The Woodland Carbon Code (1) â?? tree carbon at the expense of soil carbon

Description

The Woodland Carbon Code (WCC) describes itself (see here) as â??the UKâ??s government-backed standard for creating new woodlands that generate high-integrity carbon creditsâ?? and is managed by Scottish Forestry. The WCC is based on a number of key assumptions which are not explicitly stated:

- the first is that since trees take CO2 out of the atmosphere through photosynthesis, if there were more trees in the British Isles that would help offset the carbon emissions which are causing the world to heat up;
- the second is that extending tree cover for carbon offsetting purposes is best done by planting trees rather than through natural regeneration;
- the third is that planting trees requires private investment;
- the fourth is that this private investment is best secured through the creation of a market in which the creators of new woodland can sell carbon credits to those who wish to offset their carbon emissions;
- the fifth is that a significant proportion of the carbon trees absorb from the atmosphere remains locked up after they are harvested or die naturally.

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Following Richard Evans post on The Carbon Illusion: Why â??Net Zeroâ?• Is Not Environmental Neutrality this series of posts will take a critical at the WCC starting with the first assumption. If that assumption is wrong, the WCC and the market it is trying to create faces collapse.

Trees and soils as stores of organic carbon

Inorganic carbon, in the form of rocks like limestone, is estimated to contribute 38% of the total carbon stored in soils. The rest is made up of organic carbon. This is estimated to amount to about four times that stored in the earthâ??s plants, including trees (see here). The level of Soil Organic Carbon (SOC) varies considerably, from less than 1% in the worldâ??s deserts to over 50% in peatland. The peatland which covers over 20% of Scotland (see here) is therefore a much more important means of storing carbon than trees. The Scottish Governmentâ??s allocation of Â£250 million over 10 years to restore damaged peatland is partial recognition of this fact although at the same time it continues to allow trees to be planted on peat less than 50cms deep.

It is not just soils officially classified as peatland which are important for storing organic carbon. Forest Research estimates that within Britainâ??s forests around 70% of the organic carbon is found in â??forest soilsâ?• not the trees (see here). Of this forest SOC 11% is estimated comes from the first metre of â??deep peatâ?? on which trees have been planted. The amount of SOC stored decreases from organic > organo-mineral > mineral soils.

Evidence from across the world (see here) now shows that where trees are planted on peatland, this releases SOC over time, whereas where trees are planted on mineral soils this results in an increase in

SOC over time. If the intention of the WCC, therefore, is to help offset carbon emissions, it is crucial that trees are planted on soils with low organic content. The UKâ??s Climate Change Committee recognised this in its Seventh Carbon Budget published in February 2025 (see here) when it recommended that while Britain needs a lot more woodland:

â??Trees are only planted on mineral soils, with organo-mineral and organic soils excluded to protect biodiverse habitats and minimise soil carbon loss from planting disturbance.â??

A couple of further pieces of research on the relationship between trees and soils, which have specific implications for the WCC, are worth highlighting.

Friggens et al in 2020 (see here), coming from a soils perspective, showed that planting downy birch and Scots pine on heather moorland â?? podzols rather than peat â?? resulted in no net increase in ecosystem CO2 in four experimental sites 12-39 years after planting. In one case there was a net decrease in carbon. They hypothesised that this release of SOC, equal to or more than the carbon absorbed by the trees, resulted from the impact that trees have on soil respiration processes.

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Forest Research, coming from a trees perspective, found (see here) that while planting woodland on more mineral soils resulted in an initial rapid increase in SOC this tailored off and stabilised over time. The long-term potential of woodland to increase SOC, which comprises over two thirds of the carbon stored in forests, thus appears limited or, as the International Union for the Conservation of Nature put it (see here):

â??Forest planting and restocking on peat translocates carbon from a large soil carbon reservoir that is secure over millennia under natural conditions (i.e. peat soils) to a more reactive store (i.e. wood) which,regardless of its end use, is more likely to be converted back to carbon dioxide within years to decades.â??

What all this research shows is that if the WCC is to achieve its intended objectives, it should start with considering the soils not the trees.

The WCC calculator and soils

The WCC is underpinned by a calculator (for current version, 2.3 dated August 2025, see here). Its primary purpose is to measure the amount of CO2 absorbed by new woodland (Assumption 1) so that these â??gainsâ?? can be traded on the Woodland Carbon Market. This can be either in the form of Pending Issuance Units (PIUs) â?? a promise to deliver at a later date â?? or actual Carbon Units (each one represents a ton of CO2 removed from the atmosphere).

The WCC has from the start acknowledged that the activities involved in creating new woodland can cause carbon emissions. Allowances for this are incorporated into the calculator in Table 1 on â??Emissions from establishmentâ??;

	Emissions from establishment	Tree spacing (metres)	Area (hectares)	tCO_2e per hectare	tCO_2e
16					
17	Seedlings	Select spacing	0.00	Select spacing first	0.00
18	Tree protection - Tree shelters (1.2m)	Select spacing	0.00	Select spacing first	0.00
19	Tree protection - Spiral guards (0.6m)	Select spacing	0.00	Select spacing first	0.00
20	Tree protection - Voleguards	Select spacing	0.00	Select spacing first	0.00
21	Fertiliser	Select spacing	0.00	Select spacing first	0.00
22	Ground preparation (fuel): Mounding		0.00	-0.420	0.00
23	Ground preparation (fuel): Scarifying		0.00	-0.052	0.00
24	Ground preparation (fuel): Ploughing		0.00	-0.069	0.00
25	Ground preparation (fuel): Subsoiling		0.00	-0.173	0.00
26	Herbicide		0.00	-0.044	0.00
27	Fencing and gates		fence (m), gates (#)	tCO_2e per unit	tCO_2e
28	Length of fence in metres		0.00	-0.0022	0.00
29	Number of gates		0	-0.583	0.00
30	Road building		km	tCO_2e per km	tCO_2e
31	Length of road in kilometres		0.00	-43.13	0.00
32	Emissions from removal of trees or other vegetation at the start of the project				tCO_2e
33	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)				0.00
34	**Total emissions from establishment**				**0.00**

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Note how only the fuel expended in ground preparation is included under Establishment Costs, not any consequent CO2 emissions caused by the carbon in soils being exposed to the air ground preparation

and Table 3, 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 'no woodland creation area above.				
Previous landuse	Soil type	Ground preparation	Area (hectares)	Perc
Arable	Mineral	Negligible Disturbance: Hand screefing only	1.00	
Pasture	Organomineral	Low disturbance: Hand turfing, inverted, hinge & trench mounding, patch scarification, subsoiling, drains	0.00	
Seminatural	Please select	Medium Disturbance: Shallow/rotary (<30cm) plough, Disc/line scarification/continuous mounding	0.00	
Please select	Please select	High Disturbance: Deep (>30cm) plough, with or without tine	0.00	
Please select	Please select	Very High Disturbance: Agricultural ploughing	0.00	
Please select	Please select	Please select	0.00	
		Total	1.00	

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Table from WCC calculator. I have entered the options available under the first three columns, three ground preparation.

The assumptions built into these tables for establishment costs and soil carbon emissions account for why the WCC calculator typically predicts, as with BrewDogâ??s Lost Forest (see here), that new planted woodland starts to sequester CO2 after around 15-17 years and then starts to generate tradeable Carbon Units (rather than PIUs).

Several things have puzzled me about the WCCâ??s calculatorâ??s assumptions here I want to highlight two issues. First it only gives two options for soil type: mineral and organo-mineral, with no option for peat or soils in-between. This is despite the fact under the UK Forestry Standard trees can still be planted in Scotland on peat (i.e an organic soil) less than 50cms deep.

The second is how it deals with SOC over time:

Summary Carbon Sequestration over time

Cumulative to Year	A:	B = 80% of A	C: Negative	D:	E= B+C+D:	F:	G:	H=E+F-G	I=15- 20% of H	J=H-I	K=J/ Area
	Cumulative Carbon Sequestrn from lookup tables (tCO_2e)	Cumulative Carbon Sequestrn Less 20% model precision (tCO_2e)	Removal of vegtn and/or Establishmen t Emissions (tCO_2e)	Cumulative Soil Carbon (loss in year 1 and cumulative accumuln if relevant) (tCO_2e)	Total Project Carbon Sequestratio n (tCO_2e)	Baseline (tCO_2e) - Normally Zero - No change over time	Leakage (tCO_2e) [Emissions are negative] - Normally Zero - No change over tine	Net Project Carbon Sequestration adjusted for Baseline and Leakage (tCO_2e)	20% Contribution to buffer (tCO_2e)	Claimable Carbon Sequestratio n (tCO_2e)	Aver cla seque per by (tC
5	252	202	-604	-4890	-5292	0	0	-5292	-1058	-4234	
10	1045	836	-604	-4890	-4657	0	0	-4657	-931	-3726	
15	3606	2885	-604	-4890	-2609	0	0	-2609	-522	-2087	
20	10953	8762	-604	-4890	3268	0	0	3268	654	2614	
25	20657	16526	-604	-4890	11032	0	0	11032	2206	8826	
30	31269	25016	-604	-4890	19522	0	0	19522	3904	15618	
35	43780	35024	-604	-4890	29531	0	0	29531	5906	23625	
40	51527	41222	-604	-4890	35728	0	0	35728	7146	28582	
45	58705	46964	-604	-4890	41470	0	0	41470	8294	33176	
50	66403	53122	-604	-4890	47629	0	0	47629	9526	38103	
55	72255	57804	-604	-4890	52310	0	0	52310	10462	41848	
60	77998	62398	-604	-4890	56904	0	0	56904	11381	45523	
65	82759	66207	-604	-4890	60713	0	0	60713	12143	48570	
70	86302	69042	-604	-4890	63548	0	0	63548	12710	50838	
75	89323	71458	-604	-4890	65964	0	0	65964	13193	52771	

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Extract from the validated WCC scheme at Baddoch Hill which was bought by Oxygen Conservation part of their purchase of the Dorback Estate. The table continues to year 100.

The WCC calculator for Baddoch Hill, like every other scheme I have looked at, accounts for any predicted loss of SOC from woodland establishment in Year 1. After that it treats SOC as remaining stable contrary to the research by Friggens et al which showed that SOC can continue to be emitted over long periods of time.

I did wonder if Scottish Forestry might have decided to incorporate some allowance for SOC emissions over time in Year 1, as reflected in the figure of -4890 tCO2 recorded in column D for Baddoch Hill. However, the predicted net increase in carbon sequestration for Baddoch Hill between 2020 and 2025 from 3268 to 11032 tCO2 looks extremely high given it was mainly planted with downy birch and Scots Pine and given the research by Friggens et al. I therefore decided to ask Scottish Forestry the scientific basis for the assumptions they had used in the WCC calculator.

Scottish Forestryâ??s assumptions on Soil Organic Carbon

My first email (see here) was an information request Dr Vicky West, who has led on the development of the WCC calculator for Scottish Forestry. She responded by saying â??Itâ??s detailed in this paperâ?? and gave me this link to a paper she had written on soil carbon and the WCC back in 2011.

The paper answers the question why the WCC calculator does not include an option for organic soils. Organic soils were defined in the paper as peat over 40cm deep in England (its now over 30cms) and over 50 cm deep in Scotland, i.e based on the peat depth where planting has been banned, and so are excluded by definition. The paper then treats peat less than 40/50cm deep as an organo-mineral soil even though it has a much higher SOC content than true organo-mineral soils. No scientific justification is given for this.

The paper also helps why the WCC calculator treats all SOC losses as occurring in Year 1:

â??On soils with an organic layer of 50 cm or less [i.e those that the WCC classes as organo-mineral]*, there are still likely to be some soil carbon losses due to disturbance for establishment and management purposes, but these are likely* [my emphasis] *to be smaller.â??*

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Back in 2011 there might have been some excuse for Scottish Forestry not knowing that planting trees on peat releases SOC in organo-mineral soils over time but NOT given all the more recent research. Column D, Cumulative Soil Carbon, in the WCCâ??s Summary Carbon Sequestration Table is therefore not fit for purpose. It is also worth noting that it does not measure the potential gains in SOC from planting trees on mineral soils as demonstrated by Forest Research.

Given that Scottish Forestry uses the detailed soil classification system developed by the Forestry Commission to inform decisions about planting (see here), it seems very strange that they have reduced soils to just two categories, mineral and organo-mineral, for the purposes of measuring SOC in the WCC calculator. It is even stranger than these have never been updated..

The final section at the end of Dr Westâ??s paper on Soil and the WCC on Future Developments stated that:

*â??Ongoing research will help us better understand the changes to soil carbon due to woodland creation and management*â??,

and

â??*We will update the soil carbon methodology within 2 years using results of ongoing research. This will allow us to say with more certainty both the amount of soil carbon lost on woodland establishment as well as the rate of accumulation of soil carbon as the woodland grows and matures.â??*

I therefore decided to ask Dr West to clarify whether her paper or the assumptions on soil carbon used in the WCC calculator had ever been updated and also whether the research referred to had happened?

I did not receive a reply so after four weeks submitted a formal review of my information request to Dr West (see here), along with some further questions about what scientific evidence underpinned the selection of the options available in Table 3 and column D in the Carbon Sequestration table. It turned out Dr West was off sick, so I forwarded my information requests to the FOI section at Scottish

Forestry. I received two responses.

The first, FOI Response-202600513888, confirms that the assumptions in the WCC calculator on SOC have not been updated since 2011 and that the research which was supposed to inform revisions on SOC within two years is still ongoing:

> The responses to your questions are as follows.
>
> *a) Does this mean the assumptions on soil carbon used in the calculator have not been u since 2011?*
> **Yes, that is correct.**
>
> *b) The section on Future Developments at the end also refers to some future research years - did that research happen?*
>
> **There is ongoing work to collect further data on soils to inform the WCC models Through Forest Research, the WCC team has organised the collection of soil carb over 140 WCC sites as part of this work. Forest Research is analysing these data this is complete, we hope to provide a more detailed soil carbon calculator. Info provided on this page of the WCC website alongside other developmental work t taking forward – see Soil Carbon**

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The second, FOI Response-202600510598, confirms that Dr Westâ??s 2011 paper does not answer my questions about assumptions on SOC used in the calculator:

â??Upon reading the ten-page document you were sent [ie Dr Westâ??s 2011 paper] *I have determined that the information you sought* [on the WCC calculatorâ??s treatment of SOC] *has not been providedâ??.*

It then went on to state that Scottish Forestry does NOT hold the information that informed those assumptions:

â??I can confirm that as part of my review I commissioned new searches, which have resulted in the information being sourced from external sources.â??

While it is shocking enough that Scottish Forestry do not hold this information, they then declined to provide links to the external sources on SOC which have apparently been used to inform the assumptions in the calculator. Until those are made public and independently verified there is no reason for anyone to trust the WCC calculator.

Scottish Forestry, soil carbon and the integrity of the Woodland Carbon Code

In November last year at COP 30 in Rio de Janeiro the WCC received a Local Leaders Award from Bloomberg Philanthropies (see here):

â??Speaking about the award, Pat Snowdon, Head of Economics and Woodland Carbon Code at Scottish Forestry, said: â??The Woodland Carbon Code is a powerful example of what can be achieved through collaboration. By bringing landowners, organisations and businesses together, weâ??re creating new woodlands which address climate change, restore nature and support local communities across the UK.â??

It appears Bloomberg Philanthropies were completely unaware that the assumptions in the WCC calculator about carbon in soils does not appear to be based on any scientific evidence or that much tree planting on organic and organo-mineral soils is likely to be adding to the amounts of CO2 in the atmosphere and accelerating climate change further.

In February Dr Vicky West was nominated for an award from Confor, the body which represents the commercial forestry industry, in the â??net zero innovation categoryâ?? (see here). The award went to Ayrshire-based land energy (see here) but how anyone can regard the WCC as innovative when it disregards and underplays the impact of planting trees on SOC is a question worth asking.

In March the WCC, i.e Scottish Forestry, announced (see here) that the code is the first governmentâ??run carbon standard in the world â??to enter full assessmentâ?? by the Integrity Council for the Voluntary Carbon Market (one of whose funders is Bloomberg Philanthropies!). Commenting on this, Dr Pat Snowdon from Scottish Forestry stated:

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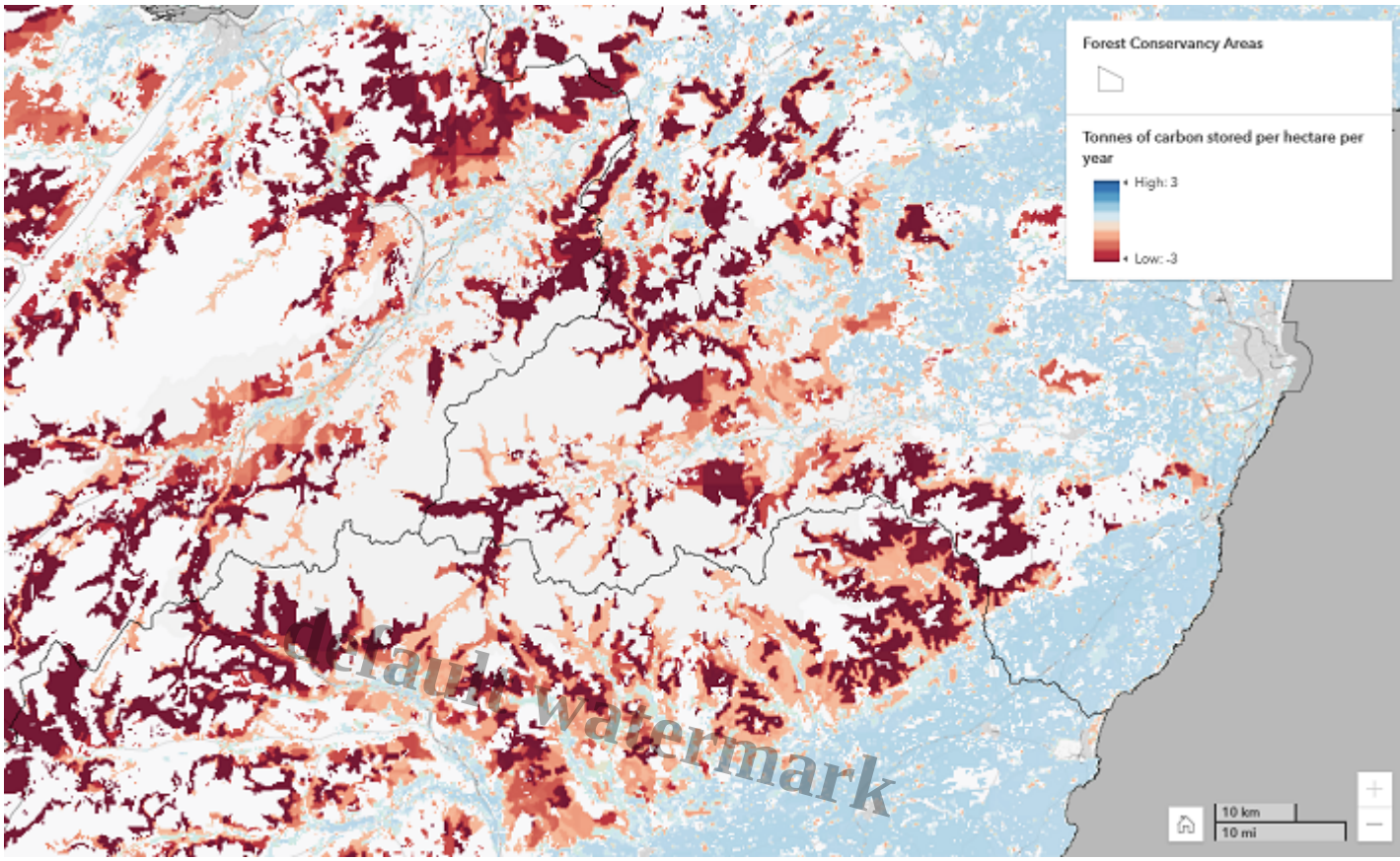
â??This is a really important step for the Woodland Carbon Code and a clear recognition of our commitment to integrity, transparency and science-led standards. We are excited to progress to full assessment and to strengthen the UKâ??s leadership in high integrity nature markets.â??

This post has demonstrated that Scottish Forestry and the WCCâ??s treatment of soils, a far more important store of carbon than trees, is far from transparent and is not science-led contrary to Dr Snowdonâ??s claims. As for integrity, the WCCâ??s promotion of trees rather than soils as a means of offsetting carbon emissions could be viewed as a means of helping Scottish Forestry to promote their own interests and meet their planting targets.

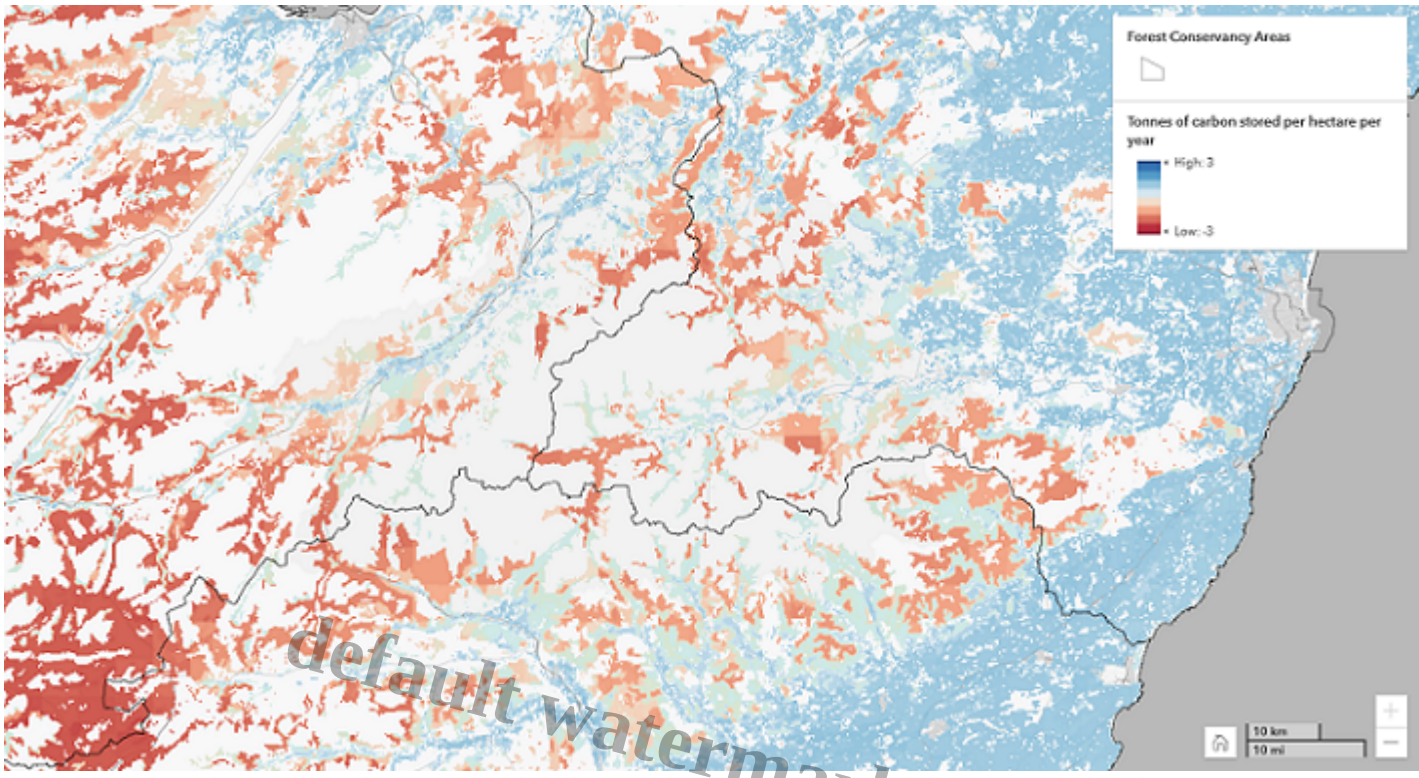
The idea of a calculator which works out the potential advantages and disadvantages of planting trees from a carbon perspective is not a bad one but needs to be firmly founded on soil carbon science. That is not Scottish Forestryâ??s area of expertise and, despite their claims to value collaboration, there is no indication that they have ever co-operated with soil scientists. The Scottish Government, which is ultimately responsible for the WCC, should therefore intervene and commission soil scientists to review and update the assumptions about SOC in the calculator.

The James Hutton Institute have done significant work on this, mapping the â??Net Carbon Change from Afforestation in Scotlandâ?? (see here). Their maps show the impact of planting different species on different soils over time:



Map showing impact of planting native conifers in north east Scotland after five years, with the blue showing positive and the red showing negative impacts on CO2. Map credit James Hutton Institute.

While the maps show the negative impact of planting species like Scots Pine on organic and organo-mineral soils decreases over time, they also show that even where there are net gains this takes significantly longer than is predicted by Scottish Forestryâ??s WCC calculator.



Map showing the carbon impact of planting native conifers in north east Scotland after 40 years, with the blue showing positive and the red showing negative impacts on CO2. Map credit James Hutton Institute

If the James Hutton Institute is correct â?? and unlike Scottish Forestry they are open about the research on which their calculations are based (see here) â?? then that has fundamental implications for the integrity of the WCC and the carbon market it is trying to create.

Category

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