

Technical Appendix 4.2: Carbon Calculator for T39 Layout

(Refer to Disc Enclosed)

ENVIRON 2014

Strathy South Wind Farm - Scottish Government Carbon Calculator for Wind Farms on Peatlands – v 2.9.1: Revised: 2nd September 2014 in response to the revised T39 Layout

Details of Data Sources

Row in Carbon Calculator	Input Parameter	Data source
Row 18	Extra Capacity	Dale et al 2004 - The extra capacity required for backup is estimated to be 5.5%, based on the fact that 22% of electricity consumed in Scotland was generated by wind power in 2012 (Scottish Renewables, Onshore Wind Briefing Note (June 2013)) http://www.scottishrenewables.com/static/uploads/publications/sr_onshore_wind_briefing_040613.pdf
Row 24	Average air temperature at site (°C)	Met office website: http://www.metoffice.gov.uk/climate/uk/averages/regmapage.html#nscotland
Row 25	Average depth of peat at site (m)	Values from the Peat Probing exercise undertaken by RPS and results presented in the Strathy South ES Addendum, Volume 4: Technical Appendices; TA A14.1: Peat Landslide Hazard Risk Assessment, SLR, 2013) and the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014
Row 26	C content of dry peat (% by weight)	Strathy South ES Addendum, Volume 4: Technical Appendices; TA A14.1: Peat Landslide Hazard Risk Assessment, SLR, 2013) showed lower values of carbon content in samples (46%). Generic data preferred therefore expected %C in peat: 55%. Minimum and maximum values of 49% and 62% used (Birnie et al. (1991)).
Row 27	Average extent of drainage around drainage features at site	Expected value provided, based on professional judgement (RPS) This is a conservative estimate (i.e. drainage effects are likely to be less than this) based on the drained / afforested nature of the site meaning the site is already significantly impacted by forestry drainage and hence water table levels are artificially low. In addition, the site is relatively flat and the peat (below the level impacted by forestry) relatively well decomposed (lower conductivity), both of which result in reduced extent of drainage.
Row 28	Average water table depth at site	SEPA recommended values used (site measurements not found to be reliable)

Row in Carbon Calculator	Input Parameter	Data source
Row 29	Dry soil bulk density (g/cm ³)	SLR confirmed that value from sampling at site was unusually low. Default generic values from the National Soil Inventory of Scotland (2007-2009) used: <ul style="list-style-type: none"> • Minimum: 0.072 • Maximum: 0.293 • Mean: 0.132 <p>Note: spreadsheet only shows to two decimal places)</p>
Row 31	Time required for regeneration of bog plants after restoration (years)	Values are based on professional judgment (RPS). These estimates are based on practical experience gained from direct involvement and monitoring (vegetation and hydrology) of restoration on similar sites (e.g. Blacklaw WF, Clyde WF, Whitelee WF) by RPS ecologist, Matthew Pannell, specialising in peat bogs and peat restoration. This estimate takes into consideration altitude, exposure, site wetness, existing vegetation and new techniques for increasing the rate of recolonisation (e.g. sphagnum beads).
Row 32	Carbon accumulation due to C fixation by bog plants in undrained peats (tCO ₂ /ha/yr)	SNH Technical Guidance Note (2003) on Wind Farms and Carbon Savings
Row 34	Average length of pits	SSE Land Take Calculations (as stated in Annex A: Calculation of Peat Excavation and Re-Use tables of the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014)
Row 45	Average width of pits	SSE Land Take Calculations (as stated in Calculation of Peat Excavation and Re-Use tables)
Row 46	Average depth of peat removed from pit (m)	Values based on desk-based assessment, site walkover and peat probing (undertaken by MouchelParkman and reported in the 2007 ES Appendix 14.2 Borrow Pit Assessment and the subsequent work completed by SLR and reported in the 2013 ES Addendum in TA A14.1: Peat Landslide Hazard Risk Assessment) (as stated in Calculation of Peat Excavation and Re-Use tables: Calculation of Peat Excavation and Re-Use tables of the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014)
Row 49	Average length of turbine foundations	SSE Land Take Calculations (Calculation of Peat Excavation and Re-Use tables of the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014)) Diameter of base of excavation = 20m; Area= 314 m ² . Foundation assumed to be square/rectangular = 17.75 m x 17.75 m

Row in Carbon Calculator	Input Parameter	Data source
Row 50	Average width of turbine foundations	SSE Land Take Calculations (Calculation of Peat Excavation and Re-Use tables of the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014) Diameter of base of excavation = 20 m; Area= 314 m ² Foundation assumed to be square/rectangular = 17.75 m x 17.75 m
Row 51	Average depth of peat removed from turbine foundations	Value based on peat probing results (Calculation of Peat Excavation and Re-Use tables of the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014) The mean, minimum and maximum values calculated statistically using Mean plus/minus standard deviation for turbine locations.
Row 52 & 53	Average length / width of hardstanding	Worst case scenario Hardstanding 18.5 x 45 m (ES Addendum, Volume 3: Figures, Figure A4.4 Typical Turbine Foundation and Hardstanding). Anticipated to be 14.8 m x 36 m.
Row 54	Average depth of peat removed from hardstanding (m)	Value based of peat probe results (Calculation of Peat Excavation and Re-Use tables of the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014) The mean, minimum and maximum values calculated statistically using Mean plus/minus standard deviation for turbine locations.
Row 58	Length of floated access track	Values based on Infrastructure details provided by SSER (Calculation of Peat Excavation and Re-Use tables of the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014)
Row 59 & 60	Floating road width and depth	ES Addendum, Volume 3: Figures, Figure A4.4: Typical Access Tracks
Row 61	Length of floating road that is drained (m)	Assumption that 50% of floating track would be drained (Calculation of Peat Excavation and Re-Use tables of the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014)
Row 62	Average depth of drains associated with floating roads (m)	Value based on depth given in SNH guidance (2 nd Edition, 2013) <i>Floating Roads on Peat</i>
Row 63	Length of access track that is excavated (m)	Values based on Infrastructure details provided by SSER (Calculation of Peat Excavation and Re-Use tables of the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014)

Row in Carbon Calculator	Input Parameter	Data source
Row 64	Excavated Road width (m)	ES Addendum, Volume 3: Figures, Figure A4.6 Typical Access Track – shows typical access track. Some tracks upgraded therefore maximum will be 8 m; some lengths are upgraded from existing tracks; some track widths have been reduced by narrowing tracks to 4.5 m. Expected value of 7 m used, based on Calculation of Peat Excavation and Re-Use tables of the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014
Row 65	Average depth of peat excavated for road (m)	Calculated on basis of peat probe results for entire site where peat depth < 1.0m (assumes that for depths > 1.0 m the tracks would be floated, and no peat excavated). The mean, minimum and maximum values calculated statistically using Mean plus/minus standard deviation. Calculation of Peat Excavation and Re-Use tables of the Technical Appendix 4.1: Peat Management Plan included in the Further Information Report for the T39 Layout, ENVIRON, 2014
Row 73	Average depth of peat cut for cable trenches	Values are based on peat depths recorded during peat probing along the route of the proposed access tracks. Minimum and maximum values are also provided, based on the results of the peat probing and the depth of cable trench.
Row 75	Volume of additional peat excavated (m ³)	<p>Values for volume of additional peat excavated in relation to the laydown areas, construction compound, concrete batching plant, switching station and welfare compound and met masts have been taken from the following sources:</p> <ul style="list-style-type: none"> • Technical Appendix 4.1: Peat Management Plan of the Further Information Report for the T39 Layout); and • Volume 2: Main Report; Chapter A4: Development Description of the ES Addendum. <p>The volumes of additional excavated peat are as follows:</p> <ul style="list-style-type: none"> • Laydown Area No. 1¹ - 5,000 m³ • Construction compound – 3,000 m³ • Concrete batching plant – 8,000 m³ • Switching Station Compound – 5,000 m³; • Temporary access track to met mast (removal of met mast 4, originally located in the northwest corner of the site) and borrow pits (plus shoulder areas on permanent tracks)= 4,349.88 m³; • Met mast area= 112.5 m³.

¹ Laydown Area 2 has been incorporated into Borrow Pit land take figures

Row in Carbon Calculator	Input Parameter	Data source
Row 76	Area of additional peat excavated (m ²)	<p>Values for area of additional peat excavated have been provided based on the information sources referenced in the row above in relation to laydown areas, construction compound, concrete batching plant, switching station and welfare compound and met masts.</p> <ul style="list-style-type: none"> • Laydown Area No. 1¹ - 10,000 m² • Construction compound – 10,000 m² • Concrete batching plant – 10,000 m² • Switching Station Compound – 10 000 m²; • Temporary access track to met mast (removal of met mast 4, originally located in the northwest corner of the site) and borrow pits (plus shoulder areas on permanent tracks)= 6,692.12 m²; • Met mast area= 300 m²
Row 81	Area of degraded bog to be improved (ha)	Information provided by RPS in (the ES Addendum, Volume 4: Technical Appendices; TA A11.2: Management at Strathy South: Forest Removal, Habitat Management and an Assessment of the Effects on Birds connected with the Caithness and Sutherlands SPA.
Row 82	Water table depth in degraded bog before improvement (m)	<p>Water depth in degraded bog has been adjusted to values provided by SEPA (letter ref: PCS/13013, dated 26/11/13) as follows:</p> <ul style="list-style-type: none"> • Expected: 0.3 m • Minimum: 0.1 m • Maximum: 0.5 m
Row 83	Water table depth in degraded bog after improvement (m)	<p>Water depth in degraded bog has been adjusted to values provided by SEPA (letter ref: PCS/13013, dated 26/11/13) as follows:</p> <ul style="list-style-type: none"> • Expected: 0.1 m • Minimum: 0.05 m • Maximum: 0.3 m
Row 84	Time required for hydrology and habitat of bog to return to its previous state on improvement (years)	Value based on professional judgement (RPS)
Row 85	Period of time when effectiveness of improvement in degraded bog can be guaranteed (years)	Natural England (2013) Restoration of Degraded Blanket Bog (NEER 003)

Row in Carbon Calculator	Input Parameter	Data source
Row 87	Area of felled plantation to be improved (ha)	Calculation provided by RPS based on forestry compartments.
Row 88	Water table depth in felled area before improvement (m)	See details provided for Row 82.
Row 89	Water table depth in felled area after restoration (m)	See details provided at Row 83.
Row 90	Time required for hydrology and habitat of felled areas to return to its previous state on restoration (years)	Value based on professional judgement (RPS)
Row 91	Period of time when effectiveness of improvement in felled plantation can be guaranteed (years)	Natural England (2013) Restoration of Degraded Blanket Bog (NEER 003)
Row 93	Area of borrow pits to be restored	Strathy South ES Addendum, Volume 3: Figures, Figures A 4.15 – A4.18 which show the borrow pits (Total area = 107,618.90 m ² = 10.76 ha)
Row 94	Water table depth in borrow pit before restoration (m)	See details provided for Row 82.
Row 95	Water table depth in borrow pit after restoration (m)	See details provided at Row 83.
Row 96	Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	Value based on professional judgement (RPS)
Row 97	Period of time when effectiveness of restoration of peat removed from borrow pits can be guaranteed (years)	Natural England (2013) Restoration of degraded blanket bog (NEER003)
Row 99	Water table depth around foundations and hardstanding before restoration (m)	See details provided for Row 82.
Row 100	Water table depth around foundations	See details provided at Row 83.

Row in Carbon Calculator	Input Parameter	Data source
	and hardstanding after restoration (m)	
Row 101	Time to completion of backfilling, removal of any surface drains and full restoration of the hydrology (years)	Value based on professional judgement (RPS)
Rows 104 – 110	Restoration of site after decommissioning	<ul style="list-style-type: none"> • Responses based on SSER and RPS professional judgement, including considerations such as: control water table in order to achieve optimal levels for restoration (see information provided by SEPA in Row 83 above), and • Information contained within the Outline Habitat Management Plan (refer to ES Addendum, Volume 4: Technical Appendices; TA A11.2: Management at Strathy South: Forest Removal, Habitat Management and an Assessment of the Effects on Birds connected with the Caithness and Sutherlands SPA.).