Pennant Walters Ltd

Trecelyn Wind Farm

Draft Environmental Statement

Appendix 2A: Carbon Balance

This report was prepared by WSP UK Limited

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Report for

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Document revisions

No.	Details	Date
1	Draft for review	October 2023
2		
3		

1. Introduction

1.1.1 The 2017 Town and Country (Environmental Impact Assessment) (EIA) Regulations require[1] consideration of the impact of the Proposed Development on climate (for example the nature and magnitude of greenhouse gas (GHG) emissions) and the vulnerability of the Proposed Development to climate change (climate change resilience (CCR)).

1.1.2 This appendix reports on the carbon balance calculation that has been completed for the Proposed Development. The assessment determines the benefit of the Proposed Development in terms of reduced carbon emissions compared to a reference energy mix. This is considered in the context of carbon budgets and targets for Wales and the UK, aligned to a trajectory compatible with limiting the increase in global average temperature below 1.5°C. This includes consideration of GHG emissions in the production, transportation, erection, operation and decommissioning phases of the Proposed Development.

1.1.3 Given the inherent carbon benefit of wind farms, a standalone GHG Environmental Statement (ES) chapter is not required. The Scottish Government Carbon Calculator Tool[2] has been used for the carbon balance calculation, in line with advice given by Planning and Environmental Decisions Wales (PEDW) within Scoping Directions for other Welsh wind farms. The Carbon Calculator Tool is designed for applications for the construction and operation of onshore windfarms in Scotland located where peat is present. The Carbon Calculator Tool has been used as it is considered to be the most reliable tool for estimating the carbon payback time associated with the Proposed Development. The calculated mean depth of recorded peat at the Proposed Development Site is 0.1m and the Welsh Government define 'true peat' as being ≥0.4m in depth. Therefore, the Site can generally be considered as not being underlain by peat.

Climate change resilience

1.1.4 As agreed with PEDW through the Scoping Direction, a standalone assessment of CCR has not been completed as part of the EIA. The projected impacts of climate change on the Proposed Development is considered in relevant sections of the following Draft ES chapters:

- **Chapter 6: Landscape and Visual;**
- **Chapter 8: Biodiversity;**
- **Chapter 10: Water Environment:**
  - Flood Consequence Assessment (**Appendix 10A**);
- **Chapter 11: Ground Conditions.**

1.1.5 The vulnerability to climate change measures are summarised in **Section 7: Climate Change Resilience.**

[1] *Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017* [online]. Available at: https://www.legislation.gov.uk/wsi/2017/567/contents [Accessed 27 October 2023].

[2] Scottish Environment Protection Agency (2020). *Carbon Calculator Tool v1.7.0* [online]. Available at: https://informatics.sepa.org.uk/CarbonCalculator/index.jsp [Accessed 27 October 2023].

2. Renewable Energy Policy Context

2.1.1 **Chapter 5: Legislative and Policy Overview** provides an overview of the applicable renewable energy policy and strategies that the proposals should have regard to. This includes the relevant UK wide and Welsh legislative and policy framework for the development of renewable energy schemes. Current legislation, national policies, and local policy and guidance recognise climate change as a pressing concern. GHG emissions are expected and required to reduce in the future.

2.1.2 The approach taken by the UK and Wales to addressing climate change has been shaped and informed by a range of international agreements and climate change obligations including the Kyoto Protocol[3], the Paris Agreement[4] and the 2021 Glasgow Climate Compact[5] reflecting the UK's role as a signatory to the United Nations Framework Convention on Climate Change (UNFCCC).

2.1.3 The UK Government has set a net zero target which requires the UK to reduce GHG emissions by 100% below 1990 levels by 2050[6], this being the UK position in terms of meeting international obligations to reduce carbon emissions. The UK carbon budgets[7] require the UK to continually reduce emissions in line with the net zero target. Wales is also committed to a net zero target for 2050, and has interim targets for 2030 and 2040, and a series of 5-year carbon budgets.[8]

[3] UNFCC (1998). *Kyoto Protocol* [online]. Available at: https://unfccc.int/resource/docs/convkp/kpeng.pdf [Accessed 27 October 2023].

[4] UNFCC (2015). *Paris Agreement* [online]. Available at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf [Accessed 27 October 2023].

[5] UNFCC (2021). *Glasgow Climate Pact* [online]. Available at: https://unfccc.int/sites/default/files/resource/cop26_auv_2f_cover_decision.pdf [Accessed 27 October 2023].

[6] *The Climate Change Act 2008 (2050 Target Amendment) Order 2019* [online]. Available at: https://www.legislation.gov.uk/uksi/2019/1056/contents/made [Accessed 27 October 2023].

[7] *The Carbon Budgets Order 2009* [online]. Available at: https://www.legislation.gov.uk/uksi/2009/1259/contents/made [Accessed 27 October 2023].

[8] Welsh Government (2021). *Climate change targets and carbon budgets* [online]. Available at: https://gov.wales/climate-change-targets-and-carbon-budgets [Accessed 27 October 2023].

3. Scope and Receptors

3.1.1 The scope of the assessment of GHG emissions associated with the Proposed Development includes GHG emissions from all activities within the Site, arising from the construction, operation, maintenance and decommissioning phases, as well as the GHG emissions associated with material processing and transportation of materials and labour outside of the Site.

3.1.2 GHG emissions have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The global climate is the only receptor for the climate change assessment.

3.1.3 Given the global impacts of climate change and the globally recognised requirement to limit GHG emissions to maintain global average temperature increase below 1.5°C to 2°C, as laid out in the Paris Agreement, the receptor is considered highly sensitive to GHG emissions.

4. Potential Energy Contribution of the Proposed Development to Government Objectives

Energy Yield

4.1.1 The installed capacity of a wind turbine is a measure of its maximum rated output, which in the context of the Proposed Development is an estimated 16.8 MW (assuming 4 x 4.2MW turbines). Calculations of the likely electricity generation of the turbines are dependent on the 'capacity factor', which involves an assessment of the actual output of the Proposed Development against its installed capacity.[9]

4.1.2 On this basis, and with an estimated installed capacity of 16.8 MW, the amount of electricity to be produced by the Proposed Development has been estimated to be 41.2 GWh per year based on the Welsh onshore wind capacity factor of 28.0% (based on an unchanged configuration basis, averaged over the last 5 years 2018 - 2022)[10].

4.1.3 This 28.0% capacity factor has been used to calculate potential annual energy yield for the Proposed Development, shown in **Table 4.1.**

Carbon Dioxide Savings and Electricity Generation

4.1.4 It is widely accepted that electricity produced from wind energy has a positive benefit with regard to reducing carbon dioxide (CO_2) emissions. However, there has been much debate about the actual level of emissions savings that might arise from a wind farm development.

4.1.5 In estimating the actual saving it is important to consider the mix of alternative sources of electricity generation, for example, coal, oil and gas powered. Digest of UK Energy Statistics (DUKES)[11] sets the static figure of emissions related with electricity generated by 'all non-renewable fuels' at 424 tonnes of CO_2 for every GWh generated.[12] A figure of 424 tonnes of CO_2 savings per GWh has therefore been assumed for the purposes of this assessment, with savings of CO_2 estimated on the basis of the capacity factor.

4.1.6 The Department of Business, Energy and Industrial Strategy (BEIS) produces a range of statistics detailing electricity consumption across the UK. The average domestic consumption in the UK, was 3,492 kWh per household in 2022.[13]

[9] The net capacity factor of a wind farm is the ratio of its actual energy output (after energy losses within the wind farm have been accounted for) over a defined period of time (typically a year) to its energy output, had it operated at maximum power output continuously, over the same period of time.

[10] Department for Energy Security and Net Zero (2023). *Regional renewable electricity in 2022.* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1187406/Regional_Renewables_2022.pdf [Accessed 27 October 2023].

[11] Digest of UK Energy Statistics (2023). *Digest of United Kingdom Energy Statistics (DUKES) 2023: Chapters 1 to 7.* [online]. Available at: https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2023 [Accessed 27 October 2023].

[12] Renewable UK (2022). *Wind Energy Statistics Explained* [online]. Available at: https://www.renewableuk.com/page/UKWEDExplained [Accessed 27 October 2023].

[13] BEIS (2023). *ECUK 2023: Consumption Data Tables* [online]. Available at: https://www.gov.uk/government/statistics/energy-consumption-in-the-uk-2023 [Accessed 27 October 2023].

4.1.7 The electricity generated by the Proposed Development will enter the National Grid, and therefore cannot be tracked to the individual consumer. Therefore, it is relevant to consider electricity demand in the context of UK as a whole, rather than within the area surrounding the Proposed Development.

4.1.8 The potential electricity generation and 'Homes Equivalent' electricity generation (based on 3,492 kWh annual domestic consumption in UK) are provided in **Table 4.1**. The potential CO_2 savings as a result of the Proposed Development generating electricity instead of conventional power stations, with an assumed 424 tonnes of CO_2 for every GWh generated, are also presented.

Table 4.1 Potential electricity generation and CO_2 savings

Capacity factor (%)	Electricity generation (MWh per year)[14]	Homes equivalent (based on average consumption)	CO_2 Savings (Tonnes of CO_2 per year) based on Renewable UK savings figure
28%	41,207	11,800	17,472

[14] Figures are derived as follows: 16.8 MW × 8,760 hours/year × 0.28 (capacity factor) = 40,324 MWh.

5. Carbon Balance of the Proposed Development

Overview

5.1.1 The following sections outline the specific values for the carbon losses and carbon gains associated with the Proposed Development. For each input parameter (as outlined in **Annex A** of this document), an expected minimum and maximum value is required to provide an expected, minimum and maximum scenario for the carbon payback.

5.1.2 For this application, version 1.7.0 of the online Scottish Government Carbon Calculator Tool was used on 27 October 2023, the reference number is not supplied in this document, but will be communicated separately to relevant consultees.

5.1.3 A table containing the values for each scenario and the justification for the values used for the carbon balance calculations is found at **Annex A.**

Carbon Losses

5.1.4 The manufacturing, construction and installation (including concrete) of the wind turbines at the Proposed Development has an associated carbon cost. Using figures from the online calculator, the expected case carbon emission losses associated with the manufacture, construction and decommissioning of the 16.8 MW installed capacity, is 14,560 tonnes of CO_2 equivalent (tCO2e), which equates to approximately 60% of total CO_2 losses.

5.1.5 The carbon payback model attributes carbon losses due to the requirement for extra capacity to back up wind power generation at times of peak demand. This is quantified as a percentage of total capacity, which was input as 5% for this case (the recommended figure within the model) and equates to 9,536 tCO_2e (i.e. approximately 39% of total CO_2 losses).

5.1.6 Measurable carbon losses associated with CO_2 release from soil organic matter are not anticipated due to the Proposed Development Site not being classified as peatland (see paragraph **Error! Reference source not found.**) and therefore have been excluded from the total losses.

5.1.7 The calculated mean depth of recorded peat at the Proposed Development Site is 0.1m and the Welsh Government define 'true peat' as being ≥0.4 m in depth. The Site is generally not underlain by peat. The Proposed Development will avoid significant impacts on peat through design, based on peat survey results. It is worth noting that this figure assumes 100% loss of CO_2 from removed/disturbed peat, as this is the default value within the carbon model and cannot be amended. Therefore, the results show small carbon losses are generated by the reduction of carbon fixing potential which occurs due to the loss of bog plants as a result of wind farm construction. For the expected case, this is 277 tCO_2e, which equates to 1% of total carbon dioxide losses.

5.1.8 The carbon payback calculations currently do not include losses from the removal of forestry. The areas of vegetation removal are currently unknown and will be updated within the carbon calculations for the final ES.

5.1.9 Total CO_2 losses due to the Proposed Development are 24,372 tCO_2e.

Carbon Gains

5.1.10 There are no carbon gains associated with the Proposed Development.

6. Carbon Payback of the Proposed Development

6.1.1 To calculate the carbon payback period, the online calculator uses three different fossil fuel displacement scenarios, which are updated automatically using data from DUKES:

- Grid mix, the mix of electricity sources supplying the UK as a whole;
- Coal fired for coal fired electricity generation; and
- Fossil fuel mix for fossil fuel sourced electricity generation alone.

6.1.2 The carbon calculator[15] recommends using the fossil fuel sourced grid mix scenario as the most appropriate for calculating the carbon payback time (the counterfactual)[16]. Based on this scenario, the payback for the Proposed Development is predicted to be 1.6 years for the expected outcome.

6.1.3 The payback period could be as low as 0.7 years for the minimum scenario but increases to 2.1 years for the maximum scenario for fossil fuel mix and 4.8 years for grid mix. The carbon payback time for each scenario is shown in **Table 6.1.**

Table 6.1 Payback in years for each scenario used in the carbon calculator

Fuel source	Carbon payback time (years) Expected value	Carbon payback time (years) Minimum value	Carbon payback time (years) Maximum Value
Coal fired	0.7	0.3	0.9
Grid mix	3.5	1.6	4.8
Fossil fuel mix	1.6	0.7	2.1

[15] Scottish Environment Protection Agency (n.d.) *Carbon Calculator: technical guidance* [online]. Available at: https://www.gov.scot/publications/carbon-calculator-technical-guidance/ [Accessed 27 October 2023].

[16] Note on limitations: wind power will not replace all forms of conventional generation equally, so the true carbon emissions displacement will be dependent on a combination of factors e.g. the types of power generation being replaced, any decrease in efficiency of conventional plant operating at part load, and the impact of any increase in frequency of start-up and shut-down of conventional plant.

7. Climate Change Resilience

7.1.1 According to the latest State of the UK Climate Report[17], the UK's climate is changing. In general, climate change in the UK is projected to lead to:

- Hotter, drier summers with increased frequency and duration of heatwaves and droughts.
- Warmer, wetter winters with reduced frequency of snow and ice, however such events and extreme cold snaps remain a risk.
- Increased frequency of extreme events such as heavy rainfall, resultant flooding, high winds and, potentially, lightning strikes.

7.1.2 The vulnerability of the Proposed Development to climate change has been considered in the design and other relevant topic chapters listed in **Section 1.1**. The environmental measures identified in topic assessments related to improving the climate change resilience of the Proposed Development have been reproduced in **Table 7.1.**

Table 7.1 Embedded measures improving climate change resilience.

Chapter	Environmental measure	Relevance for climate change resilience
Chapter 4: Project Description	Modern wind turbines are designed to withstand high wind speeds and are normally certified against structural failure for wind speeds up to 150 mph. At high wind speeds, the wind farms will shut themselves down to avoid excessive wear.	These measures increase the resilience of the wind turbines to increasing wind speeds that may be experienced as part of storm events associated with climate change.
	The wind turbines will be fitted with a lightning protection system as part of the design.	These measures increase the resilience of the wind turbines to increasing lightning strikes that may be experienced associated with climate change.
	Occasionally very heavy snow and ice may affect the anemometer or aerodynamics of the turbine blades resulting in temporary automatic shutdown. The wind turbine would restart automatically after accumulations have naturally thawed.	Although climate change trends show increasing mean annual temperatures, cold weather events could still occur. These measures increase the resilience of the wind turbines to cold weather events.
	Turbines and High Voltage equipment (substation) would be inspected and maintained by a local team of technicians. Turbines would be typically maintained at 6 monthly internals.	This allows for adaptative capacity to be built into the operation of the wind turbines. The routine maintenance would identify any impacts to the wind turbines from extreme weather associated with

[17] Met Office. (2022). State of the UK Climate. Available online at: https://www.metoffice.gov.uk/research/climate/maps-and-data/about/state-of-climate. (Accessed: November 2023).

Chapter	Environmental measure	Relevance for climate change resilience
		climate change, allowing for replacement or upgrades, if required.
	Site tracks are likely to be maintained annually.	Any deterioration or degradation of access track surfacing due to climate change events (i.e., increasing temperatures) will be identified during annual maintenance and rectified.
Chapter 6: Landscape and Visual **Chapter 8: Biodiversity**	Temporary and permanent habitat loss will be kept to a minimum. The Landscape and Ecological Management Plan (LEMP) will set out management proposals for any replacement or enhancement planting.	The measures or management proposals within the LEMP will help any replacement or enhancement planting to succeed in response to changing climatic conditions i.e., drought conditions or increasing temperatures.
Chapter 10: Water Environment	Climate change allowances in line with Natural Resources Wales guidance have been applied to the hydrological modelling inputs to minimise vulnerability and provide resilience to the impacts of climate change.	Fluvial flood risk is considered to pose a limited risk to the Proposed Development. Further details of the allowances are contained within **Chapter 10** and within **Appendix 10A**.
Appendix 10A: Flood Consequence Assessment	The proposed drainage strategy includes the incorporation of Sustainable Drainage Systems (SuDS). The sizing of the attenuation volumes includes for up to the 1% AEP event including the appropriate allowances for climate change covering the lifetime of the Proposed Development (20% for the construction phase (precautionary upper estimate up to the 2050s) and 40% for the operation phase (precautionary upper estimate up to the 2080s)).	The drainage design and sizing of SuDS to appropriately account for climate change will help prevent damage or deterioration to the assets resulting from extreme precipitation and the action of pluvial flooding.
Chapter 11: Ground Conditions	The design for the Proposed Development will comply with good practice in structural design including compliance with the Eurocodes and relevant British Standards. The design will account for the expected ground conditions and design loads, accounting for the effects of climate change.	The detailed design of the foundations and supports will take into account changing ground conditions for the soil type with fluctuations in rainfall anticipated with climate change.

8. Summary

8.1.1 On the basis of potential annual CO_2 savings of 17,472 tonnes/year (based on figure of 424 tonnes of CO_2 savings per GWh and a capacity factor of 28.0%), the Proposed Development could result in a total carbon saving of approximately 524,153 tonnes over its 30-year operational life and generate electricity to annually supply the equivalent of 11,800 homes.

8.1.2 It is predicted that the carbon loss in developing the Proposed Development would be paid back in ~1.6 years (5% of the 30-year operational life) based upon the expected outcome under the fossil fuel mix scenario. Even considering the maximum scenario against the fossil fuel mix, the Proposed Development would have achieved the carbon balance within ~2.1 years (7% of the 30-year operational life).

8.1.3 It is concluded that the GHG impact of the Proposed Development will have a significant beneficial effect. The Proposed Development causes an indirect reduction in atmospheric GHG emissions which has a positive impact on achievement of carbon budgets and targets for Wales and the UK, and a 1.5°C compatible trajectory.

8.1.4 The vulnerability of the Proposed Development to climate change has been addressed throughout the ES in relevant topic chapters identified in **Section 1.1**. The design of the wind turbines includes measures to improve the resilience of the Proposed Development, which will continue to be developed throughout the detailed design.

9. Annex A: Carbon Calculator – Justification for Values Used

Carbon Calculator v1.7.0
Trecelyn Windfarm   Location: 51.675456 -3.106002
Pennant Walters

Core input data

Input data	Expected value	Minimum value	Maximum value	Source of data
Windfarm characteristics				
Dimensions				
No. of turbines	4	4	4	Proposed Development Project Description V3 (paragraph 4.2.1).
Duration of consent (years)	30	30	30	Proposed Development Project Description V3 (Paragraph 4.2.12).
Performance				
Power rating of 1 turbine (MW)	4.2	4.2	4.2	Proposed Development Project Description V3 (paragraph 4.5.6) Vestas-4.2 is the nominal turbine.
Capacity factor	28	25.2	30.8	No site specific capacity factor available. Welsh average onshore capacity factor for the last 5 years is 28% based on Regional (Wales) load factors on an unchanged configuration basis (DESNZ, 2022). Min and max +/- 10%
Backup				
Fraction of output to backup (%)	5	0	5	Following the guidance provided by Nayak et al, UK Energy in brief 2013 confirms that wind energy accounts for less than 20% of total national electricity generation therefore 0% could be used however 5% has been used to reflect a worst case scenario 0% is entered as a minimum value.
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	10	10	10	Fixed
Total CO2 emission from turbine life ($tCO_2\ MW^{-1}$) (eg. manufacture, construction, decommissioning)	Calculate wrt installed capacity	Calculate wrt installed capacity	Calculate wrt installed capacity	
Characteristics of peatland before windfarm development				
Type of peatland	Acid bog	Acid bog	Acid bog	An 'acid bog' is fed primarily by rainwater and often inhabited by sphagnum moss, thus making it acidic. See Stoneman & Brooks (1997). Peat Factual Report concludes the site is covered by freely draining acid loamy soils over rock.
Average annual air temperature at site (°C)	9.25	5.76	12.73	Average annual temperature taken for Tredegar, Bryn Bach Park No 2 Met Office station 1991-2020 . Expected value calculated using average of minimum and maximum average temperatures.
Average depth of peat at site (m)	0.05	0	0.1	Peat Survey Factual Report: potential peat depths in the range of between 0.00m and 0.10m. The Welsh Government define true peat as being ≥0.4m in depth therefore the site is generally considered not underlain by peat.
C Content of dry peat (% by weight)	55	49	62	Calculated using typical values provided in carbon calculator tool.

Input data	Expected value	Minimum value	Maximum value	Source of data
Average extent of drainage around drainage features at site (m)	7.5	5	10	No site specific measurements available, precautionary values used.
Average water table depth at site (m)	0.3	0.2	0.4	No site specific values - estimates used.
Dry soil bulk density (g cm^{-3})	0.25	0.2	0.3	Due to lack of site specific information, indicative figures from National Soil Inventory of Scotland have been used.
Characteristics of bog plants				
Time required for regeneration of bog plants after restoration (years)	3	2	5	Estimated values.
Carbon accumulation due to C fixation by bog plants in undrained peats (tC ha^{-1} yr^{-1})	0.25	0.12	0.31	Default values provided by Turunen et al., 2001; Botch et al., 1995.
Forestry Plantation Characteristics				
Area of forestry plantation to be felled (ha)	0	0	0	Not none at this time. This data will be used for final ES.
Average rate of carbon sequestration in timber (tC ha^{-1} yr^{-1})	3.6	3.4	3.8	Figures from Cannell, 1999. min and max entered as a range.
Counterfactual emission factors				
Coal-fired plant emission factor (t CO2 MWh^{-1})	1.002	1.002	1.002	
Grid-mix emission factor (t CO2 MWh^{-1})	0.19338	0.19338	0.19338	
Fossil fuel-mix emission factor (t CO2 MWh^{-1})	0.432	0.432	0.432	
Borrow pits				
Number of borrow pits	0	0	0	Proposed Development Project Description V3 (paragraph 4.5.2 - no borrow pits proposed).
Average length of pits (m)	0	0	0	Proposed Development Project Description V3 (paragraph 4.5.2 - no borrow pits proposed).
Average width of pits (m)	0	0	0	Proposed Development Project Description V3 (paragraph 4.5.2 - no borrow pits proposed).
Average depth of peat removed from pit (m)	0	0	0	Proposed Development Project Description V3 (paragraph 4.5.2 - no borrow pits proposed).
Access tracks				
Total length of access track (m)	3460	2767.6	4152.4	As provided in Construction Quantities spreadsheet. Minimum and maximum entered as 20% range to allow for variations
Existing track length (m)	675	539.6	809.4	Updated from construction quantities spreadsheet. Figures have been normalised to include for widened of existing track.
Length of access track that is floating road (m)	0	0	0	Proposed Development Project Description (paragraph 4.5.18 - no floating road proposed).
Floating road width (m)	5	5	5	Proposed Development Project Description (paragraph 4.5.18 - no floating road proposed). Value must be 5 or larger
Floating road depth (m)	0	0	0	Proposed Development Project Description (paragraph 4.5.18 - no floating road proposed).

Input data	Expected value	Minimum value	Maximum value	Source of data
Length of floating road that is drained (m)	0	0	0	Proposed Development Project Description (paragraph 4.5.18 - no floating road proposed).
Average depth of drains associated with floating roads (m)	0	0	0	Proposed Development Project Description (paragraph 4.5.18 - no floating road proposed).
Length of access track that is excavated road (m)	0	0	0	New access tracks are all stone roads
Excavated road width (m)	5	5	5	ew access tracks are all stone roads. Minimal values needed in tool.
Average depth of peat excavated for road (m)	0.05	0	0.1	The Welsh Government define true peat as being ≥0.4m in depth. Peat factual report - no true peat recorded
Length of access track that is rock filled road (m)	2785	2228	3343	Updated from values for 'stone' provided in Construction Quantities
Rock filled road width (m)	5.5	5.5	5.5	Updated from values for 'stone' provided in Construction Quantities
Rock filled road depth (m)	0.6	0.54	0.66	Updated from values for 'stone' provided in Construction Quantities. 10% allowed for minimum and maximum
Length of rock filled road that is drained (m)	0	0	0	N/A will be updated with drainage information for final ES
Average depth of drains associated with rock filled roads (m)	0	0	0	N/A will be updated with drainage information for final ES
Cable trenches				
Length of any cable trench on peat that does not follow access tracks and is lined with a permeable medium (eg. sand) (m)	0	0	0	Description of the Proposed Development, paragraph 4.5.24. Cables will be routed alongside the access track.
Average depth of peat cut for cable trenches (m)	0	0	0	The Welsh Government define true peat as being ≥0.4m in depth. Peat survey factual report - no true peat across the site.
Additional peat excavated (not already accounted for above)				
Volume of additional peat excavated (m^3)	0	0	0	N/A
Area of additional peat excavated (m^2)	0	0	0	N/A
Peat Landslide Hazard				
Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments	negligible	negligible	negligible	Fixed
Improvement of C sequestration at site by blocking drains, restoration of habitat etc				
Improvement of degraded bog				
Area of degraded bog to be improved (ha)	0	0	0	N/A
Water table depth in degraded bog before improvement (m)	0	0	0	N/A
Water table depth in degraded bog after improvement (m)	0	0	0	N/A

Input data	Expected value	Minimum value	Maximum value	Source of data
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)	2	2	2	N/A Minimal values needed for tool
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)	2	2	2	N/A Minimal values needed for tool
Improvement of felled plantation land				
Area of felled plantation to be improved (ha)	0	0	0	Unknown as this stage. Will be updated for final ES.
Water table depth in felled area before improvement (m)	0	0	0	N/A
Water table depth in felled area after improvement (m)	0	0	0	N/A
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)	2	2	2	N/A. Minimal value needed for tool.
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	2	2	2	N/A. Minimal value needed for tool.
Restoration of peat removed from borrow pits				
Area of borrow pits to be restored (ha)	0	0	0	N/A
Depth of water table in borrow pit before restoration with respect to the restored surface (m)	0	0	0	N/A
Depth of water table in borrow pit after restoration with respect to the restored surface (m)	0	0	0	N/A
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	2	2	2	N/A. Minimal values needed for tool.
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	2	2	2	N/A. Minimal values needed for tool.
Early removal of drainage from foundations and hardstanding				
Water table depth around foundations and hardstanding before restoration (m)	0	0	0	Assumed no removal of drainage
Water table depth around foundations and hardstanding after restoration (m)	0	0	0	N/A

Input data	Expected value	Minimum value	Maximum value	Source of data
Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)	0.1	0.1	0.1	N/A. Minimal values needed for tool.
Restoration of site after decomissioning				
Will the hydrology of the site be restored on decommissioning?	No	No	No	
Will you attempt to block any gullies that have formed due to the windfarm?	Yes	Yes	No	Assumes that any gullies caused by construction of the wind farm would be blocked to maintain habitats except worst case scenario (maximum column).
Will you attempt to block all artificial ditches and facilitate rewetting?	No	No	No	Assumed no.
Will the habitat of the site be restored on decommissioning?	No	No	No	
Will you control grazing on degraded areas?	Yes	Yes	Yes	If required
Will you manage areas to favour reintroduction of species	No	No	No	Assumed no
Methodology				
Choice of methodology for calculating emission factors	Site specific (required for planning applications)			

Forestry input data

N/A

Construction input data

Input data	Expected value	Minimum value	Maximum value	Source of data
Crane pad, foundations and substation				
Number of turbines in this area	4	4	4	As per project description
Turbine foundations				
Depth of hole dug when constructing foundations (m)	0.05	0.01	0.1	The Welsh Government define true peat as being ≥0.4m in depth. Peat survey confirmed no true peat, nominal amount included
Aproximate geometric shape of whole dug when constructing foundations	Circular	Circular	Circular	Chapter 4 - Description of the Proposed Development 4.5.15. Confirmed in Construction Quantities Spreadsheet
Diameter at bottom	20	20	20	
Diameter at surface	20	20	20	
Hardstanding				
Depth of hole dug when constructing hardstanding (m)	0.05	0.01	0.1	The Welsh Government define true peat as being ≥0.4m in depth. Peat survey confirmed no true peat, nominal amount included
Aproximate geometric shape of whole dug when constructing hardstanding	Rectangular	Rectangular	Rectangular	Description of the Proposed Development - this will be associated infrastructure around foundations, crane pad, substations, compounds which require concrete / foundations
Length at surface	120	120	120	
Width at surface	120	120	120	
Length at bottom	120	120	120	
Width at bottom	120	120	120	
Piling				
Is piling used?	No	No	No	Description of the Proposed Development: (e.g. it is currently expected that turbines will not require piled foundations, paragraph 4.5.14.)
Volume of Concrete				
Volume of concrete used (m^3) in the entire area	2318	2318	2318	Calculated from construction quantities spreadsheet for crane pads (inclusive of foundations), and substation hardstanding.

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