JAHAMA HIGHLAND ESTATE

FORT WILLIAM

LAND USE AND CARBON SEQUESTRATION ESTIMATES

INTERIM REPORT

Client: Jahama Highland Estate

Prepared by:

Charles Cowap

MBA MRICS FAAV ARAgS PFIAgM CEnv

Stapeley House, Nantwich, Cheshire

CW5 7JW

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Preparation and Review

Commissioned by	Jahama Highland Estate, Julia Stoddart
Prepared by	Charles Cowap
Reviewed by	Julia Stoddart and Dimitri Harrison
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EXECUTIVE SUMMARY

1. The Jahama Highland Estate (JHE) extends to 461 sq km in the vicinity of Fort William, Scotland. The estate is a large mixed highland estate with farming, forestry, sporting, recreation, property and diversified business enterprises. It is owned by a larger business which also operates the aluminium smelter at Lochaber. The arc furnaces in this smelter are powered by hydro-electricity which is sourced from the estate. JHE was acquired by its current owners, GFG, in 2016 and they are managing the estate under the broad vision of 'Inspiring Places, Inspiring People'. In 2020 GFG committed to achieve carbon neutrality in its aluminium and steel producing activities through a blended approach to emission reductions and positive offsets, articulated in its CN30 (Carbon Neutral by 2030) project.
2. Three main land uses on the estate have been appraised for their carbon sequestration in the desk top study reported here. They are woodland, grassland and peatland.
3. Annual carbon sequestration rates on the estate have been conservatively estimated at 112,000 tonnes of CO_2 (Carbon dioxide) per annum, equivalent to 30,665 tonnes of carbon. However, this figure does not allow for the emissions of Methane and Nitrous Oxide from peatland in good condition or undergoing restoration. Once these are included the annual sequestration rate comes down to a low-range estimate of 62,170 tonnes of CO2e pa. The published ranges suggest the actual figure could vary substantially, up to double this figure from woodland and grassland alone. The estimate of 62,170 tonnes has a financial value according to government carbon valuation methodology of c. £1.3 million. Capitalised over 50 years this equates to a capital value of £195 million and over 100 years £281 million.
4. Although a broad estimate it is also likely that there is already in storage in the peat on the estate another 10 million tonnes of carbon, at a value of approximately £800 million according to the same government method.
5. The estate has already undertaken significant peatland restoration and woodland planting work. There is considerable scope to refine these estimates and to work with stakeholders in better understanding the measurement and management of carbon on a traditional estate and its potential contribution to GHG (Greenhouse Gas) reduction and therefore to the ambition for Net Zero. Jahama is well placed to develop this potential because of its position, prominence and the internal company connection to industrial metal processing.
6. This project is part of a wider appraisal of the natural capital assets on the estate and their value which continues. Our work on this project has tested and demonstrated the potential for land managers to undertake a strategic review of an estate's contribution to natural capital management and in particular the assessment of carbon reserves and their management. There are valuable wider lessons to be drawn from this process which deserve to be shared more widely. There are also valuable lessons for policy development in terms of the tools which land managers need to be able to prepare appraisals like this, and for the development of new carbon reporting and trading mechanisms. This is particularly timely as the UK develops its own Emissions Trading Scheme following Brexit. There is an opportunity to match industrial carbon accounting and reduction with land management such that industry, rural land management and the environment and society more broadly will benefit by greater climate resilience and security against resource depletion and degradation. The estate is already making an important contribution to GFG's CN30 ambitions which is not widely understood beyond the estate itself. It deserves to be better known. Nevertheless we cannot be complacent. This report has been based on the potential within 'business as usual', but if we are to slow the pace of global warming we will have to go further.

INTRODUCTION

8. This is an interim report from an ongoing study to review the natural capital assets of the Jahama Highland Estate and their value. It has been commissioned by the estate to provide a strategic overview of the extent of its carbon assets. A description of the estate is followed by an assessment of the carbon sequestration which might be expected of the main current land uses on the estate. Estimates of value are provided for annual sequestration rates, stored carbon, annual financial values and capital values over periods from 50 to 100 years. A broad strategic overview of this nature is bound to be subject to limitations and the main ones are described in the next section before presenting overall conclusions and recommendations for further development.
9. The estate's new owners have recognised the intrinsic and strategic importance of the asset under their management and this review has been undertaken to further develop our understanding of the resources on the estate.

THE JAHAMA HIGHLAND ESTATE

10. The Jahama Highland Estate (JHE) was purchased by the present owners in 2016. Jahama Highland Estate is part of the GFG (Gupta Family Group) Alliance. In 2020 GFG published its commitment to CN30, its programme to become carbon neutral by 2030. This programme recognises that the production of steel and aluminium accounts for over 10% of the world's direct emissions from use of fossil fuels. The programme is committed to a mixed model of emissions reduction under which emissions will be reduced wherever possible and offset where not (GFG not dated). The origins of the modern estate lie with the British Aluminium Company which erected aluminium smelters in Lochaber and Kinlochleven in the early 20th century. Wishing to secure the water supply for the new hydro-generation schemes which powered the smelters, the company bought various estates, now comprised within three main parts, namely Mamore (Kinlochleven), Killiechonate (Spean Bridge) and Glenshero (Laggan) estates, combined and managed as one. The estate now extends to 46,135 ha (461.35 sq km) of which 4,856 ha is farmed in-hand as an upland farming enterprise, located to the east of Fort William.
11. The estate is also home to significant woodland areas. The Kinlochleven Native Woodland Regeneration Project covers 228ha and is the largest regeneration scheme in the UK, possibly in Europe. Other enterprises on the estate include deer stalking and other quarry (grouse, duck and rough shooting). The estate is also home to protected species, and has been able to provide fledgling Golden Eagles for a restoration project further south in Scotland. There are 19 bothies on the estate, two long distance paths (the official West Highland Way and the unofficial East Highland Way) and the footpath to the top of Ben Nevis from the Ben Nevis Visitor Centre and youth hostel. The estate also includes the north face of Ben Nevis itself.
12. Of the two hydro-electric schemes one still powers the smelter at Lochaber. The Kinlochleven smelter is closed and the electricity is now fed to the National Grid. The first stage of the Lochaber scheme was built between 1924 and 1929, first generating power in 1929. It was extended in the second world war by the construction of the Spey Dam and a connecting section of channel and tunnel. The scheme at Kinlochleven is older, completed in 1907 and earning the village the epithet, 'the electric village'.
13. In addition to the bothies the estate has a two-cottage holiday letting enterprise. Tenants of the estate include the Ben Nevis Distillery which also draws water from the estate. Its output is reported to be 2 million litres a year (Litres Pure Alcohol).
14. Two farms on the estate are let under traditional (1991 Act) tenancies. The estate also hosts numerous public events, marathons, races, location filming, a new venison shop, *Fiadh á Fireach* – the Wild Venison Shop and is awaiting the outcome of an application for a new windfarm. Parts of the estate are used for military training and at Kinlochleven a new zipwire is due to be built, one wire offering the longest run in Scotland and the other the steepest descent in the UK.
15. Before coming under new ownership in 2016 the estate had been subject to a regime of minimal maintenance and development. Under its new owners a new vision and strategy has been developed for the estate under the broad theme of 'Inspiring Places, Inspiring People'. The new approach is now beginning to bear fruit even though the new managers have had much to address as they have started to implement the new policy.
16. Environmental enhancement work since the new owners took over has included:

- Planting 49.2 ha at Creagan Breaca, Glenshero. 90,000 trees will provide an improved environment for salmon spawning on the Spey. Species included Birch, Scots Pine, Willow, Alder, Rowan and Juniper.

- Glenshero: An Maol, 84 ha planted with 204,530 broadleaves and conifers.
- In all the area of planting has increased the woodland area on the estate by 608 ha.
- Ninety hectares of peatland have been restored under the Peatland Action Programme

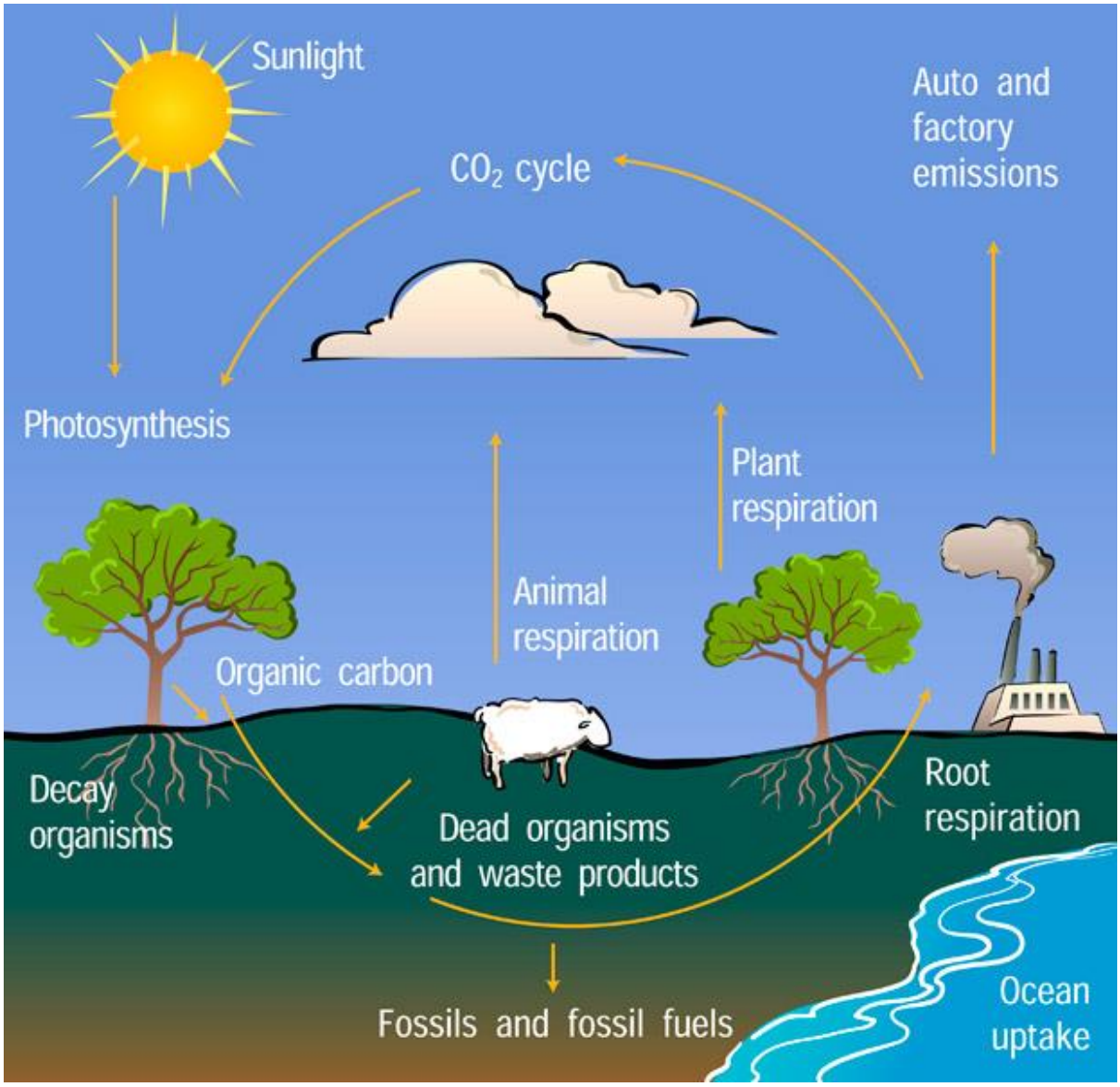
17. Some of this work was recognised in 2019 by a 'Finest Woods Award' given by the Royal Highland and Agricultural Society of Scotland.
18. Relevant land use for the purpose of this report has been taken as:

- Peatland: 14,200 ha
- Woodland: 4,103 ha
- Grassland: 12,811 ha
- Total: 31,114 ha
- This leaves a balance of c 15,000 ha, largely water and bare rock and some inorganic soils or peatland outside Class 1 and 2 on the Scotland Peatland Maps.

CARBON

20. Carbon is common to all known life. The human body is approximately 18% carbon, second only to Oxygen in content. There are about 10 million compounds of carbon and it has sometimes been called the King of the Elements – diamonds, graphite, graphene are all important examples.
21. The carbon cycle is a staple of the school science curriculum (Figure 1)

Figure 1: The Carbon Cycle



(UCAR nd)

22. The role of plant and soil sequestration of carbon from atmospheric Carbon Dioxide in the carbon cycle is widely understood in principle, yet our detailed understanding and insight remains patchy and limited.
23. The language of carbon can also be confusing. The terms Carbon (C), Carbon Dioxide (CO_2) and Carbon Dioxide equivalent (CO_2e) all have distinct meanings.
24. CO_2 is one of the Greenhouse Gases (GHG). Their impact on climate change is measured according to their global warming potential (GWP). GWP is expressed in relation to Carbon

Dioxide, hence the phrase Carbon Dioxide Equivalent, or CO_2e. Table 1 shows the values for some of the GHGs:

Table 1: Greenhouse Gas Equivalence

Greenhouse Gas	Formula	100-year GWP
Carbon dioxide	CO_2	1
Methane	CH_4	25
Nitrous oxide	N_2O	298
Sulphur hexafluoride	SF_6	22,800

Adapted from Myhre *et al* 2013

25. This is a selective list excluding the highly-damaging hydrofluorocarbons and perflurocarbons. CO_2 has the lowest CO_2e of the gases on the list but nevertheless is important because of its abundance and persistence in the atmosphere compared with CH_4 for example.
26. The EU Emissions Trading Scheme is an obligation on large-scale producers of GHGs to report and purchase Emissions Permits. It is due to be replaced in the UK from January 2021 by a new UK scheme. GHGs are reported in terms of their CO_2e value. The Lochaber smelter reported 64,000 tonnes for 2019.
27. CO_2 is a compound of carbon and oxygen. Therefore its C content is only part of the reported figure. A standard conversion figure is used to convert CO_2 to C (multiply by 12/44). This cannot be done directly for CO_2e without knowing the detailed breakdown of the various GHGs which are present, but it is understood that the bulk of the GHG CO_2e output from the Lochaber smelter does consist of CO_2 itself rather than the other GHGs.
28. Various sources have been consulted for estimates of sequestration rates, with the following ranges identified and chosen from the sources given.
29. Peatland blanket bogs in a stable healthy condition will be growing by 0.5 to 1 mm a year and may conservatively be sequestering 2 to 4 tonnes of CO_2 per hectare per year. The government uses an annual figure of 3.54 tonnes per hectare per annum and this project has adopted this figure (ONS 2019). We have estimated from the Peatland Maps of Scotland (Carbon and peatland Map 2016) that the area of Class 1 and 2 peat on the estate is 142 km^2. Class 1 peat is described as:

    Class 1 - Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas likely to be of high conservation value

30. Class 2 peat is described as:

    Class 2 - Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas of potentially high conservation value and restoration potential

    (both definitions from Carbon and Peatland Map 2016)

31. Peatland can vary in its global warming potential between negative and positive contributions. Peat in deteriorating condition will release CO_2 to the environment and the methane generated by newly restored peat will generally exceed the global warming potential of the CO_2 being sequestered in the early stages of restoration (see IUCN 2017 for an introduction and further references). The figures adopted for the estate have therefore been restricted to areas of peat which are in a healthy and stable condition. Further comment will follow on the peatland restoration work undertaken since 2016 by the estate.

32. Woodland Carbon annual sequestration rates have been quoted as ranging from 5 tonnes to 20 tonnes pa (Morison *et al* 2012). A rate of 10 tonnes per hectare pa has been adopted from the conservative end of this range for the 4,103 ha of woodland on the estate (figure from Estate Records).
33. Grassland rates of sequestration have been found to range from less than 0 to more than 8 tonnes C per hectare pa (Jones and Donnelly 2004) whereas Rees et al (2018) have suggested figures for Scotland ranging from 0 to 900 kg C per ha pa. A mid range figure of 450 kg has been adopted for this project and applied to grassland, in-hand and let, on the estate of 12,811 ha.

CARBON DIOXIDE ESTIMATES AT JAHAMA HE

34. Table 2 summarises our carbon calculations for the estate:

Table 2: Jahama Highland Estate Estimated Sequestration (Tonnes of CO_2 per annum with C equivalent)

Land cover	Area (ha)	Minimum	Maximum	Adopted CO_2	Equivalent C
Peatland	14,200	28,400	56,800	50,268	13,709
Woodland	4,103	20,516	82,064	41,032	11,191
Grassland	12,811	0	42,275	21,138	5,765
Totals	**31,114**	**48,916**	**181,139**	**112,438**	**30,665**
EU ETS 2019 (CO2e)				64,000	
Balance				48,438	13,210 [a]

[a] The balance given compares the annual estimated sequestration rate from the main land uses on the estate with the figure reported for CO_2e under the EU ETS. The balance for C assumes that all the CO_2e reported under the EU scheme is CO_2.

35. Table 2 shows a range of annual CO_2 sequestration rates from approximately 49,000 tonnes pa to 181,000 tonnes. A mid range figure of 112,438 tonnes has been adopted. The annual ETS figure for 2019 may help to put this quantity in context – at its simplest the land on the estate may be sequestering 75% more carbon than the smelter generates. However some caution is needed over simplistic comparisons like this. The sections on Other Greenhouse Gases and Limitations below expands on this point.

OTHER GREENHOUSE GASES

36. Carbon Dioxide is only one of the greenhouse gases. Two others of notable concern with regard to peatland management and restoration are Methane (CH_4) and Nitrous Oxide (N_2O). Upland peat bogs pose a particular greenhouse gas challenge. Developed over many years they hold large deposits of carbon. An upland peat bog in good condition can sequester and store large amounts of carbon as the previous figures show. As upland peat bogs deteriorate, through erosion for example whether natural or induced by man, they start to release the considerable quantities of carbon stored in them. Deteriorating upland peat bogs are significant emission sources. The Peatland Carbon Code is based on restoring peat bogs in order to curb these emissions.

37. The process of restoration also stimulates the production of Methane and Nitrous Oxide. Both gases have far higher CO_2e values than Carbon Dioxide itself. Quantification is more difficult as sources vary in the volumes and CO_2e values reported. The Peatland Carbon Code currently uses 23.84 t CO_2e/ha pa as the emission rate for Actively Eroding areas, which reduces to emissions of 1.08 tonnes for near natural areas, ie the reduction in total GHG emissions would be 22.76 t CO_2e/ha pa. ONS figures (used above) quote sequestration rates for carbon dioxide of 3.54 tonnes/ha pa, but reduce this to an emission rate of 0.01 t CO_2e/ha pa when Methane and Nitrous Oxide are allowed for. Dickie *et al* (2019) in their report on testing a natural capital approach on SNH land adopted an emission rate of 0.1 t CO_2e/ha pa.
38. Looking at the results in Table 2 again, removal of peat's contribution would reduce the total CO_2e from 112,438 tonnes of CO_2e to 62,170 tonnes, 1,830 tonnes less than the 2019 ETS Report. For practical purposes given the scientific limitations applying to these figures these figures are to all intents and purposes about the same. The application of an emissions figure of 0.01 or 0.10 tonnes/hectare pa would make a difference of 142 and 1,420 tonnes respectively, amounts which should also not be regarded as significant in this context.
39. The key message to be taken from these figures is the practical message about priority setting in land management on the estate. Peatland restoration work is already in hand on parts of the estate. There remain large areas of peat where initial survey work has not yet been undertaken and this should be given urgent priority to ensure that all practical steps are being taken to reduce the danger of emissions from eroding peat.

VALUE

40. The UK government reviewed its approach to the pricing of Carbon in 2009 (see DECC 2009 and 2011a). A new 'Target Consistent Approach' replaced the earlier approach based on the social cost of carbon (shadow price). The new approach uses the cost of mitigation of damage from carbon compared with the earlier approach based on the cost of that damage. Revised figures are issued for traded and non-traded carbon prices of Carbon, the latest being issued in April 2019 at 2018 prices (DBEIS 2019). Three prices are given for each year, a Low, Central and High Price. This appraisal has used the Central price throughout. Further information on values beyond 2050 has also been published by DECC (2011b). The different prices converge in 2030 and thereafter rise to a target price of £200/tonne CO2e. Traded C is carbon covered by the EU ETS. The non-traded price is used for other economic and policy appraisal. These figures have been applied to the estate's estimated sequestration potential of 62,170 tonnes of CO2e pa.
41. On this basis the annual value of the carbon sequestered by the estate in 2021 is £1,276,972. Future years can be discounted to a present value using HM Treasury's Social Time Preference Rates (STPR) of interest ie 3.5, 3.0 and 2.5%. Table 3 summarises the present value over periods of 50,60 and 100 years and for the rest of the 21st century. The full figures are shown in Appendix A. The methodology for discounting is set out in The Green Book (HM Treasury 2020).

Table 3: Summary of Discounted Carbon Future Values (2021 at 2018 prices)

Period	Present Value at Treasury STPR (£)
50 years	195,330,017
60 years	219,524,090
Until 2100	252,059,327
100 years	280,669,869

PEATLAND RESTORATION WORK

42. An area of 90 ha of degraded peat has also been restored under the Scottish Peatland Action Programme (estate data). This area will currently be in a considerable state of GHG flux during which full rates of CO_2 sequestration will not yet have been achieved during a period in which the CO_2e of methane emissions is likely to be exceeding the value of CO_2 sequestration. In future the restored areas should be able to match the steady rate of sequestration of the established peatland areas, ie 90 ha x 3.54 tonnes/ha = 318.6 tonnes pa. Taking the reduction in emissions to be expected from peat during restoration (as above) at 22.76 t CO_2e/ha pa this would equal an annual reduction in emissions of 2,048.40 tonnes with an annual value at 2018 prices for 2021 of £42,074. The Present Value of this figure over 10 years using the methodology above is £971,714.
43. A limited Scoping Study in 2018 (Caledonian Conservation 2018) examined five sample areas totalling 484.79 ha. All were entirely or partly within the Ben Nevis Special Area for Conservation. The area of 'Extensive Hag Zone' and 'Bare Peat Pan/Sill' mapped by the survey was 17.75 ha. The length of hag and gully erosion features mapped was 8,471 m, equated to an area of 4.24 ha at a width of 5 m. The CO_2e savings from restoring this area were estimated to be 468 t CO_2e pa.

LIMITATIONS

45. The project reported here has been undertaken as a desk study of the Jahama Highland Estate, during the period January and February 2021. We have therefore had to rely on documentary sources with virtually no ability to verify conditions on the ground.
46. Land use figures for woodland and grassland were provided by the estate and can be taken as reasonably accurate to the hectare.
47. Peatland area figures were estimated from a small scale map and were originally recorded to the nearest square kilometre. For calculation purposes they have been converted to hectares which may therefore suggest a level of accuracy greater than the original measurements could accommodate (one sq km = 100 hectares).
48. As indicated elsewhere in this report a number of sources were consulted for carbon data and in every case the available data suggested a wide range of potential sequestration rates. We have chosen from the cautious end of these ranges while reporting the high and low values of the ranges we adopted. The estimates can therefore be regarded as cautious and low.
49. Carbon prices have been calculated and discounted using official government figures. Market values are different from these figures and market discount rates and expectations are also likely to differ from the Treasury's Green Book guidance.
50. This project has been solely concerned with the estate's ability to sequester CO_2 from the atmosphere. No allowance has been made for other GHGs which may be sequestered or generated by the estate, in particular from livestock and vehicle use. Future work will be able to examine this more closely. There is however potentially some headroom in the figures we have reported to accommodate some or all of this.
51. This project has not addressed the carbon reserves which are already stored in the peat on the estate. The depth of the peat deposits are needed as a minimum to do this. Average depth across Scotland reported in 2020 (SNH 2020) was 1.37 m, with a maximum depth of 11 m. Lindsay (2010) summarised various studies into the carbon content of deep peats in Table 4.

Table 4: Quantities of carbon contained within various cubic metres of peat

	An earlier study	Natural cubic metre	Haplotelmic cubic metre	Natural wet catotelm	Damaged catotelm
kg carbon	47	57	61	52	104

Table adapted from Lindsay (2010) Table 6, p63

52. Again taking a low range 50 kg/cubic metre at a depth of 1.37 m over the full area of Class 1 and 2 Peat of 14,200 ha would suggest that 9.727 million tonnes of C may already be stored in the peatland on the estate. Given the uncertainties around this figure but the cautious figure adopted for carbon storage it is probably not unreasonable to say that the estate is already storing at least 10 million tonnes of carbon, equivalent to approximately 39 million tonnes of CO_2. Using the values for 2020 already given in this report this is an additional value of approximately £800 million.

FURTHER WORK

54. The scope for further work is indicated by some of the limitations of the work to date, for example

- The need to refine the peatland inventory in terms of extent, condition and depth
- The scope for more restoration work under the Peatland Action Programme
- Extend our full understanding of the GHG impact of the estate through Carbon Footprinting, for farming and other operations on the estate

55. We should evaluate the Peatland Carbon Code as a means to demonstrate the estate's commitment to the sustainable management of its peat resource
56. It would be helpful to be able to extract financial information from estate records with which to analyse the financial commitments to maintaining natural capital assets.
57. There is scope to raise the profile of the estate in land management, government, industrial and academic spheres to recognise the extensive work which is being undertaken.

CONCLUSIONS AND RECOMMENDATIONS

58. The estate is a significant repository of stored carbon, particularly in its peatland soils.
59. The estate is sequestering large amounts of carbon every year at substantial value to society more widely.
60. It is important to at least maintain this position and extend it where possible. The estate is already playing an important part in GFG's ambition to CN30, albeit one which is not widely recognised and with useful scope for development.
61. Given that the owners of the estate have been required to report their GHG emissions under the EU ETS there is an opportunity here to explore the potential for earning credits for land management activities which would offset the GHG impacts of aluminium processing. No such mechanism exists currently but the development of a new UK ETS provides an ideal opportunity to explore this.
62. The estate can be a beacon to other estates and rural land managers, encouraging them to learn from its experience and to emulate its behaviour. A focus on this would fit very well with the leadership aspirations articulated by GFG in their CN30 programme.
63. The estate should initiate a carbon footprinting exercise for its farming and other estate management activities.
64. There is great potential to work with other stakeholders to further our understanding of carbon and other GHG management in a rural estate context, in turn being able to learn from and build upon those activities.
65. This review had made a start, but it is no more than an assessment of 'business as usual'. It provides the platform from which the estate can take measures to reduce its own carbon footprint while making a positive contribution to the overall reduction in greenhouse gases in our atmosphere.

Charles Cowap

24 May 2021

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APPENDIX A: DISCOUNTED FUTURE CARBON VALUES

Year	Year	Discount Rate	Discount Factor	CO2e pa	£/t	Annual Value	Discounted Value	Present Value
2021	0	0.035	1.0000	62,170	20.54	1,276,972	1,276,972	
2022	1	0.035	0.9662	62,170	27.24	1,693,511	1,636,242	
2023	2	0.035	0.9335	62,170	33.94	2,110,050	1,969,754	
2024	3	0.035	0.9019	62,170	40.64	2,526,589	2,278,838	
2025	4	0.035	0.8714	62,170	47.33	2,942,506	2,564,224	
2026	5	0.035	0.8420	62,170	54.03	3,359,045	2,828,226	
2027	6	0.035	0.8135	62,170	60.73	3,775,584	3,071,440	
2028	7	0.035	0.7860	62,170	67.43	4,192,123	3,294,971	
2029	8	0.035	0.7594	62,170	74.13	4,608,662	3,499,871	
2030	9	0.035	0.7337	62,170	80.83	5,025,201	3,687,146	
2031	10	0.035	0.7089	62,170	86.79	5,395,641	3,825,071	29,932,756
2032	11	0.035	0.6849	62,170	92.75	5,766,081	3,949,452	
2033	12	0.035	0.6618	62,170	98.71	6,136,521	4,061,047	
2034	13	0.035	0.6394	62,170	104.66	6,506,961	4,160,578	
2035	14	0.035	0.6178	62,170	110.62	6,877,401	4,248,733	
2036	15	0.035	0.5969	62,170	116.58	7,247,841	4,326,168	
2037	16	0.035	0.5767	62,170	122.54	7,618,281	4,393,508	
2038	17	0.035	0.5572	62,170	128.50	7,988,721	4,451,345	
2039	18	0.035	0.5384	62,170	134.46	8,359,161	4,500,247	
2040	19	0.035	0.5202	62,170	140.42	8,729,601	4,540,751	
2041	20	0.035	0.5026	62,170	146.37	9,100,040	4,573,370	
2042	21	0.035	0.4856	62,170	152.33	9,470,480	4,598,590	
2043	22	0.035	0.4692	62,170	158.29	9,840,920	4,616,874	
2044	23	0.035	0.4533	62,170	164.25	10,211,360	4,628,663	
2045	24	0.035	0.4380	62,170	170.21	10,581,800	4,634,375	
2046	25	0.035	0.4231	62,170	176.17	10,952,240	4,634,407	
2047	26	0.035	0.4088	62,170	182.12	11,322,680	4,629,138	

2048	27	0.035	0.3950	62,170	188.08	11,693,120	4,618,926	
2049	28	0.035	0.3817	62,170	194.04	12,063,560	4,604,110	
2050	29	0.035	0.3687	62,170	200.00	12,434,000	4,585,015	
2051	30	0.035	0.3563	62,170	200.00	12,434,000	4,429,966	
2052	31	0.030	0.4000	62,170	200.00	12,434,000	4,973,440	
2053	32	0.030	0.3883	62,170	200.00	12,434,000	4,828,583	
2054	33	0.030	0.3770	62,170	200.00	12,434,000	4,687,944	
2055	34	0.030	0.3660	62,170	200.00	12,434,000	4,551,402	
2056	35	0.030	0.3554	62,170	200.00	12,434,000	4,418,837	
2057	36	0.030	0.3450	62,170	200.00	12,434,000	4,290,133	
2058	37	0.030	0.3350	62,170	200.00	12,434,000	4,165,178	
2059	38	0.030	0.3252	62,170	200.00	12,434,000	4,043,862	
2060	39	0.030	0.3158	62,170	200.00	12,434,000	3,926,080	
2061	40	0.030	0.3066	62,170	200.00	12,434,000	3,811,728	
2062	41	0.030	0.2976	62,170	200.00	12,434,000	3,700,707	
2063	42	0.030	0.2890	62,170	200.00	12,434,000	3,592,919	
2064	43	0.030	0.2805	62,170	200.00	12,434,000	3,488,271	
2065	44	0.030	0.2724	62,170	200.00	12,434,000	3,386,671	
2066	45	0.030	0.2644	62,170	200.00	12,434,000	3,288,030	
2067	46	0.030	0.2567	62,170	200.00	12,434,000	3,192,262	
2068	47	0.030	0.2493	62,170	200.00	12,434,000	3,099,283	
2069	48	0.030	0.2420	62,170	200.00	12,434,000	3,009,013	
2070	49	0.030	0.2350	62,170	200.00	12,434,000	2,921,372	
2071	50	0.030	0.2281	62,170	200.00	12,434,000	2,836,283	195,330,017
2072	51	0.030	0.2215	62,170	200.00	12,434,000	2,753,673	
2073	52	0.030	0.2150	62,170	200.00	12,434,000	2,673,469	
2074	53	0.030	0.2088	62,170	200.00	12,434,000	2,595,601	
2075	54	0.030	0.2027	62,170	200.00	12,434,000	2,520,001	
2076	55	0.030	0.1968	62,170	200.00	12,434,000	2,446,603	
2077	56	0.030	0.1910	62,170	200.00	12,434,000	2,375,343	

2078	57	0.030	0.1855	62,170	200.00	12,434,000	2,306,158	
2079	58	0.030	0.1801	62,170	200.00	12,434,000	2,238,988	
2080	59	0.030	0.1748	62,170	200.00	12,434,000	2,173,775	
2081	60	0.030	0.1697	62,170	200.00	12,434,000	2,110,461	219,524,090
2082	61	0.030	0.1648	62,170	200.00	12,434,000	2,048,991	
2083	62	0.030	0.1600	62,170	200.00	12,434,000	1,989,312	
2084	63	0.030	0.1553	62,170	200.00	12,434,000	1,931,371	
2085	64	0.030	0.1508	62,170	200.00	12,434,000	1,875,117	
2086	65	0.030	0.1464	62,170	200.00	12,434,000	1,820,502	
2087	66	0.030	0.1421	62,170	200.00	12,434,000	1,767,478	
2088	67	0.030	0.1380	62,170	200.00	12,434,000	1,715,998	
2089	68	0.030	0.1340	62,170	200.00	12,434,000	1,666,018	
2090	69	0.030	0.1301	62,170	200.00	12,434,000	1,617,493	
2091	70	0.030	0.1263	62,170	200.00	12,434,000	1,570,381	
2092	71	0.030	0.1226	62,170	200.00	12,434,000	1,524,642	
2093	72	0.030	0.1190	62,170	200.00	12,434,000	1,480,235	
2094	73	0.030	0.1156	62,170	200.00	12,434,000	1,437,121	
2095	74	0.030	0.1122	62,170	200.00	12,434,000	1,395,264	
2096	75	0.030	0.1089	62,170	200.00	12,434,000	1,354,625	
2097	76	0.025	0.1531	62,170	200.00	12,434,000	1,903,694	
2098	77	0.025	0.1494	62,170	200.00	12,434,000	1,857,262	
2099	78	0.025	0.1457	62,170	200.00	12,434,000	1,811,963	
2100	79	0.025	0.1422	62,170	200.00	12,434,000	1,767,769	252,059,327
2101	80	0.025	0.1387	62,170	200.00	12,434,000	1,724,653	
2102	81	0.025	0.1353	62,170	200.00	12,434,000	1,682,588	
2103	82	0.025	0.1320	62,170	200.00	12,434,000	1,641,549	
2104	83	0.025	0.1288	62,170	200.00	12,434,000	1,601,511	
2105	84	0.025	0.1257	62,170	200.00	12,434,000	1,562,450	
2106	85	0.025	0.1226	62,170	200.00	12,434,000	1,524,342	
2107	86	0.025	0.1196	62,170	200.00	12,434,000	1,487,163	

2108	87	0.025	0.1167	62,170	200.00	12,434,000	1,450,890	
2109	88	0.025	0.1138	62,170	200.00	12,434,000	1,415,503	
2110	89	0.025	0.1111	62,170	200.00	12,434,000	1,380,978	
2111	90	0.025	0.1084	62,170	200.00	12,434,000	1,347,296	
2112	91	0.025	0.1057	62,170	200.00	12,434,000	1,314,435	
2113	92	0.025	0.1031	62,170	200.00	12,434,000	1,282,376	
2114	93	0.025	0.1006	62,170	200.00	12,434,000	1,251,098	
2115	94	0.025	0.0982	62,170	200.00	12,434,000	1,220,584	
2116	95	0.025	0.0958	62,170	200.00	12,434,000	1,190,813	
2117	96	0.025	0.0934	62,170	200.00	12,434,000	1,161,769	
2118	97	0.025	0.0912	62,170	200.00	12,434,000	1,133,433	
2119	98	0.025	0.0889	62,170	200.00	12,434,000	1,105,788	
2120	99	0.025	0.0868	62,170	200.00	12,434,000	1,078,818	
2121	100	0.025	0.0846	62,170	200.00	12,434,000	1,052,505	280,669,869