Using the carbon calculator
Version 3.0
August 2025

Contents

Updates to versions

Version No	Date	Amendment	Who
1.0	19/08/2010	--	Vicky West
1.1	01/10/2010	Correction to calculation in 3.5 – Clearfell after n years. Does not affect method or outcome	Vicky West
1.2	14/01/2011	-Description of 'Max clearfell values' sheet at 1.2 -Addition of guidance on native species mixtures at 3.2/3.4 -Change to guidance on clearfell regimes at 3.5 -Further clarity on the permanence/risk buffer at 4.	Vicky West
1.3	21/07/2011	-Update to model: Slight changes to figures in examples. -Addition of emissions from woodland management	Vicky West
1.4	27/07/2012	-Slight amendment to 3.6 Emissions from woodland management, Table 6, seedling cost. -Reflect changes to risk rating	Vicky West
2.0	08/03/2018	-Update to match carbon calculation spreadsheet V2.0 and carbon lookup tables V2.0	Vicky West
2.4	March 2021	-Update to match WCC Carbon Calculation Spreadsheet V2.4	Vicky West
3.0	August 2025	-Update to match carbon calculator V3.0.	Vicky West and Phoebe Golden

Disclaimer of warranty

The Woodland Carbon Code is a voluntary standard. The Woodland Carbon Code standard, tools and documents, including the carbon calculator, are distributed 'as is' and without warranties as to performance or merchantability or any other warranties whether expressed or implied. There is no warranty for the predictions derived from the carbon calculator as they are regarded as indicative and not prescriptive.

No responsibility for loss occasioned to any person or organisation acting, or refraining from action, as a result of any material in the standard, tools and guidance can be accepted by Scottish Forestry, the Forestry Commission, Welsh Government or Northern Ireland Forest Service. Validation and verification does not imply endorsement by Scottish Forestry of the value of any investment.

1 Introduction

The carbon calculator version 3.0 provides the template to carry out a prediction of carbon sequestration for a woodland project. There are a number of sheets in the workbook to be used at validation:
- Standard project carbon calculator – for projects over 10 hectares projects
- Small project carbon calculator – for projects 10 hectares or less using the 'small woods' process
- Summary PIU area table - for projects which have multiple parts to a calculation

There are also two sheets to be used if a project updates its carbon calculator in future:
- Comparison old and new – to compare calculator versions
- Units to issue or cancel – to identify any buyers impacted if pending issuance units are to be marked not delivered

The workbook also contains the following pages of data used in the calculations:
- Biomass carbon lookup table – Carbon sequestration over time for a number of species, spacing, yield classes and management options
- Clearfell maximum sequestration values. This sets out the maximum that can be claimed for a range of species when clearfelling at a range of ages.
- Species lookup. This shows how all tree species are mapped to the available models
- Validation lists. This lists some of the assumptions that are made and figures that are used for emissions from establishment and emissions from soil disturbance
- Sources. This provides information on data sources for emissions from establishment, soil emissions and sequestration and biomass sequestration.

The data behind the carbon calculator is currently being reviewed and revised by Forest Research. It will incorporate new growth and yield models and refine estimates of contributions from root and branch biomass. The revised estimates for some tree species may be more conservative than current predictions, particularly for the early growth period of broadleaved species. The carbon calculator already subtracts 20% from modelled predictions and it is anticipated that these revisions will fall within this threshold.

2 How to complete a carbon calculation

The standard project and small project tabs follow the same principle. Complete the green cells, and then the calculation is automatic. Blue cells provide guidance.

2.1 Small projects

The small project calculator is much simpler to use than the standard project calculator, as it makes certain assumptions about the establishment technique and the growth rate of trees planted. It conservatively estimates that broadleaves will grow at yield class four and conifers at yield class twelve. If you use the small project calculator, there are reduced monitoring requirements at verification.

The small project carbon calculator and small woods process can only be used
- For projects with ten hectares net area or less.
- For planted sections, maximum average spacing of 3.5 metres or 816 stems per hectare.
- For natural regeneration sections, maximum average spacing of 5.0 metres or 400 stems per hectare.

If your small woodland doesn't satisfy these conditions, use the standard project calculator.

As part of the validation process, we also need to see the species breakdown of the project. This should be added in columns F to K for validation, but it does not affect the carbon calculation.

2.2 Standard-sized projects

If your project is larger than ten hectares, or you do not meet the criteria to use the small woods process, the standard project carbon calculator requires a few more inputs. There are three example calculations for information. See template documents:
- A productive conifer scenario (no thinning, clearfell only)
- A productive conifer scenario (regular thin only)
- A mixed native woodland (minimum intervention, no thinning or clearfell)

The calculator is divided into a number of tables from left to right. The actions to take in each are described below.

2.2.1 Emissions from establishment, baseline and leakage

Table 1 (columns A to E) brings together the assumptions about:
- The timing and area of the project (start date, duration, net planting area)
- Emissions generated whilst establishing the woodland, including any removal of vegetation prior to creating the woodland
- Soil carbon accumulation
- Baseline – whether there would be a significant increase in carbon onsite without creating your woodland
- Leakage – whether there will be any significant emissions outside your project area

Emissions due to establishment are accounted for in year 1 of the project. Baseline and leakage are calculated over the lifetime of the project, if significant.

When completing the emissions from establishment table, note the following:

Start date: The start date for standalone projects is the date planting was completed and should match your project design document. For group projects, use the group start date as the start date for each carbon calculator in the group, regardless of the actual start date of the individual project.

Emissions due to establishment:
- For seedlings, enter the average spacing of seedlings across your project and the area planted.
- For tree protection and fertiliser, enter the average spacing where tree shelters or fertiliser are used and the area where each treatment was used.
- For ground preparation and herbicide, enter the area for which these are applicable. Remember herbicide could be applied more than once (double the area if you apply twice).
- For fencing, enter the length of fence in metres.
- For gates, enter the number of gates installed.
- If any forest roads are constructed, enter the length in kilometres, even if the roads aren't planned to be constructed later in the project.

Vegetation removed at the start of the project:
If any trees or other vegetation was removed prior to the start of the project this should be assessed separately and added to your calculation. See Guidance on 3.3 Project Carbon Sequestration

Soil carbon accumulation:
Under certain conditions, with minimal ground disturbance, soil carbon can accumulate as a woodland grows. Currently it is only possible to claim for this accumulation for a woodland managed as minimum intervention (without thinning or clearfelling), which is on mineral soil and was previously in arable use. Select 'Yes' if you would like to claim soil carbon accumulation and it will automatically be included.

Baseline and leakage:

Baseline: If your project might sequester a significant amount without planting trees/managing for natural regeneration (more than 5% of what the woodland would sequester), this should be accounted for. Please see the 3.1 Baseline Guidance and contact us for further advice info@woodlandcarboncode.org.uk.

Leakage: If your project might cause significant emissions outside the project area, then you need to account for this (more than 5% of what the woodland would sequester). Please see the 3.2 Leakage Guidance and contact us for further advice info@woodlandcarboncode.org.uk.

Assumptions Table 1: Example for a mixed native woodland

Table 1: Assumptions - emissions from establishment, baseline and leakage					
Project name	Example Woods				
Calculation completed by	Phoebe Golden				
Date calculation completed	15 July 2025				
Version of carbon calculator	Verson 3.0 August 2025				
Project basics					
Project start date			01 August 2025		
Project duration (years)			100		
Total net area of woodland creation (ha)			20.00		
Country			Scotland		
If in England, Are you using the Woodland Carbon Guarantee?			N/A		
If using the Woodland Carbon Guarantee, 10-yearly or 5-yearly verifications?			N/A		
Emissions from establishment	spacing (m)	area (ha)	tCO₂e/ha		tCO₂e

Emissions from establishment	spacing (m)	area (ha)	tCO₂e/ha	tCO₂e
Seedlings	2.5	20.00	-0.24	-4.8
Ground preparation (fuel)		20.00	-0.06	-1.2
Tree shelters		20.00	-0.82	-16.4
Herbicide		60.00	-0.001	-0.1
Fencing		metre	tCO₂e/ metre	tCO₂e
Length of fence		1800.00	-0.0022	-4.0
Road building		km	tCO₂e/km	tCO₂e
Roads		0.00	-43.13	0.0
Emissions from removal of trees or other vegetation at the start of the project				tCO₂e
To be calculated separately if any trees or other vegetation is removed prior to planting. Show working on a separate sheet. (See Guidance 3.3 project carbon sequestration)				0.0
Total emissions from establishment				-22.5
Soil Carbon accumulation. Currently only claimable for a site with mineral soil which was previously in arable use, with trees managed with minimum intervention (no thinning or clearfelling)				area (ha)
If previously arable site on mineral soil: Over what area are you claiming soil carbon sequestration?				0.00
Baseline and Leakage				Yes or No
Baseline: Will your project area sequester a significant amount without planting trees? (See Guidance 3.1). If yes, ask the WCC team for further assistance				No
Leakage: Will your project cause significant emissions outside the project area? (See Guidance 3.2). If yes, ask the WCC team for further assistance				No

2.2.2 Species, spacing, yield class, management

Table 2 provides the space to specify the actual areas and spacing of species planted as well as predicted yield classes and management (columns G to V). You need to know the proportions of each species planted at a given spacing. There is space for 25 species/spacing/management options. If your woodland is very large and complex you could consider showing sections with the same species/spacing/management. structure together. Use a second sheet if necessary (copy the sheet selecting 'create a copy') and add them together using the 'Summary PIU area table' tab.

Complete the following columns:

Section (column G): If your woodland has separate sections with different composition (in terms of species, spacing, management or establishment type (planted and natural regeneration/colonisation)) you can use this column to delineate the sections. This could be used if, for example:
- One section is a conifer mix and another is a broadleaved mix, or
- One section is planted at an average of 2m spacing and another at an average of 3m spacing, or
- One section is clear-felled on a regular rotation but another will only be thinned, or
- One section is planted in year 2020/21 and another section will be planted in year 2021/22

These separate sections should also be made clear on your map of the site.

Actual species (column H): Select the species planted from the dropdown list.
1. If your species is not present in the dropdown list, use the 'Other conifers', 'Other willows', 'Other broadleaves', etc categories. If you use an 'Other' category, specify which species in the 'additional information' section at the bottom of the calculator. If you are planting a species such as Paulownia which grows at a very different rate to species normally used in UK forestry, contact us for more information info@woodlandcarboncode.org.uk.
2. **Future claimable natural regeneration:** Add any areas of natural regeneration you are claiming as 'future claimable' in the penultimate row (See 2.2.3 Natural regeneration/colonisation). These will not be included in the prediction of carbon sequestration, but at verification they can be surveyed and the carbon sequestered can me claimed at that time.
3. **Woody shrubs:** Add any areas of woody shrubs not included in the tree species list in the final row of the table. These will not be included in the prediction of carbon sequestration, but at verification they can be surveyed and the carbon sequestered can be claimed at that time.

Planned spacing (column I): For each of your species, complete the planned spacing column. For native broadleaved woodlands where the planting could be 'clumped', use the average spacing across the net area (excluding any open areas identified). The planned spacing should indicate the density you hope to successfully establish by year 5 and should match the planned spacing in your grant documents if you have a grant. If you planted extra trees anticipating that some might not survive, add a note to table 4 – further comments, but do not include them in the planned spacing.

Spacing used in lookup tables (column L): There are only a limited number of spacing 'models' for each species. Choose the closest spacing option to your actual spacing. If

your spacing is exactly half way between two options (e.g. you plant at 2.0 metre and the options are 1.5 and 2.5 metre), choose the wider spacing.

Wider spacing/less dense planting
Note the maximum spacing allowed as 'woodland' under the Woodland Carbon Code is 5 metre spacing, or 400 stems per hectare, as this is expected to create a woodland with at least 20 percent canopy cover.

For planted broadleaves and Scots pine as well as for natural regeneration, data is available for 3.0, 4.0 and 5.0 metre spacing, pro-rated from the widest modelled data (3.0 metre for broadleaves and 2.0 metre for Scots pine).

If you plant conifers other than Scots pine at a spacing more than 1.0 metre wider than an available model in the lookup table, then you need to make an adjustment and account for an 'effective area' at the modelled spacing (the widest model currently available):

Example for if you plant western red cedar at 3.0 metre spacing, where the model is at 1.5 metre spacing:

- Actual net area planted: 10 hectares
- Largest planting density/spacing in lookup table: 4,444 stems per hectare or 1.5 metre spacing
- Actual planting density/spacing: 1,111 stems per hectare or 3.0 metre spacing
- Effective area to claim in carbon calculator: 10 x 1,111/4,444 = 2.5 hectares

These estimates will be conservative. When you monitor your project at verification, if the trees have grown more than predicted, you will be able to claim the 'extra' carbon sequestered at that time.

You should explain any 'effective area' calculations in the 'further comments section of your calculator. Note that this will mean the 'area claimed' (in column T) is less than the actual 'Net area' (in cell E12). Continue to use the actual 'Net area' (cell E12) in your project design document and other documents. Note the is the only circumstance where the total of column T could be less than the 'Net area' (in cell E12).

Yield class (columns N and P):
Yield class for your particular species and site should be predicted using the Ecological Site Classification (ESC) tool (http://www.forestdss.org.uk/geoforestdss/). See the manual within the tool for further guidance.

Note:
- ESC Version 4 uses 'default' soil moisture and nutrient assumptions from a low resolution soil map. You should conduct your own soil and/or vegetation survey to enable you to input more precise soil information into the ESC model. The ESC manual explains how to add better soil information.
- ESC Version 4 gives predicted yield classes in whole numbers (e.g. yield class 4, 5, 6 and 7) whereas the carbon calculator only contains estimates for yield class in even numbers. If ESC suggests an 'odd' yield class, you should round down to the nearest even number (e.g. if ESC suggests yield class 5, use the model for yield class 4). Enter the yield class given by ESC in column N and the 'even number' yield class used for the carbon model in column P.

- ESC Version 4 provides estimates for yield classes under future climate change scenarios, for 2050 and for 2080. If ESC predicts that the yield class of a particular species is likely to be less favourable in a 2050 climate, then this should be taken into account. Use the following future climate scenario:
  - Medium-High 2050(A1b 3q0/AWC)[1]
- If site-specific soil information has been entered and you believe ESC predicted yield class to be inaccurate, you may provide alternative evidence for increasing or decreasing the predicted yield class by up to four classes, and this shall be justified in table 4: additional comments. Alternative evidence could be, for example, mensuration survey results from a neighbouring stand of the same species on similar soil.

ESC does not currently cover Northern Ireland, but should be extended to include the whole of the United Kingdom later in 2025. Until ESC is updated, please contact us info@woodlandcarboncode.org.uk for further advice on projects in Northern Ireland.

Management types (column R)
There are models available for managing a stand as minimum intervention (ie no thinning or clearfell) and thinning to standard regimes. There are also models available for regular clearfell, with and without thinning.

A different thinning regime (either % thinned or timing of thinnings)
If you are thinning the woodland but using a thinning regime other than the standard 5-yearly thinning, you should still use the 'thinned' tables. If you only plan to thin a proportion of the woodland, or one section of a woodland then you can enter two lines – one area as 'No thin' and one area as 'Thinned'.

Clearfelling (column U)
If you plan to clearfell and restock the woodland at any point in its future, then you can only claim sequestration up to the long-term average carbon stock of the site, as after each clearfell, the carbon stock in live trees on the site effectively returns to zero (albeit that a proportion will be retained in harvested wood products for a period of time). The long-term average carbon stock tends to be between 30% and 50% of the cumulative total carbon sequestered over one rotation. There are also emissions associated with the clearfell operation and these are accounted for within the long-term average carbon stock.

This long-term average is the maximum amount of sequestration you can claim, irrespective of the length of the project, if a project is regularly clearfelled. Claims can be made as the carbon is sequestered in the first rotation up to the time this 'clearfell cap' is reached, normally by year 25 or 35. The subsequent growth of the forest should continue to be monitored for the remainder of the project duration.

Note that for projects involving clearfell, the minimum project duration is 40 years or length of the shortest rotation within the project, so if the shortest rotation is longer than 40 years, the duration should be at least the length of that rotation.

Enter the age of clearfell in column U for every species that will be clearfelled. You could have one section clearfelled at year 40 and one at year 60 for example and another section with no clearfell.

---

[1] The numbers and letters denote the model option used in ESC, from those produced by the Met Office. It is close to the 'average' for the Medium-High scenario options.

Continuous cover forestry

Other management regimes such as continuous cover forestry are not yet covered within the lookup tables. If continuous cover is the longer-term objective, you should use the 'Thined' option.

Area (column S and T)

Enter the area of each species/spacing/management/yield class option. Either enter the percentage area of each option in column S, and calculate the area in column T, or enter the areas in column T and calculate the percentages. Ensure the percentage column S adds to 100.

Assumptions Table 2: Example for a mixed native woodland

Sectn No:	Species	Planned spacing (m)	Species model used in lookup table	Spacing used in lookup tables (m)	only if 'ERROR' then check spacing (column L)	Yield class in Ecological Site Classification	Yield class used in lookup tables	only if 'ERROR' then check Yield Class (column P)	Management (lookup table options)	% of area	Area (ha)	Age at clearfell (years)	Clearfell cap (tCO2 of ha)
	Pedunculate/common oak	2.2	OK	2.5	NO	4.0	4	NO	No_thin	20.00%	4.00	0	0.0
	Sycamore	2.2	SAB	2.5	NO	6.0	6	NO	No_thin	20.00%	4.00	0	0.0
	Birch (downy/silver)	2.2	SAB	2.5	NO	8.0	8	NO	No_thin	20.00%	4.00	0	0.0
	Aspen	2.3	SAB	2.5	NO	8.0	8	NO	No_thin	8.00%	1.60	0	0.0
	Alder	2.6	SAB	2.5	NO	5.0	4	NO	No_thin	10.00%	2.00	0	0.0
	Rowan	2.2	SAB	2.5	NO	5.0	4	NO	No_thin	10.00%	2.00	0	0.0
	Hazel	2.2	SAB	2.5	NO	4.0	4	NO	No_thin	7.00%	1.40	0	0.0
	Goat willow	2.6	SAB	2.5	NO	4.0	4	NO	No_thin	5.00%	1.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin				
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin				
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Select Species		Select species first	Select Species First	NO		Select Species First	NO	No_thin	0.00%	0.00	0	0.0
	Future claimable natural regeneration	State whether broadleaves, Scots pine, or both				Not accounted for in calculation - insert area				0.00%	0.00		
	Woody Shrubs	State which woody shrub species here				Not accounted for in calculation - insert area				0.00%	0.00		
Total Area										**100.0%**	**20.00**		

Enter Management Regime
No_thin or Thinned

2.2.3 Natural regeneration/colonisation

If a woodland is to be established by natural colonisation rather than planting, trees are likely to take longer to establish and the Woodland Carbon Code requires further consideration of the areas where natural colonisation is likely to be successful.

Participants are also reminded that an Environmental Impact Assessment determination for afforestation is necessary whether projects are planted, direct seeded or colonise naturally.

The Woodland Carbon Code also requires a management plan to be in place (see section 2.2 of the standard). For natural regeneration, this should consider the soil moisture/nutrient status, competition with other vegetation and the subsequent management of regeneration. There are also additional maps required for natural regeneration (See section 2.2).

There should also be appropriate consultation with relevant organisations and neighbours to occur, in line with planted woodlands.

For the purposes of this methodology, seedlings, saplings or trees greater than 1.0 metre height and/or greater than 7 centimetres diameter at breast height are considered to be 'established' and part of the 'existing woodland', and therefore not eligible.

For the purposes of this methodology, 'suppressed' seedlings means that on average 50% of seedlings are browsed at a High or Very High level (Appendix 1 Level of herbivore impacts). Natural regeneration is likely to be successful where the soil moisture should be very moist to drier and the soil nutrient status very poor to rich (Appendix 2 Soil nutrient and moisture types for natural regeneration/colonisation).

- **Identify the gross area** including all open ground and existing woodland.
- **Map out areas of existing woodland and 'established' seedlings/saplings over 0.25 hectares** (over 20 percent canopy cover or 400 stems per hectare of 'established' seedlings/saplings/trees).
- **Map out other ineligible areas:** Deep peat, rock, other open areas (e.g. for archaeology). Aerial imagery can be helpful in mapping net area.
- **Identify individual seed trees/clumps of seed trees outside** of mappable woodland.
- **Upfront claimable natural regeneration within 50 metres of seed source**. Apply a 50 metre buffer to the existing woodland. These areas are claimable without the need for a seedling survey.
- **Outside the 50 metre buffer:** Carry out a seedling survey to determine presence, height and level of browsing. See Appendix 3 Baseline seedling survey protocol.
    - **Upfront claimable natural regeneration more than 50 metres from seed source:** Eligible areas will have a seedling height on average less than 0.5 metres high, suppressed by browsing. Saplings between 0.5 and 1.0 metres are acceptable provided the average seedling or sapling height across the 'claimable area' of the site is less than 0.5 metres.
    - **Future claimable natural regeneration more than 50 metres from seed source:** Will have little or no evidence of seedlings at the present time, but you hope will regenerate in future.
- **Net area is the total of:**
    - claimable upfront natural regeneration less than 50 metres from seed source

- o claimable upfront natural regeneration more than 50 metres from seed source
- o future claimable natural regeneration more than 50 metres from seed source

In your carbon calculator, for the natural regeneration portion of your project, you should:
1. **Choose the relevant natural regeneration 'species' options**, which are based on planted stands, but delaying their growth by five years:
   - o Natural regeneration – Mixed broadleaves or
   - o Natural regeneration – Scots pine
2. **Choose the relevant spacing,** either 3, 4 or 5 metres
3. **Choose the relevant conservative yield class** (only yield classes 2 or 4 are options here)

2.2.4 Soil carbon emissions due to ground preparation

Disturbance of soil during ground preparation can lead to greenhouse gas emissions from the soil itself. The greater the volume of soil disturbance, the higher the level of emissions. This is especially an issue on organomineral soils with greater carbon content and potential for loss. These soil carbon emissions are accounted for in year 1 of the project. See 1.2 Eligible activities – soil type and landuse for more information.

To calculate the emissions from soil disturbance during ground preparation, enter the soil type, previous land-use and site preparation technique using the dropdown menus (See Table 3, row 42-51, columns A to J). If more than one technique is used across the site, enter the area of each in separate rows. There is the option to state 'negligible disturbance' for some or all of the site. The whole site should be considered (so the total area in this table should be at least the net planted area of the project).

Assumptions table 3: Ground preparation and soil carbon emissions

Table 3: Assumptions - soil carbon emissions						
Use one line for each landuse, soil type and site preparation combination. If there were areas with no ground preparation, add a line and select 'none' for ground preparation. Check the total is at least the net woodland creation area above.						
Previous landuse	Soil type	Ground preparation	Area (hectares)	Percentage topsoil carbon (0-30cm) lost	Soil carbon emissions (tCO$_2$e/ha)	Soil carbon emissions (tCO$_2$e/area)
Pasture	Organomineral	Low disturbance: Hand turfing, inverted, hinge & trench mounding, patch scarification, subsoiling, drains	1.00	05	-29.3	-29.3
Please select	Please select	Please select	0.00	0	0.0	0.0
Please select	Please select	Please select	0.00	0	0.0	0.0
Please select	Please select	Please select	0.00	0	0.0	0.0
Please select	Please select	Please select	0.00	0	0.0	0.0
Please select	Please select	Please select	0.00	0	0.0	0.0
		Total	1.00			-29.3

2.3 Pending Issuance Units by vintage

This table will complete automatically in both the small project and standard project calculators (columns AB to AG for small woods, and columns CO to CT for the standard project calculator). It is this table that will summarise the monitoring period (vintage) dates and determine how many Pending Issuance Units are issued for each vintage/monitoring period.

There are three versions of this table:
- Use the top PIU table unless you are applying to the woodland carbon guarantee in England.
- If you are applying to the guarantee, you need to use either the second or third version of the PIU table depending whether you wish to verify at 10-yearly or 5-yearly intervals (5-yearly will only be viable for large projects).

2.3.1 Project duration less than 100 years

If you choose a project duration which is less than 100 years, you will need to amend the Pending issuance unit by vintage' table to reflect the length of your project. For example, if you choose a project duration of 75 years, delete the data in the periods 75 to 85, 85 to 95 and 95 to 100 (see below). Remember that for clearfell projects, the project duration is at least the length of the shortest rotation in the project.

This table should be copied and pasted into your project design document when your calculation is finalised.

Verification: years since start date	Vintage start date	Vintage end date	Total PIUs in vintage (tCO$_2$e)	Buffer contribution (tCO$_2$e)	PIUs to project (tCO$_2$e)
5	01 August 2025	31 July 2030	49	10	39
15	01 August 2030	31 July 2040	1112	222	890
25	01 August 2040	31 July 2050	3150	630	2520
35	01 August 2050	31 July 2060	2979	596	2383
45	01 August 2060	31 July 2070	1760	352	1408
55	01 August 2070	31 July 2080	998	200	798
65	01 August 2080	31 July 2090	602	120	482
75	01 August 2090	31 July 2100	444	89	355
85	01 August 2100	31 July 2110	405	81	324
95	01 August 2110	31 July 2120	422	84	338
100	01 August 2120	31 July	136	27	109
Total			12057	2411	9646

If your project is less than 100 years, 'clear contents' from the relevant rows beyond your project duration (e.g. if your project is 75 years long, delete the last 3 vintages/periods)

	Vintage start date	Vintage end date	Total PIUs in vintage (tCO$_2$e)	Buffer contribution (tCO$_2$e)	PIUs to project (tCO$_2$e)
25		31 July 2030	49	10	39
		31 July 2040	1112	222	890
		31 July 2050	3150	630	2520
		31 July 2060	2979	596	2383
		31 July 2070	1760	352	1408
55	01 August 2070	31 July 2080	998	200	798
65	01 August 2080	31 July 2090	602	120	482
75	01 August 2090	31 July 2100	444	89	355
Total			11094	2219	8875

2.4 Multiple sections within a project

If your project is complex with several sections of different species or management, or is planted over more than one year, it might be easier to use a 'Standard project carbon calculator' for each section or year. You will then need to add together the sections to get a total figure for the project. Use the sheet 'Summary PIU area table' to add together the carbon sequestration (PIU table), and area/woodland type from each sheet/tab. Rename this sheet/tab so it's clear what it refers to.

3 Useful information to understand carbon sequestration

Both the small woods and standard size project calculators display other useful information to help understand the likely sequestration over time in your woodland creation project.

3.1 Total cumulative project carbon sequestration

- The cumulative carbon sequestration by the project is given at 5-yearly intervals (columns W to Y in the small woods calculator and CJ to CL in the standard calculator). This is divided into the proportion that the project can sell or claim (the claimable carbon sequestration), and the proportion that will be set aside in the Woodland Carbon Code buffer (20 percent contribution to buffer).
- To the right of these is the average claimable sequestration per hectare by the end of each 5-year 'chunk' – this explains the tonnes of carbon dioxide equivalent per hectare that you can claim for a project of a given length.

**Cumulative total sequestration and average per hectare by the given year from the small woods calculator**

Sequestration to year	Net project carbon sequestration (tCO$_2$e)	Buffer contribution (tCO$_2$e)	Claimable carbon sequestration (tCO$_2$e)	Average total claimable sequestration per hectare by year x (tCO$_2$e/ha)
0	-172	-34	-138	-14
5	-151	-30	-121	-12
10	-77	-15	-62	-6
15	172	34	138	14
20	895	179	716	72
25	1758	352	1406	141
30	2383	477	1906	191
35	2837	567	2270	227
40	3202	640	2562	256
45	3512	702	2810	281
50	3868	774	3094	309
55	4041	808	3233	323
60	4159	832	3327	333
65	4258	852	3406	341
70	4307	861	3446	345
75	4364	873	3491	349
80	4421	884	3537	354
85	4467	893	3574	357
90	4513	903	3610	361
95	4663	933	3730	373
100	4678	936	3742	374

By year 60, this 10 hectare project is predicted to sequester 4,258 tCO$_2$e, of which you will be able to sell/claim 3,327 tCO$_2$e in total, or 333 tCO$_2$e/ha

3.2 Graph showing the cumulative sequestration over time

To the right of the pending issuance unit tables is a graph showing the cumulative predicted sequestration over time for your project, divided into the claimable amount and the 20 percent that will be allocated to the Woodland Carbon Code buffer (See columns AI to AS in the small woods calculator and columns CV to DE for the standard project calculator).
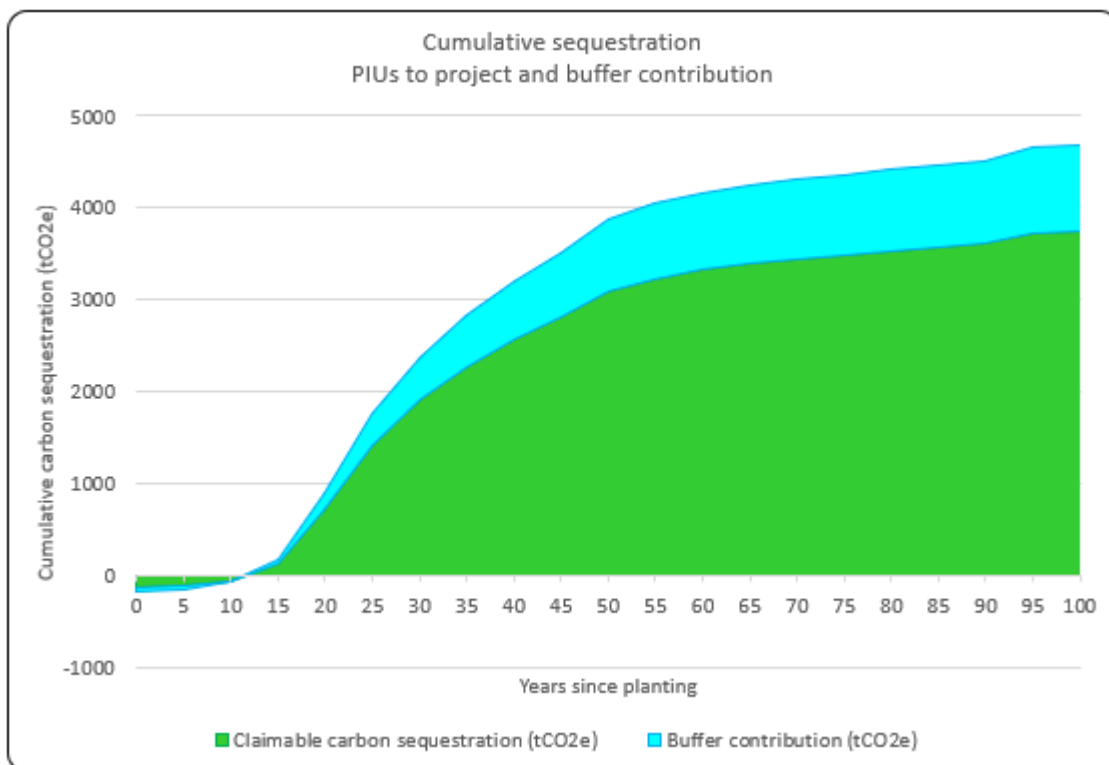
4 Updating your carbon calculator at verification

If you need to update your carbon calculator at verification, you should complete the following steps:

1) Complete your new carbon calculation in the latest version of the carbon calculator.
2) Copy and paste your old carbon calculation (the standard or small project tab only) into your new carbon calculator.
3) Follow the instructions on the **comparison old and new** tab to compare both calculations and work out whether you have extra units to issue or units to mark not delivered in each vintage.
4) If you have sold any units and some units will be marked not delivered, you'll also need to complete the **units to issue or cancel** tab and indicate whether any buyers are impacted. You need to consider units you've transferred to buyers and units you have assigned.
5) If any pending issuance units you have sold will be marked not delivered, you should state whether and how the buyers of these units be compensated (e.g with units from a different project or using unsold units in another vintage).

5 References

Creber, H. (2019) Woodland creation establishment carbon dioxide equivalent emissions model, Forest Research, Unpublished.

Matthews, R.W. Henshall, P.A. Beauchamp, K. Gruffudd, H. Hogan, G.P. Mackie, E.D. Sayce, M. and Morison, J.I.L. (2022). **Quantifying the sustainable forestry carbon cycle: Summary report.** Forest Research, Farnham.

Morison, J. Matthews, R.W. Miller, G. Perks, M. Randle, T. Vanguelova, E. White, M. and Yamulki, S. (2012) **Understanding the Carbon and Greenhouse Gas Balance of UK Forests.** Forestry Commission, Edinburgh.

Nixon, C.J. and Worrell, R. (1999) **The potential for the natural regeneration of conifers in Britain,** Forestry Commission Bulletin 120, Forestry Commission, Edinburgh

Randle, T.J. Jenkins T.A.R. and Matthews, R.W (2011). **The production of lookup tables for estimating changes in carbon stock forestry projects: A document for users of the Forestry Commission's Woodland Carbon Code.** Forestry Commission, UK.

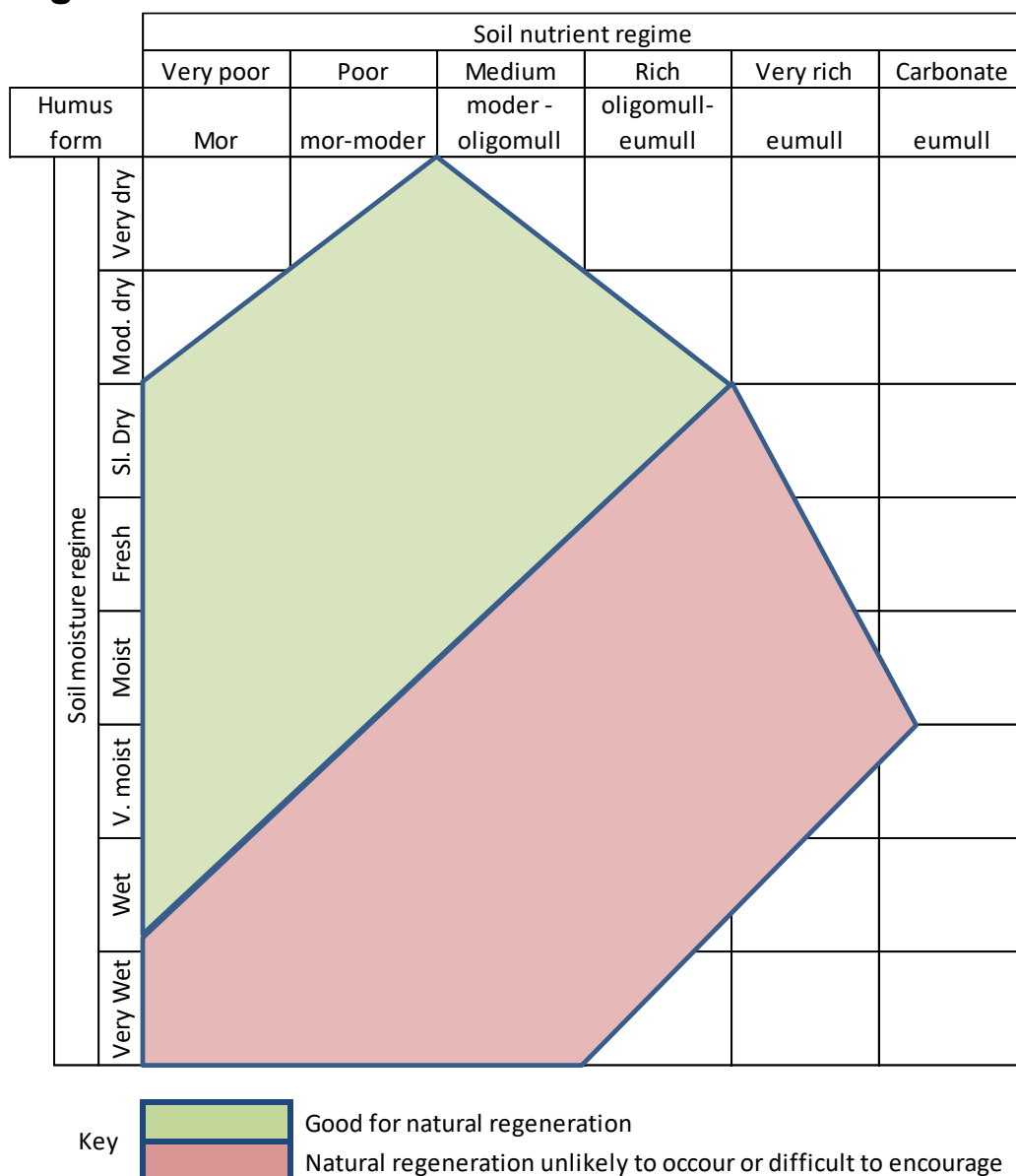West, V. (2011). **Soil Carbon and the Woodland Carbon Code,** Forestry Commission, Edinburgh.

Whittaker, C. Killer, D. Zybert, D. and Russel, D. (2008). **Life cycle assessment of construction of forest roads**. (Spreadsheet tool). Imperial college, London.

Appendix 1 Level of herbivore impacts

Guidance on Tree species palatability

Current Herbivore Impacts					
Indicator	Very High	High	Medium	Low	No impact
Seedlings and saplings Seedlings are 50 cm tall or less. Saplings are 50 cm to 200 cm tall. "Old seedlings" are trees less than 50 cm tall that may be many years old but adverse conditions, usually browsing pressure, prevent them from growing upwards Score as 'Not applicable' if seedlings and saplings are absent.	"Old seedlings" very heavily browsed into a topiaried form. Other seedlings, of all species, will only be present if in their first growing season. All will be browsed the following winter. **Saplings** battered by very heavy browsing, with many woody side shoots browsed back or snapped. Leaders of saplings undamaged only if they cannot be reached by herbivores.	**Seedlings** of unpalatable species and all "old seedlings" moderately or heavily browsed. Seedlings of palatable and browse-sensitive species are likely to be absent (apart from possibly first year seedlings in the growing season). If they are present, they will be very heavily browsed. **Saplings** of all species heavily browsed. Leaders of saplings undamaged only if they cannot be reached by herbivores.	**Seedlings** of unpalatable species unbrowsed or lightly browsed. Those of palatable species moderately or heavily browsed **Saplings** of unpalatable species lightly to moderately browsed. Those of palatable species heavily browsed. Groups of birch, alder and willow saplings may have some unbrowsed leaders. Otherwise, leaders undamaged only if they cannot be reached by herbivores.	**Seedlings** of unpalatable species generally unbrowsed but some may be lightly browsed. Seedlings of palatable species generally lightly browsed but some may be moderately browsed. Most **saplings** of palatable species lightly browsed. Most saplings of unpalatable species unbrowsed.	Numerous **seedlings** present provided that there is an adequate seed source, suitable ground conditions, and an absence of very dense shading. These will be unbrowsed by large herbivores. **Saplings** of all species (if present) un-browsed.

Appendix 2 Soil nutrient and moisture types for natural regeneration/colonisation

		Soil nutrient regime					
		Very poor	Poor	Medium	Rich	Very rich	Carbonate
Humus form		Mor	mor-moder	moder - oligomull	oligomull- eumull	eumull	eumull

Key

Good for natural regeneration

Natural regeneration unlikely to occour or difficult to encourage

Ecological Site Classification soil moisture and nutrient regimes grid showing the prospects for natural regeneration of conifers (after Nixon and Worrell, 1999). Although species differ, natural colonisation of broadleaves by seed will tend to follow a similar pattern.

Appendix 3 Baseline seedling survey protocol

1. Aims

1. To determine the number of seedlings and level of suppression in across the site/potential regeneration area
2. To demonstrate that there is herbivore impact on seedlings/saplings of high or very high levels and that there will be no change in carbon stocks over time without intervention (i.e. browsing control)
3. To confirm mature tree baseline of less than 400 stems per hectare (i.e. less than 20 percent canopy cover of 'established' saplings/ existing trees)

2. Methodology

Plots
5.6 metre radius circular plots are located on a 100 metre grid across the potential regeneration area, after excluding areas of existing/'established' woodland and the 50 metre buffer from seed source.

Where the area is less than 12 hectares, there should be a minimum of
- 12 plots where the potential regeneration area is 2 to 12 hectares,
- 8 plots if it is 0.5 to 2 hectares and
- 6 plots if the area is less than 0.5 hectares.

Data (to be collected in each sample plot)
- British national grid reference (GPS from GPS device, phone or within metadata of photo)
- Number of live seedlings/saplings
- Percentage of seedlings/saplings browsed
- Average height of vegetation
- Number of mature stems
- Nearest seed source
- Geotagged photograph

3. Assessment

1. Within each 5.6 metre radius sample plot, record the number of live:
    a. seedlings 0.5 metre or less
    b. saplings from 0.5 to 1.0 metre
    c. saplings more than 1.0 metre (counted as 'established/existing woodland') and
    d. trees more than 7 centimetre diameter at breast height)
2. If there are more than 20 eligible seedlings/saplings in the plot, then allocate to the following categories:
    a. 20-50
    b. 50-100
    c. >100
3. Estimate percentage of total seedlings/eligible saplings that are browsed and in High or Very High herbivore impact category (see Appendix 1 Level of herbivore impacts above)
4. Photograph whole plot facing North

5. Record nearest seed source to plot

4. Assessment equipment

- Data collection forms (waterproof paper)
- Weatherwriter and pencils,
- Waterproof notepad
- Centimetre rule for measuring height.
- 10 metre tape measure
- Bamboo canes and tree tape for marking plots.