Using the WCC Carbon Calculation Spreadsheet
Version 2.0
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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 WCC Carbon Calculation Spreadsheet V2.0 and WCC Carbon Lookup Tables V2.0	Vicky West

Disclaimer of Warranty – WCC Carbon Lookup Tables

The Woodland Carbon Code Carbon Lookup Tables are distributed 'as is' and without warranties as to performance or merchantability or any other warranties whether expressed or implied. In particular, there is no warranty for the predictions derived from the Carbon Lookup Tables as they are regarded as indicative and not prescriptive.

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1. Introduction

The Workbook 'WCC Carbon Calculation Spreadsheet Version 2.0' provides a template in which to carry out a prediction of carbon sequestration for a woodland project. There are a number of sheets in the workbook:

- Standard Project Carbon Calculator – for 'standard' sized (> 5ha) projects
- Small Project Carbon Calculator – for projects ≤ 5ha
- A Summary PIU table for any projects which have multiple parts to a calculation or for groups of projects to provide a total amount of carbon.
- 3 examples of use of the Standard Project Carbon Calculator for a Productive conifer clearfell, regular thinned and a mixed native woodland.

The Carbon Calculation Spreadsheet should be used in conjunction with the updated WCC Carbon Lookup Tables Version 2.0 which contains the following sheets:

- Biomass Carbon Lookup Table
- Clearfell Maximum Sequestration Values
- Soil Carbon Emissions from Ground Preparation
- Soil Carbon accumulation Lookup Table

2. How to Complete a Carbon Calculation using the workbook provided

Within the 'WCC Carbon Calculation Spreadsheet', both 'Standard Project' and 'Small Project' Carbon Calculators follow the same principle. The blue 'assumptions' cells need to be completed, and then the calculation should occur automatically.

2.1 Small project (≤ 5 ha net planting area)

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. Only the blue boxes need to be completed and then the calculation is automatically completed.

Note the Small Project Calculator can only be used for projects with 5 hectares net planting area or less, and only for projects which do not involve clearfelling.

On the Small Project calculator you need to add

1. Project name
2. Name of person completing calculation
3. Date of calculation
4. Project start date (last day of planting) consistent with your PDD
5. Area of woodland creation which is:
    a. Broadleaved minimum intervention
    b. Broadleaved thinned
    c. Conifer minimum intervention
    d. Conifer thinned
6. To establish soil carbon emissions:
    a. Soil type
    b. Previous land-use
    c. Site preparation technique
    d. Area of land that was prepared.

The prediction of the carbon to be sequestered will then be calculated automatically, and the 'Pending Issuance Units by Vintage' table should be copied to the Project Design Document.

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 form part of the carbon calculation.

2.2 Standard-sized project (over 5 ha net planting area)

The Standard Project Carbon Calculator requires a few more inputs to be clarified by the project developer. Within the WCC Carbon Calculation Spreadsheet there are three example calculations which should also help:

- A productive conifer scenario (no thinning, clearfell only)
- A productive conifer scenario (regular thin only)
- A mixed native woodland (minimum intervention)

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 Assumptions table 1:

The first table brings together the assumptions about:

- The timing and area of the project (start date, duration, net planting area)
- The emissions generated whilst establishing the woodland
- The soil carbon emissions due to disturbing the soil during establishment
- The desire to claim for soil carbon accumulation

These emissions due to establishment are accounted for in year 1 of the project.

Timing and area:
Start date: Enter the start date in dd/mm/yyyy format. The start date is the last date of planting.
Project duration: Enter the project duration in years.
Net planting area: Enter the net planting area (excluding open space/open ground)

Emissions due to establishment:

- For seedlings, enter the spacing used and the area of seedlings planted.
- For Ground prep, tree shelters, fencing and herbicide, enter the area for which these are applicable. Remember a larger area could have been fenced, and herbicide could be applied more than once (double the area if two applications).
- If any forest roads are constructed, enter the length in km.
- If any trees or vegetation was removed prior to the start of the project this should be accounted for separately. See Guidance on 3.3 Project Carbon Sequestration

Soil carbon emissions from site preparation:
Disturbance of soil during ground preparation can lead to greenhouse gas emissions from the soil. The greater the volume of soil disturbance, the greater the level of emissions. This soil carbon emission is accounted for in year 1 of the project.

Enter the soil type, previous land-use, site preparation technique and country using the dropdown menus. You then need to select the area which has been prepared using this technique - for some projects only a proportion of the site might have been mounded for example.

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, which is on mineral soil and was previously in arable use. Select ‘Yes’ if you would like to claim soil carbon accumulation.

Assumptions Table 1, Example for a mixed native woodland

Assumptions Table 1				
Project Basics				
Project start date				01 April 2018
Project duration (years)				100
Total net planting area - excluding open space (ha)				10.00
Emissions from establishment	**spacing (m)**	**area (ha)**	**tCO_2e/ha**	**tCO_2e**
Seedlings	2.5	10.0	-0.24	-2.4
Ground Preparation (Fuel)		10.0	-0.06	-0.6
Tree Shelters		0.0	-0.82	0.0
Fencing		15.0	-1.64	-24.6
Herbicide		10.0	-0.001	0.0
Road Building		**km**	**tCO_2e/km**	**tCO_2e**
Roads		0.0	-43.13	0.0
Emissions from removal of trees or other vegetation at the start of the project				
To be calculated separately if any trees or other vegetation is removed prior to planting. See 3.3 Guidance				0.0
Total Emissions from establishment				**-27.6**
Soil carbon emissions (establishment) and sequestration				
Soil Type				Mineral
Previous Landuse				Arable
Site Preparation Technique				Negligible Disturbance: Hand screefing only
Country				England
% Topsoil Carbon Lost				0
Soil C emissions from site preparation		**Area**	**tCO_2e/ha**	**tCO_2e**
Total soil carbon emissions		10	0.0	**0.0**
Soil Carbon accumulation (currently only claimable for a site with mineral soil which was previously in arable use)				
If previously arable site on mineral soil: Are you claiming any carbon sequestration? Yes/No				Yes

2.2.2 Assumptions table 2:

This table provides the space to specify the actual areas/spacing of species planted and predicted yield class. For mixed species, it allows the user to see which 'models' from the Biomass Carbon Lookup Tables are required. There is not a model for every species/spacing/management regime, so the guidance below explains how to adapt if there is not a model that fits your situation precisely. In general, the closest scenario should be chosen.

Species

Check whether the species you are planting is in the Biomass Carbon Lookup Table (bear in mind there's one scenario called SAB (Sycamore-Ash-Birch) which applies to a number of broadleaved species – See Appendix 1). If the species you are planting is not in the lookup tables, then use the table in Appendix 2 for broadleaved species and Appendix 3 for conifer species to work out which species in the tables most closely represents what you are planting.

For example

- If you are planting alder, then you should use the SAB (Sycamore/Ash/Birch) scenario in the lookup tables as the one which most closely represents your plans(see Appendix 2).
- If you are planting maritime pine you should use the lodgepole pine scenario in the lookup tables as the one which most closely represents your plans (see Appendix 3).

Please ensure you clearly state the model you have chosen to represent your species in the Assumptions Table 2.

Mixed species planting

If you are planting a compartment with a mixture, then apportion an area of each species according to the % stems of each species planted.

For example if you are planting a 10ha wood which is 50% Sitka spruce, 30% Douglas fir and 20% European Larch see the apportionment of area as follows:

Apportioning area to a species mix

Species	% stems	Area (ha)
Sitka spruce	50	5
Douglas fir	30	3
European larch	20	2
Total Area	**100%**	**10**

This calculation assumes that the forest is being managed to maintain a consistent species mix over the period of the project. Please ensure that you clearly state what assumptions you have made regarding species mixes.

Spacing

There are a limited number of spacings in the Biomass Carbon Lookup Table. If the planting spacing you are using is not in the table, then use the closest spacing in the table. Make it clear in the Assumptions Table 2 which spacing you have used.

Estimating Yield Class

Yield class for your particular species and site should be predicted using Ecological Site Classification (ESC). This can be accessed online: http://www.forestdss.org.uk/geoforestdss/. An ESC Manual is contained within the tool.

Note:

- ESC Version 4 gives predicted Yield Classes in whole numbers (eg YC 4, 5, 6 & 7) whereas the Biomass Lookup Table 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 (eg if ESC suggests YC5, use the model for YC4)
- ESC Version 4 provides estimates for yield class 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:
    - Look at the 'Med-High 2050/AWC' option if your Soil Moisture Regime in ESC is 'Fresh' or wetter.
    - Look at the 'Med-High 2050' option if your Soil Moisture Regime is drier than this.

Management types

There are models available for managing a stand as minimum intervention and thinning to standard regimes. There is also a method do deal with stands that are managed with regular clearfell.

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 use the 'thinned' tables.

Clearfelling

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. The long-term average 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, which tends to happen by year 25 or 35. The subsequent growth of the forest should continue to be monitored as per the Carbon Assessment Protocol for the remainder of the project duration.

A separate worksheet 'Clearfell_Max_Seq_Values' – and gives the maximum amount of sequestration that can be claimed for a given rotation length for each model/scenario (known as the 'Clearfell Cap'). Within this sheet, select your scenario (for example, SS, 2.0m, YC16, thin) as you did on the 'Biomass Carbon Lookup Table' sheet. Next, look along the row to the figure relating to the length of rotation you have planned. For example a 50-year rotation shows the 'Clearfell Cap' is 226 tCO_2e/ha. At the right side of Assumptions Table 2, there is a space to enter the length of rotation, and also the 'Clearfell Cap' which is ascertained as suggested above.

Continuous Cover Forestry
Other management regimes such as Continuous Cover Forestry regimes are not yet covered within the lookup tables. In the first instance you should use the standard thinning table if continuous cover is the longer-term objective.

Assumptions Table 2: Example for a Mixed Native Woodland

Assumptions Table 2									If Clearfelling only	
Sectn No:	Actual Species	Actual Spacing (m)	Scenario/ Model from Lookup Table	Spacing used in Lookup tables (m)	Yield Class Used in Lookup Tables (Get from ESC)	Management Regime from Lookup Tables	% of Area if mixture	Area (ha)	Age at clearfell (years)	Clearfell Cap (tCO2e/ha)
1	Oak	2.2	OK	2.5	4	No thin no clearfell	20.00%	2.00		
1	Sycamore	2.2	SAB	2.5	6	No thin no clearfell	20.00%	2.00		
1	Birch	2.2	SAB	2.5	8	No thin no clearfell	20.00%	2.00		
1	Aspen	2.2	SAB	2.5	8	No thin no clearfell	8.00%	0.80		
1	Alder	2.2	SAB	2.5	4	No thin no clearfell	10.00%	1.00		
1	Rowan	2.2	SAB	2.5	4	No thin no clearfell	10.00%	1.00		
1	Hazel	2.2	SAB	2.5	4	No thin no clearfell	7.00%	0.70		
1	Willow	2.2	SAB	2.5	4	No thin no clearfell	5.00%	0.50		
Total Area							100.0%	10.00		

2.2.3 Sequestration per hectare Table 3

Having made the assumptions above, you will have selected a number of 'model' scenarios' which will represent your woodland creation project. For each 'model scenario' you will need to name a column in 'Sequestration per hectare Table 3', and then look-up in the Biomass Carbon Lookup Table, how carbon will be sequestered over time for that model scenario, and copy these figures to the Sequestration per hectare Table 3.

For example, if one model scenario is that your woodland contains:

- 2.8ha of birch (modelled as SAB)
- planted at 2.5m spacing;
- predicted yield class 8
- not thinned

Simply select these options in the 'Biomass Carbon Lookup Table' by clicking on the 'down arrow' in the header of each of columns 1-4, and you will be presented with the information in Table 4. You then need to copy this into the relevant column in 'Sequestration per hectare Table 3' within the WCC Carbon Calculation Spreadsheet.

Example scenario from the Carbon Lookup Tables showing woodland carbon sequestration rate

Species	Spacing (m)	Yield Class	Management	Period (year)	Carbon Standing (tCO2e/ha/yr)	Debris (tCO2e/ha/yr)	Total (tCO2/ha/yr)	Cumulative in-period (tCO2e/ha/ 5yr period)	Cum. Biomass Sequestrn (tCO2e/ha)	Cum. Emis. Ongoing Mgmt (tCO2e/ha)	Cumulative Total Sequestrn (tCO2e/ha)	Removed from Forest (tCO2e/ha/yr)
SAB	2.5	8	NO_thin	0-5	1.70	0.23	1.92	9.6	9.6	0.00	9.6	0.00
SAB	2.5	8	NO_thin	5-10	7.29	0.44	7.72	38.6	48.2	0.00	48.2	0.00
SAB	2.5	8	NO_thin	10-15	21.76	1.18	22.95	114.7	163.0	0.00	163.0	0.00
SAB	2.5	8	NO_thin	15-20	28.81	1.23	30.04	150.2	313.1	0.00	313.1	0.00
SAB	2.5	8	NO_thin	20-25	20.89	0.39	21.28	106.4	419.5	0.00	419.5	0.00
SAB	2.5	8	NO_thin	25-30	15.40	6.39	21.79	109.0	528.5	0.00	528.5	0.00
SAB	2.5	8	NO_thin	30-35	11.30	8.79	20.08	100.4	628.9	0.00	628.9	0.00
SAB	2.5	8	NO_thin	35-40	9.88	2.26	12.14	60.7	689.6	0.00	689.6	0.00
SAB	2.5	8	NO_thin	40-45	9.10	-0.03	9.07	45.4	734.9	0.00	734.9	0.00
SAB	2.5	8	NO_thin	45-50	8.26	-1.18	7.08	35.4	770.4	0.00	770.4	0.00
SAB	2.5	8	NO_thin	50-55	7.05	-1.58	5.47	27.4	797.7	0.00	797.7	0.00
SAB	2.5	8	NO_thin	55-60	6.01	-1.68	4.32	21.6	819.3	0.00	819.3	0.00
SAB	2.5	8	NO_thin	60-65	5.20	-0.97	4.23	21.1	840.5	0.00	840.5	0.00
SAB	2.5	8	NO_thin	65-70	4.54	-1.23	3.32	16.6	857.1	0.00	857.1	0.00
SAB	2.5	8	NO_thin	70-75	3.99	-1.18	2.81	14.1	871.1	0.00	871.1	0.00
SAB	2.5	8	NO_thin	75-80	3.65	-0.68	2.97	14.8	886.0	0.00	886.0	0.00
SAB	2.5	8	NO_thin	80-85	3.29	-0.48	2.81	14.0	900.0	0.00	900.0	0.00
SAB	2.5	8	NO_thin	85-90	2.92	-0.63	2.29	11.4	911.4	0.00	911.4	0.00
SAB	2.5	8	NO_thin	90-95	2.57	-0.55	2.02	10.1	921.6	0.00	921.6	0.00
SAB	2.5	8	NO_thin	95-100	2.35	-0.46	1.89	9.5	931.0	0.00	931.0	0.00

Sequestration per hectare Table 3

From Carbon Lookup Tables: 'Cumulative total sequestration' (column L): t CO_2/ha						SOIL
Period (year)	Birch (SAB YC8 2.5m, No thin)					Soil C ac[illegible]ral previously arable use
0-5	9.6					2.8
5-10	48.2					5.5
10-15	163.0					8.3
15-20	313.1					11.0
20-25	419.5					13.8
25-30	528.5					16.5
30-35	628.9					19.3
35-40	689.6					22.0
40-45	734.9					24.8
45-50	770.4					27.5
50-55	797.7					29.3
55-60	819.3					31.2
60-65	840.5					33.0
65-70	857.1					34.8
70-75	871.1					36.7
75-80	886.0					38.5
80-85	900.0					40.3
85-90	911.4					42.2
90-95	921.6					44.0
95-100	931.0					45.8

Copy and 'paste special' (values only) the figures from the selected model in the Biomass Carbon Lookup Table to the 'Sequestration per hectare Table 3' in the Carbon Calculator.

Projects involving clearfelling

If your project involves clearfelling, you need to do one extra step. In 2.2.2, you looked up the 'clearfell cap' for your project. You need to apply this to the 'sequestration per hectare' table from the point at which the clearfell cap is reached. Continuing the example from 2.2.2, if you have SS, 2.0m, YC16, thin, clearfelled at year 50, then we ascertained the 'Clearfell Cap' was 226 tCO_2e/ha. In this case this should be applied from the period 20-25 years.

Sequestration per hectare Table 3

From Carbon Lookup Tables: 'Cumulati (column L): t CO_2/ha

Period (year)	SS, YC16, 2.0m, Thinned		
0-5	5.9		
5-10	22.0		
10-15	68.2		
15-20	190.4		
20-25	247.4		
25-30	297.3		
30-35	369.7		
35-40	433.5		
40-45	483.3		
45-50	519.4		
50-55	555.0		
55-60	582.7		
60-65	611.2		
65-70	631.2		
70-75	650.3		
75-80	669.1		
80-85	683.7		
85-90	693.6		
90-95	702.6		
95-100	711.4		

Apply the 'Clearfell Cap' (226 tCO_2) from the time it is reached (in this case from the period 20-25 up to the 95-100 year period)

Sequestration per hectare Table 3

From Carbon Lookup Tables: 'Cumulati (column L): t CO_2/ha

Period (year)	SS, YC16, 2.0m, Thinned		
0-5	5.9		
5-10	22.0		
10-15	68.2		
15-20	190.4		
20-25	226.0		
25-30	226.0		
30-35	226.0		
35-40	226.0		
40-45	226.0		
45-50	226.0		
50-55	226.0		
55-60	226.0		
60-65	226.0		
65-70	226.0		
70-75	226.0		
75-80	226.0		
80-85	226.0		
85-90	226.0		
90-95	226.0		
95-100	226.0		

Projects involving natural regeneration
If a woodland is to be established by natural regeneration rather than planting, trees are likely to take longer to establish. As such, projects should

- Use a conservative scenario (eg assume SAB, YC4, 2.5m spacing, no thin)
- 'Set back' the growth of trees by 5 years (so anticipated sequestration for year 0-5 from a planted stand occurs in year 5-10 of a natural regeneration area

Sequestration per hectare Table 3

From Carbon Lookup Tables: 'Cumulat (column L): t CO_2/ha

Period (year)	Nat Regen (SAB YC4 2.5m, No thin)		
0-5	2.6		
5-10	11.8		
10-15	43.0		
15-20	133.3		
20-25	241.2		
25-30	319.3		
30-35	376.1		
35-40	421.6		
40-45	460.5		
45-50	505.0		
50-55	526.6		
55-60	541.3		
60-65	553.6		
65-70	559.8		
70-75	566.9		
75-80	574.1		
80-85	579.9		
85-90	585.5		
90-95	604.3		
95-100	606.1		

Sequestration per hectare Table 3

From Carbon Lookup Tables: 'Cumulat (column L): t CO_2/ha

Period (year)	Nat Regen (SAB YC4 2.5m, No thin)		
0-5	0.0		
5-10	2.6		
10-15	11.8		
15-20	43.0		
20-25	133.3		
25-30	241.2		
30-35	319.3		
35-40	376.1		
40-45	421.6		
45-50	460.5		
50-55	505.0		
55-60	526.6		
60-65	541.3		
65-70	553.6		
70-75	559.8		
75-80	566.9		
80-85	574.1		
85-90	579.9		
90-95	585.5		
95-100	604.3		

2.2.4 Project sequestration Table 4

The next step is to multiply the sequestration per hectare figures by the area accounted for with each model. Continuing the example from above, if we have 2.8 hectares of birch, yield class 8, 2.5m spacing, no thinning so in the 'area' box of 'Sequestration for whole project Table 4' we need to add 2.8. You need to repeat this for each model scenario being used. Thus the sequestration for the whole project Table 4 would look like this:

If you plan to claim soil carbon accumulation (only if you have mineral soil which was previously in arable use), then you need to remember to include the relevant area you are claiming in the 'Soil' area box.

Sequestration for whole project Table 4					
Lookup table multiplied by relative area (ha)			Total (ha):	2.80	SOIL
2.80	0.00	0.00	0.00	0.00	0.00
SAB YC8 2.5m, No thin					Soil C accumuln for mineral soil previously arable use
26.9	0.0	0.0	0.0	0.0	0.0
135.1	0.0	0.0	0.0	0.0	0.0
456.3	0.0	0.0	0.0	0.0	0.0
876.8	0.0	0.0	0.0	0.0	0.0
1174.7	0.0	0.0	0.0	0.0	0.0
1479.7	0.0	0.0	0.0	0.0	0.0
1760.9	0.0	0.0	0.0	0.0	0.0
1930.8	0.0	0.0	0.0	0.0	0.0
2057.8	0.0	0.0	0.0	0.0	0.0
2157.0	0.0	0.0	0.0	0.0	0.0
2233.6	0.0	0.0	0.0	0.0	0.0
2294.1	0.0	0.0	0.0	0.0	0.0
2353.3	0.0	0.0	0.0	0.0	0.0
2399.7	0.0	0.0	0.0	0.0	0.0
2439.1	0.0	0.0	0.0	0.0	0.0
2480.7	0.0	0.0	0.0	0.0	0.0
2520.0	0.0	0.0	0.0	0.0	0.0
2552.0	0.0	0.0	0.0	0.0	0.0
2580.3	0.0	0.0	0.0	0.0	0.0
2606.8	0.0	0.0	0.0	0.0	0.0

2.2.5 Net Carbon Sequestration Table 5

Net Carbon Sequestration Table 5 is mostly completed automatically. If your Baseline or Leakage calculations are anything but ‘no change over time’ you need to add your Baseline/Leakage prediction to the relevant column in this table. Otherwise move onto the Pending Issuance Units by Vintage Table.

2.2.6 Pending Issuance Units by Vintage

This table will complete automatically. It is this table that will summarise the monitoring period dates and determine how many Pending Issuance Units are issued for which vintage/ monitoring period. This table should be copied and pasted into your Project Design Document. If you choose a project duration which is less than 100 years, you will need to amend the Pending Issuance 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 75-85, 85-95 and 95-100:

Verification: years since start date	Vintage Start Date	Vintage End Date	Total PIUs in vintage to be listed	PIUs to Buffer	PIUs to Project
5	01 April 2018	31 March 2023	35	7	28
15	01 April 2023	31 March 2033	612	122	490
25	01 April 2033	31 March 2043	1629	326	1303
35	01 April 2043	31 March 2053	1545	309	1236
45	01 April 2053	31 March 2063	935	187	748
55	01 April 2063	31 March 2073	545	109	436
65	01 April 2073	31 March 2083	337	68	269
75	01 April 2083	31 March 2093	259	51	208
85	01 April 2093	31 March 2103	240	48	192
95	01 April 2103	31 March 2113	247	50	197
100	01 April 2113	[illegible]rch 2118	86	17	69
Total			**6470**	**1294**	**5176**

If your project is less than 100 years, delete the data from the relevant rows after your project duration (eg if your project is 75 years long, delete the last 3 vintages/periods

Verification: years since start date	Vintag[illegible]t Date	Vintage End Date	Total PIUs in vintage to be listed	PIUs to Buffer	PIUs to Project
5	01 A[illegible]018	31 March 2023	35	7	28
15	01 Ap[illegible]3	31 March 2033	612	122	490
25	01 Apr[illegible]	31 March 2043	1629	326	1303
35	01 April [illegible]	31 March 2053	1545	309	1236
45	01 April 20[illegible]	31 March 2063	935	187	748
55	01 April 20[illegible]	31 March 2073	545	109	436
65	01 April 2073	31 March 2083	337	68	269
75	01 April 2083	31 March 2093	259	51	208
Total			**5897**	**1179**	**4718**

2.3 Total for groups or compartments within a project

2.3.1 Multiple compartments within a project

If your project is complex with several compartments of different species or management, it might be easier to use a 'Standard Project Carbon Calculator' for each compartment. You will then need to add together the compartments to get a total figure for the project. Use the sheet 'SummaryPIU_Table_comptmt_groups' to add together the individual PIU tables from each compartment and re-name this sheet/tab so it's clear what it refers to.

2.3.2 Multiple projects within a group

If you are submitting a group of projects for validation, you will need to copy the relevant Carbon Calculator to a new sheet so you have a separate sheet for each project. You will also need to come up with a 'total' sequestration for your whole group. Use the sheet 'SummaryPIU_Table_comptmt_groups' to add together the individual PIU tables from each project and re-name this sheet/tab so it's clear what it refers to.

5. References

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.

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.

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Appendix 1: The Makeup of the Biomass Carbon Lookup Table

1.1 The 'Biomass Carbon Lookup Table'

The 'Biomass Carbon Lookup Table' gives annualised sequestration rates at 5-yearly intervals for a range of woodland types in terms of species, initial spacing, yield class and management activity. A separate table deals with woodlands which are periodically clearfelled and another document deals with how the tables were constructed (Randle *et al* 2011). Morison *et al* (2012) provides a more technical description of the processes accounted for in modelling the carbon balance in forests.

The Biomass Carbon Lookup Table contains the information described in Table 1, for 5-yearly intervals, 0-5, 5-10, 10-15 etc up to years 195-200:

Table 1: Description of Fields in the Woodland Carbon Lookup Tables

Purpose	Column	Contents	Units
Input values – Choose the situation most suited	A	Species	Standard abbreviation
	B	Initial Spacing	m
	C	Yield Class	Standard yield classes
	D	Management	Standard thinning or no thinning
Rate of carbon sequestration in each period.	E	Period	years
	F	Standing carbon	tCO_2e/ha/year
	G	Debris	tCO_2e/ha/year
	H	Total Carbon	tCO_2e/ha/year
	I	In-period cumulative total C	tCO_2e/ha/5-years
Cumulative CO_2e sequestered over time in the biomass	J	Cum. Biomass Sequestrn	tCO_2e/ha
Cumulative Emissions from Ongoing woodland management	K	Cum. Emis. Ongoing Mgmt.	tCO_2e/ha
Total Cumulative CO_2e sequestered over time	L	Cumulative Total Sequestrn	tCO_2e/ha
For information only: Carbon removed from forest during thinning	M	Removed from forest	tCO_2e/ha/year

Positive values represent carbon sequestration; negative values represent carbon emissions.

1.1.1 Input values

Species

17 major UK forest species are currently represented in the Biomass Carbon Lookup Tables (Table 2). There are 3 broadleaved scenarios (including Sycamore/Ash/Birch which is applicable to these species individually or as a mixture) and 14 conifer species.

Table 2: Species included within the woodland Carbon Lookup Tables

Broadleaved species	Name	Botanical Name
BE	Beech	*Fagus sylvatica*
OK	Oak	*Quercus spp.*
SAB	sycamore, ash, birch (mix or pure species)	*Acer pseudoplatanus/ Fraxinus excelsior/ Betula spp.*
Conifer species	**Name**	**Botanical Name**
CP	Corsican pine	*Pinus nigra var maritima*
DF	Douglas fir	*Pseudotsuga menziesii*
EL	European larch	*Larix decidua*
GF	grand fir	*Abies grandis*
HL	hybrid larch	*Larix x eurolepis*
JL	Japanese larch	*Larix kaempferi*
LEC	Leyland cypress	*Cupressocyparis leylandii*
LP	lodgepole pine	*Pinus contorta*
NF	noble fir	*Abies procera*
NS	Norway spruce	*Picea abies*
RC	western red cedar	*Thuja plicata*
SP	Scots pine	*Pinus sylvestris*
SS	Sitka spruce	*Picea sitchensis*
WH	western hemlock	*Tsuga heterophylla*

Initial spacing (m) Tables currently contain initial spacings from 1.2m (ie 6,944 stems per ha) to 3.0m (i.e. 1,111 stems per ha). The spacings shown depend upon the species.

Yield Class The predicted yield class of the woodland. Again the options available vary with species from 4 (for beech) to 30 (for grand fir).

Management Currently there are two options available

- **Thin.** In this option the crop is regularly thinned to the standard 5-yearly thinning regime
- **No Thin**. In this option there is no management intervention the crop is simply left to grow.

1.1.2 Rate of carbon sequestration in each period

Period The period is indicated as 5-year periods since establishment. The tables run from the first period 0-5 years, to 195-200 years.

Carbon Standing The rate of carbon sequestration for the whole tree (including roots, stem, branch and foliage) in each 5-year period.

Debris The rate of sequestration for the debris (a positive figure indicates that more has been added to the debris ‘pool’ than has decayed from it (eg as litter fall or dead wood left in the forest at thinning))

Total = Rate of carbon sequestration for the whole tree biomass plus debris. Soil carbon is dealt with separately.

Cumulative In-period = five-year total of carbon standing plus debris. Again changes to soil carbon is dealt with separately.

1.1.3 Cumulative sequestration in biomass. Cumulative total carbon stored per hectare in the biomass as the forest grows from establishment to year 200.

1.1.4 Cumulative emissions from ongoing woodland management. Cumulative emissions (shown as negative) due to thinning operations.

1.1.5 Total cumulative sequestration. This column shows the net cumulative carbon sequestration taking into account the ongoing emissions from woodland management. **These are the figures that need to be used in calculations of carbon sequestered in a potential new woodland creation project.**

1.1.6 Removed from Forest. For completeness, this column shows the carbon that is removed from a woodland during thinnings. These figures should not be used in any calculations of carbon stored in woodland creation projects. They are shown to aid understanding of the difference between the thinned and unthinned scenarios.

1.2 'Clearfell_Max_Seq_Values' for clearfell options

The figures given in the standard 'Biomass Carbon Lookup Table' assume that woodlands are managed without clearfelling. If a woodland is to be managed on a clearfell basis, then an adjustment needs to be made to these figures, to find the long-term average carbon on the site when periodically clearfelling trees. This is effectively a 'cap' to the amount of CO_2e that could be claimed from the 'Biomass Carbon Lookup Table' (which assumes no clearfelling). These figures are found on the 'Clearfell_Max_Seq_Values' sheet (Table 3).

Table 3: Description of Fields in the 'Max Sequestration Values' Table

Purpose	Column	Contents	Units
Input values – Choose the situation most suited	A	Species	Standard abbreviation
	B	Initial Spacing	M
	C	Yield Class	Standard yield classes
	D	Management	Standard thinning or no thinning
Long-term average carbon sequestration for various clearfell rotation lengths	E to T	Cap for clearfell scenarios of various rotation lengths	tCO_2e/ha

Species, Initial Spacing, Yield Class and Management as per the Carbon Lookup Table and described in 1.1

Cap for scenarios with varying rotation lengths The long-term average amount of carbon that will be sequestered for each scenario, for a given rotation length (20 to 200 years). This is the maximum amount of CO_2e per hectare that can be claimed, in the first rotation only, where woodlands are managed on a clearfell regime. It also allows for the operational emissions from carrying out the clearfell within this 'cap'.

Appendix 2: Default values to use for broadleaved species

Abbr.	Name	Botanical name	Use table for:
	Alder	*Alnus spp.*	SAB
AH (SAB)	Ash	*Fraxinus excelsior*	SAB
	Aspen	*Populus tremula*	SAB
BE	Beech	*Fagus sylvatica*	BE
	big leaf maple	*Acer macrophyllum*	SAB
BI (SAB)	birch (downy/silver)	*Betula spp.*	SAB
	bird cherry	*Prunus padus*	SAB
	black poplar	*Populus nigra*	SAB
	black walnut	*Juglans nigra*	OK
	Blackthorn	*Prunus spinose*	SAB
	Box	*Buxus spp.*	SAB
	cider gum	*Eucalyptus gunnii*	SAB
	common alder	*Alnus glutinosa*	SAB
	common lime	*Tilia europea*	SAB
	common walnut	*Juglans regia*	OK
	crab apple	*Malus sylvestris*	SAB
	crack willow	*Salix fragilis*	SAB
	downy birch	*Betula pubescens*	SAB
	downy oak	*Quercus pubescens*	OK
	Elm	*Ulmus spp.*	BE
	English elm	*Ulmus procera*	BE
	field maple	*Acer campestre*	SAB
	goat willow	*Salix caprea*	SAB
	green alder	*Alnus viridis*	SAB
	grey alder	*Alnus incana*	SAB
	grey poplar	*Populus canescens*	SAB
	grey willow	*Salix cinerea*	SAB
	hawthorn species	*Crataegus spp*	SAB
	Hazel	*Corylus avellana*	SAB
	holly species	*Ilex spp.*	SAB
	Holm oak	*Quercus ilex*	OK
	Hornbeam	*Carpinus betulus*	BE
	horse chestnut	*Aesculus hippocastanum*	SAB
	Hungarian oak	*Quercus frainetto*	OK
	hybrid poplars	*Populus serotina/trichocarpa etc.*	SAB
	Italian alder	*Alnus cordata*	SAB
	large-leaved lime	*Tilia platyphyllos*	SAB
	Lenga	*Nothofagus pumilio*	SAB
	Lime	*Tilia spp.*	SAB
	London plane	*Platanus* x *acerifolia*	SAB
	mixed broadleaves		SAB
	Narrow-leafed ash	*Fraxinus angustifolia*	SAB

Abbr.	Name	Botanical name	Use table for:
	Norway maple	*Acer platanoides*	SAB
OK	oak (robur/petraea)	*Quercus spp.*	OK
	oriental beech	*Fagus orientalis*	BE
	other birches	*Betula spp.*	SAB
	other broadleaves		SAB
	other cherry spp	*Prunus spp.*	SAB
	other Eucalyptus	*Eucalyptus spp.*	SAB
	other Nothofagus	*Nothofagus spp.*	SAB
	other oak spp	*Quercus spp.*	OK
	other Poplar spp	*Populus spp.*	SAB
	other walnut	*Juglans spp.*	OK
	other willows	*Salix spp.*	SAB
	paper-bark birch	*Betula papyrifera*	SAB
	pedunculate/common oak	*Quercus robur*	OK
	plane spp	*Platanus spp.*	SAB
	Pyrenean oak	*Quercus pyrenaica*	OK
	raoul/rauli	*Nothofagus nervosa*	SAB
	red alder	*Alnus rubra*	SAB
	red ash	*Fraxinus pennsylvanica*	SAB
	red oak	*Quercus borealis*	BE
	Roble	*Nothofagus obliqua*	SAB
	Rowan	*Sorbus aucuparia*	SAB
	sessile oak	*Quercus petraea*	OK
	shagbark hickory	*Carya ovata*	BE
	shining gum	*Eucalyptus nitens*	BE
	silver birch	*Betula pendula*	SAB
	silver maple	*Acer saccharinum*	SAB
	small-leaved lime	*Tilia cordata*	SAB
	smooth-leaved elm	*Ulmus carpinifolia*	BE
	sweet chestnut	*Castanea sativa*	BE
SY (SAB)	Sycamore	*Acer pseudoplatanus*	SAB
	tulip tree	*Liriodendron tulipifera*	BE
	Turkey oak	*Quercus cerris*	OK
	white ash	*Fraxinus Americana*	SAB
	white oak	*Quercus alba*	OK
	white poplar	*Populus alba*	SAB
	white willow	*Salix alba*	SAB
	Whitebeam	*Sorbus aria*	SAB
	wild cherry, gean	*Prunus avium*	SAB
	wild service tree	*Sorbus torminalis*	SAB
	wych elm	*Ulmus glabra*	BE

Appendix 3: Default values to use for conifer species

Abbr.	Name	Botanical name	Use table for:
	Armand's pine	*Pinus armandii*	SP
	Atlas cedar	*Cedrus atlantica*	NF
	Austrian pine	*Pinus nigra var nigra*	CP
	Bhutan pine	*Pinus wallichiana*	SP
	Bishop pine	*Pinus muricata*	CP
	Bornmuller's fir	*Abies bornmuelleriana*	NF
	Calabrian pine	*Pinus brutia*	SP
	cedar of Lebanon	*Cedrus libani*	NF
	Coast redwood	*Sequoia sempervirens*	GF
CP	Corsican pine	*Pinus nigra var maritima*	CP
DF	Douglas fir	*Pseudotsuga menziesii*	DF
EL	European larch	*Larix decidua*	EL
	European silver fir	*Abies alba*	NF
GF	Grand fir	*Abies grandis*	GF
	Grecian fir	*Abies cephalonica*	NF
HL	hybrid larch	*Larix x eurolepis*	HL
	Japanese cedar	*Cryptomeria japonica*	RC
JL	Japanese larch	*Larix kaempferi*	JL
	Korean pine	*Pinus koreana*	SP
	Lawson's cypress	*Chamaecyparis lawsoniana*	RC
LEC	Leyland cypress	*Cupressocyparis leylandii*	LEC
	loblolly pine	*Pinus taeda*	CP
LP	lodgepole pine	*Pinus contorta*	LP
	Macedonian pine	*Pinus peuce*	CP
	Maritime pine	*Pinus pinaster*	LP
	Mexican white pine	*Pinus ayacahuite*	SP
	mixed conifers		NS
	Monterey pine	*Pinus radiata*	CP
	mountain pine	*Pinus uncinata*	SP
NF	noble fir	*Abies procera*	NF
	Nordmann fir	*Abies nordmanniana*	NF
NS	Norway spruce	*Picea abies*	NS
	oriental spruce	*Picea orientalis*	NS
	other Cedar	*Cedrus spp.*	NF
	other conifers		NS
	other firs (Abies)	*Abies spp.*	NF
	other larches	*Larix spp.*	EL
	other pines	*Pinus spp.*	SP
	other spruces	*Picea spp.*	NS
	Ponderosa pine	*Pinus ponderosa*	SP
	red fir (pacific silver)	*Abies amabilis*	GF
SP	Scots pine	*Pinus sylvestris*	SP
	Serbian spruce	*Picea omorika*	NS
SS	Sitka spruce	*Picea sitchensis*	SS

Abbr.	Name	Botanical name	Use table for:
	slash pine	*Pinus ellottii*	LP
	Wellingtonia	*Sequoiadendron giganteum*	GF
WH	western hemlock	*Tsuga heterophylla*	WH
RC	western red cedar	*Thuja plicata*	RC
	western white pine	*Pinus monticola*	LP
	Weymouth pine	*Pinus strobus*	SP
	Yew	*Taxus baccata*	SP
	Yunnan pine	*Pinus yunnanensis*	SP