrics help to identify any potential issues that need to be addressed.
- **Tree protection:** helps identify any issues with that need to be addressed.
- **General comments:** helps understand the overall growth and health or reasons for poor performance

4.2 Assessing project success

Your project will be given a rating (green, amber, red, or not verified) based on the survey results. The verifier will consider stocking density, as well as the growth and health of the trees. See verification guidance for more information.

If the project is rated amber or red, you will be asked to provide a remedial plan (template available).

5. Year 15+ survey: measurement

In the year 15+ survey, trees are categorised as seedlings, saplings or trees (See Introduction for definitions). Each category should be sampled separately.

This guide describes how to monitor broadleaves and conifers according to methods B (broadleaves) and C (conifers) from the carbon assessment protocol and annex.

Before you go to site:

Review how many species are likely to be present in each strata and how you will 'group' these when you survey.

Each 'major' species should be assessed separately within each plot, but where a species constitutes less than 10% of the total tree numbers, this should be treated as a 'minor species' and grouped with the most similar alternative species present in the woodland as follows:

1. Try to group minor species with the largest major species component by genus. For example, group pines together, group spruces together, group oaks together etc.

2. If (1) fails, try to group minor species with the largest major species component by the following genus groups:
    a. Pines, larches
    b. Spruces, coast redwood, Wellingtonia (giant sequoia), Douglas fir, firs
    c. Western red cedar, Western hemlock, cypresses
    d. Oak, ash, beech, alder, elm, hornbeam, nothofagus, chestnut
    e. Birch, cherry, poplars, maples/sycamore, hazel

3. If (2) fails, group minor species with the largest major species component by phylum/type:
    a. Conifers with conifers
    b. Broadleaves with broadleaves

The 'Planning StratumX _Species' tabs in the year 15+ monitoring report provide space to review the species mix of each stratum and decide how to group the species.

You will need one 'seedlings' and 'saplings' sheet per stratum and a 'tree' sheet for each species or species group in the stratum.

The monitoring report provides space to enter results for up to four strata, each with up to four tree species groups. You may not need all the sheets. If you think your project will require more than four strata, please contact info@woodlandcarboncode.org.uk.

There is also a template seedling, sapling and species sheet for you to take to site.

5.1 Seedlings

1. Count and record the number of living seedlings of both conifer and broadleaves within each plot.
2. Note the main conifer or broadleaf species in each plot.
3. Measure the height (in centimetres, to the nearest 10cm) of the three conifer and three broadleaf seedlings closest to the centre of each plot. Where there are fewer than three conifer or three broadleaf seedlings, you should measure the heights of all of them.

Example 3: Seedling count and height:

Broadleaves. Count all the broadleaf seedlings in the plot but only measure the height of the three broadleaf seedlings closest to the centre

Plot number	Main broadleaf seedling species	Number of seedlings	Broadleaf seedling heights (centimetres)		
			1	2	3
1					
2					
3					
4					

Conifers. Count all the conifer seedlings in the plot but only measure the height of the three coniferseedlings closest to the centre

Plot number	Main conifer seedling species	Number of seedlings	Conifer seedling heights (centimetres)		
			1	2	3
1					
2					
3					
4					

5.2 Saplings

1. Count and record the number of living conifer and broadleaf saplings within each plot.
2. Note the main conifer and broadleaf species in the plot.
3. Measure the heights of the three conifer and three broadleaf saplings closest to the centre of each plot (to the nearest 10 cm). Where there are fewer than three conifer or three broadleaf saplings, you should measure the heights of all of them.

Example 4: Sapling count and height:

Broadleaves. Count all the broadleaf saplings in the plot but only measure the height of the three broadleaf saplings closest to the centre

Plot Number	Main broadleaf sapling species	Number of saplings	Broadleaf sapling heights (metres)		
			1	2	3
1					
2					
3					
4					
5					

Conifers. Count all the conifer saplings in the plot but only measure the height of the three conifer saplings closest to the centre

Plot Number	Main conifer sapling species	Number of saplings	Conifer sapling heights (metres)		
			1	2	3
1					
2					
3					
4					
5					

5.3 Trees

1. For each species or species group within each plot, measure and record the diameter at breast height of every living tree where this is seven centimetres or more. Do not include large trees which would have existed prior to the woodland creation project.

Example 5: Recording diameter at breast height

Diameter at breast height. Enter the diameter at breast height of every tree in the species/species group where the diameter is seven centimeters or more. If there are two trees of 7cm dbh in plot 1, enter '2'.

Diameter at breast height (cm)	Plot number																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
7																					
8																					
9																					
10																					
11																					
12																					

2. Identify the two trees of each species/species group nearest to the plot centre. These will be your height sample trees. If species are grouped, these should be two trees of the 'main' species if possible.
3. Measure and record diameter at breast height and the height of the two sample trees of each species.
4. **Notes on measuring tree height:**
    a. For broadleaves, measure the timber height (the distance from the base of the tree to the lowest point on the main stem where the diameter is at least 7cm. This point may be the 'spring of the crown' – the lowest point at which no main stem is distinguishable).
    b. For conifers, measure the total height (the distance from the base of the tree to the uppermost point/tip).
    c. Each tree should ideally be measured from opposite sites perpendicular to any lean and the two measurements averaged. The distance from the tree to the observation point should be 1 to 1.5 times the height of the tree. Accurate use of hypsometers of clinometers requires training, checking and practice.

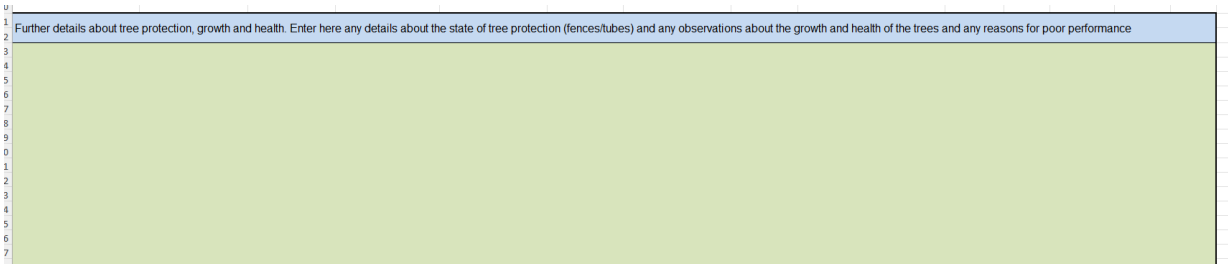
Example 6: Recording tree height data

Tree height. Measure the height of two trees per species/species group nearest to the plot centre. If you have grouped species, ideally these will be the 'main' species in the group.					
Sample tree number	**Plot number**	**Species**	**Diameter at breast height (cm)**	**Total height (conifer) or timber height (broadleaves) (m)**	**Tarriff number (rounded)**
1	1				0.0
2	1				0.0
3	2				0.0
4	2				0.0
5	3				0.0
6	3				0.0
7	4				0.0
8	4				0.0

5.4 Tree protection, growth and health

Provide further details about tree protection, grow and health for your strata in the 'Further details…' box on the 'Planning StratumX_Species' tabs. Include information on the state of tree protection (fences and tubes) and the reasons for poor performance. This could include poor leader growth or multi-stems, foliage health, browsing or other pests and diseases, weeds, or windblow.

Example 7: Recording any general information on tree growth/health and protection



6 Year 15+ survey: results

6.1 Calculate carbon stock and compare to prediction:

The year 15+ monitoring report will semi-automatically carry out further calculations if data is entered into the relevant sheet. Follow additional guidance within the sheet.

If you have a suitable device, enter data direct into the excel sheets in the field. Do this back in the office if you take paper sheets to site.

1. Use one monitoring report for your entire site. The report template has space for up to four strata. If you think your project will require more than four strata, please contact info@woodlandcarboncode.org.uk.
2. The 'planning_stratumX species' sheets will help you to identify the species groups you will use to survey. It also has a space to note the grid reference of each plot that you survey and provide further details for the stratum on growth, health and tree protection.
3. You need one seedling and sapling sheet for each stratum and one tree species sheet per species/species group in the stratum. Once you enter the relevant details into these sheets, the carbon content of that element will be calculated automatically, and will be added to the 'result_project total carbon' sheet.
4. The 'result_project total carbon' sheet provides a space to add together all the elements of each stratum across your project (e.g. the seedlings, saplings and tree species across each stratum in the project).

Example 8: Summarising the elements of each stratum across the project

Seedling, sapling or tree species in the stratum	Stratum 1 - tCO2e	Stratum 2 - tCO2e	Stratum 3 - tCO2e	Stratum 4 - tCO2e	**Total CO2e**
Seedlings	1.00	0.00	0.00	0.00	**1.00**
Saplings	2.00	0.00	0.00	0.00	**2.00**
Tree species 1	10.00	0.00	0.00	0.00	**10.00**
Tree species 2	15.00	0.00	0.00	0.00	**15.00**
Tree species 3	4.00	0.00	0.00	0.00	**4.00**
Tree species 4	25.00	0.00	0.00	0.00	**25.00**
Total CO2 sequestered to date in biomass	**57.00**	**0.00**	**0.00**	**0.00**	**57.00**

5. The result_project total carbon sheet also provides a space to compare your actual survey result with the predicted carbon sequestration at that point in time. On first use, you will need to copy and paste information from the validated carbon calculator used at validation into the sheet to make the comparison. This allows us to adjust for any elements considered in the original prediction including:
    a. emissions from establishment
    b. soil carbon losses/sequestration
    c. baseline and leakage estimates
6. You should also compare your predicted and actual sequestration for the vintage on this sheet, and copy the result back to your project progress report.
7. The sheet 'result_species spacing' may be used to calculate the overall stocking density of each stratum, by adding up the number of stems in the seedling, sapling and tree elements to give an overall stocking density for the stratum. This will help you to decide how to update your carbon calculator if your project is doing less well than planned.
8. If you need further guidance please contact info@woodlandcarboncode.org.uk.

Example 9: Planned and actual units delivered within the vintage under assessment

Planned and actual units delivered within the vintage under assessment			
Vintage start date:	**01/04/2015**	**Vintage end date:**	**31/03/2025**
	Total units in vintage (tCO2e)	**Units to buffer (tCO2e)**	**Units to project (tCO2e)**
Predicted units (PIUs) in vintage being assessed	**100.0**	**20.0**	**80.0**
Actual units (WCUs) in vintage being assessed	**110.0**	**22.0**	**88.0**
PIUs to be cancelled	**0.0**	**0.0**	**0.0**
Extra WCUs to be issued	**10.0**	**2.0**	**8.0**

Annex 1: Calculating plot size on sloped ground

If the ground to be surveyed is at a significant slope, you may need to increase the plot size to account for measuring at an angle. Table A1 shows the size of plot you should use on sloped ground, for common plot sizes on flat ground. For example, if you would normally use a 5.6m radius plot on flat ground, you should increase the radius to 6.2m where the slope is 25^{o}.

Table A1: Plot radius at various slope angles for common 'flat ground' plot sizes

Radius on flat ground	5.6	8	12.6
Adjusted radius at 25^{o} slope	6.2	8.8	13.9
Adjusted radius at 30^{o} slope	6.5	9.2	14.5
Adjusted radius at 35^{o} slope	6.8	9.8	15.4
Adjusted radius at 40^{o} slope	7.3	10.4	16.4
Adjusted radius at 45^{o} slope	7.9	11.3	17.8

If you need to calculate the plot radius for a different 'flat ground' plot radius or slope, then follow the formula below. Email info@woodlandcarboncode.org.uk for further advice.

Flat ground radius x 1/cos(angle) = sloped ground radius

For example, for an 8m 'flat ground' plot radius, where the ground is at 45º the plot radius would be:

45º sloped ground radius = 8m x 1/cos(45º)

45º sloped ground radius = 8m x 1.4142

45º sloped ground radius = 11.3m.