ARCUS

LLANDINAM WINDFARM REPOWERING
TIMESCALE EXTENSION
INFORMATION TO INFORM AN EIA SCREENING OPINION

JUNE 2019

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TABLE OF CONTENTS

1 INTRODUCTION

CeltPower are the holders of a Section 36 Consent for Llandinam Windfarm Repowering, comprising the decommissioning of the existing 102 wind turbines and their replacement with 34 new wind turbines (the "Development"). The consent was granted in September 2015, and it specifies that construction must begin within 5 years of the grant of consent. CeltPower is applying to extend this period for a further 5 years in order to allow sufficient time for prerequisites.

In terms of Environmental Impact Assessment (EIA), this application falls under the EIA Regulations[1]. Schedule 2 of the EIA Regulations identifies "*development requiring screening if no EIA Report is provided*". Paragraph 3 of Schedule 2 specifies "*development to provide a change or extension of (a) a generating station … where the generating station … is already authorised … and the change or extension may have significant adverse effects on the environment.*"

The Section 36 Consent was granted following an application that included an Environmental Statement (ES)[2], comprising:

- The 2008 ES;
- The Supplementary Environmental Information (SEI) dated 2011; and
- The SEI dated 2013.

The only change proposed is to extend the period allowed between consent and the start of construction from 5 years to 10 years.

This document provides information to inform that screening process.

It is the opinion of the principal author of this document[3] that, based on the information set out in this document, the change will not have significant adverse effects on the environment, and hence the conclusion of the screening process should be that the application does not require EIA.

The change of period prior to construction will, itself, have no effects on the environment, because during this period the Development will continue not to have started. The potential for the change to have significant adverse effects in terms of the EIA Regulations is therefore limited to changes to the EIA Regulations since the EIA was last updated (2013). For the purposes of completeness, changes to the baseline environment since the EIA was last updated (2013) have also been set out, to provide commentary on whether there would be any change to the assessment of likely significant effects.

The following sections are included in this document:

- **Baseline review**: a review of the baseline environment referred to in the Environmental Statement (ES)[4] that accompanied the application for the Section 36 Consent that was granted, to understand if the baseline environment may have changed sufficiently to change the assessment of likely significant effects;
- **Cumulatives development update**: a summary of changes to windfarm developments in the vicinity of the Development, to understand if the cumulative situation may have changed sufficiently to change the assessment of likely significant effects;

[1] The Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2017. SI 2017/580. Available at: http://www.legislation.gov.uk/uksi/2017/580/contents/made [accessed on 04/06/2019].

[2] The ES comprised the original ES document submitted in 2008, and Supplementary Environmental Information (SEI) submitted in 2011 and 2013.

[3] Dr Paul Phillips, a Registered EIA Practitioner, as set out in Section 6 of this document.

[4] The ES comprised the original ES document submitted in 2008, and Supplementary Environmental Information (SEI) submitted in 2011 and 2013.

- **Assessment of effects on climate change**: updating the assessment to meet the requirements of the latest EIA Regulations, to demonstrate no significant adverse effects;
- **Assessment of effects on human health**: providing a summary of potential effects on human health, to meet the requirements of the latest EIA Regulations, to demonstrate no significant adverse effects;
- **Authorship of this document**: providing commentary on the experience and professional status of the authors of this document, in response to requirements for EIA Reports in the latest EIA Regulations; and
- **Conclusions**.

2 BASELINE REVIEW

This section provides commentary on the extent to which the baseline as described in the ES remains applicable in 2019, and provides commentary on whether the baseline environment may have changed sufficiently to change the assessment of likely significant effects. This section includes a sub-section for each chapter in the ES, for ease of cross-referencing.

2.1 Site Walkover

The principal aspects of the baseline with the potential to have changed since the ES was last updated relate to site characteristics.

A walkover of the site was carried out to determine whether there had been any substantive changes to habitats or other site characteristics since the previous survey in 2008.

The walkover was carried out by an ecologist and an EIA project manager, on 21st and 22nd May 2019. Conditions were good: 14°C, clear skies, light winds and minimal haze. The preceding few days and weeks had been drier than the average for the area, such that conditions underfoot were relatively dry. Areas previously identified as blanket bog were visited, and broad coverage of the area proposed for new turbines and the minor road access route from the A483 was achieved.

Any deviations from the Phase 1 Habitats Map presented in the 2008 ES (Figure 8-2 in Volume 1) were noted. Other observations were also recorded, including features such as off-site wind turbines, evidence of birds (sightings and calls), hydrological features (flush areas and springs) and new developments.

Figure 1 replicates Figure 8-2 of the ES, showing target notes of observations made during the walkover survey. It also shows the route taken on site, either by car or on foot.

Chapter 6: Landscape and VIsual

The only potential for substantive changes to the landscape and visual baseline relate to major new developments within proximity to the Development site. One such development was observed, this being the new A483 bypass of Newtown.

The Newtown bypass was completed in February 2019, substantially easing traffic pressure through the town. It passes to the east and south of the town centre, on a rising then falling route of 6 km from a new roundabout with the A483 to the north-east of Newtown at grid reference 313216 292218 to a new roundabout with the A489 south-west of Newtown at 308360, 290191. There is another roundabout near the centre of the new route, linking again with the A483 as it exits Newtown towards the south, towards the Development site. The new route involves new embankments and cuttings, and a substantial bridge approximately 1 km due south of the centre of Newtown, at 310753 290224.

Where the new road and associated earthworks and infrastructure is visible from viewpoints that may also have views of the Development, the new road will be a new, man-made feature in the landscape, in addition to features previously present. The change will make the assessment reported in the ES more conservative, therefore.

Chapter 7: Ornithology

The walkover survey identified no substantive changes to habitats reported and assessed in the ES. The small changes noted under "Chapter 8: Ecology", below, will not substantially affect the ornithological baseline. Overall, site observations provided no cause to consider that the ornithological baseline reported in the ES had changed.

Chapter 8: Ecology

The walkover survey sought to identify any substantive changes to the ecology baseline by reviewing habitats within the Development site.

Figure 2 replicates Figure 8-2 (Habitats) of the ES, showing target notes of observations made during the walkover survey. These are summarised in Table 1.

Table 1: Target Notes from Walkover Survey

Target Note	Grid Reference	Notes
1	SO 02101 81661	Blanket Bog within the south-western boundary of the site, no change noted.
2	SO 02216 81511	Acid/neutral flush, no change noted.
3	SO 02113 80868	Borrow Pit location. C. 15 m across. Appears old, but was not noted in the original ES.
4	SO 02865 81110	Blanket bog to the east, outside of the site boundary. No change identified.
5	SO 03765 83684	Waterbody, no change in size. Open with no aquatic vegetation or shading present. No change identified.
6	SO 03487 84100	New borrow pit location. C. 10 m across. Appears new and is currently being worked, apparently for a track leading out of the site boundary to the west.
7	SO 04428 84754	Turbine 5 proposed location, within area of semi-improved grassland. No change identified.
8	SO 04568 85539	Turbine 7 proposed location, within area of poor semi-improved grassland. No change identified.
9	SO 04558 85743	Area of semi-improved grassland and scattered shrub heath. No change identified.
10	SO 08415 84247	Site access entrance. No change identified.
11	SO 08293 84109	Access road, with strips of semi-improved grassland and scattered scrub to the west and arable fields to the east. No change identified.
12	SO 07816 84023	Access road slopes and narrows. No change identified.
13	SO 07673 84092	Tight corner on the access road. No change identified.

Target Note	Grid Reference	Notes
14	SO 07334 84689	Tight corner on the access road. No change identified.
15	SO 07148 84649	Access road, tight corner with small embankment to the east. Some trees overhanging onto the access road. No change identified.
16	SO 06992 84722	Access road, telegraph lines adjacent to the east. No change identified.
17	SO 06754 84369	Several overhanging trees over the access road. Data provided by Powys and BBNP Environmental Records Centre show this strip of woodland is a restored Ancient Woodland. No change identified.
18	SO 06595 84139	Tight corner on the access road. No change identified.
19	SO 06241 84138	Scattered trees to the west of the access road and overhead telegraph lines. No change identified.
20	SO 05800 83988	Several overhanging trees onto the access road. No change identified.
21	SO 05149 83759	Access road, telegraph lines adjacent to the east. No change identified.
22	SO 04995 83640	Tight corner on the access road with some scattered trees present to the west. No change identified.
23	SO 07564 83797	Wind turbine south of access road, outside of the site boundary. No change identified.
24	SO 08862 84240	Location of met mast, to the east of the site access entrance, outside of the site boundary. No change identified.

In conclusion, site observations provided no cause to consider that the ecological baseline reported in the ES had substantially changed.

Chapter 9: Traffic, Access and Transport

The only potential for substantive changes to the traffic, access and transport baseline relate to road upgrades and new developments of relevance to the Abnormal Indivisible Loads (AIL) route and other HGV route proposed for access to the Development site. One such development was observed, this being the new A483 bypass of Newtown, as described in "Chapter 6: Landscape and Visual", above.

This route could be used in preference to the option for AIL routing presented in the ES that passed through Newtown. This new route would avoid the need for street furniture management in Newtown, and for congestion management in Newtown. The change will make the assessment reported in the ES more conservative, therefore.

Chapter 10: Cultural Heritage

No potential was identified for the archaeological baseline to have changed since the ES.

The only potential for substantive changes to the cultural heritage baseline relates to major new developments within proximity to the Development site and to heritage features. One

such development was observed, this being the new A483 bypass of Newtown, as described in "Chapter 6: Landscape and Visual", above.

Where the new road and associated earthworks and infrastructure is visible from within the setting of heritage features, and from locations that may also have views of the Development, the new road will be a new, man-made feature, in addition to features previously present. The change will make the assessment reported in the ES more conservative, therefore.

Chapter 11: Noise and Vibration

The only potential for substantive changes to the noise and vibration baseline relates to new noise- and/or vibration-sensitive developments, specifically residential properties, within proximity to the Development site. No such new developments were observed during the walkover survey.

The Section 36 Consent for the Development should have prevented planning permission being granted for new residential properties that could experience unacceptable levels of noise from the Development, and hence there is good reason for the baseline not to have substantially changed in respect of noise and vibration.

The new A483 bypass of Newtown, as described in "Chapter 6: Landscape and Visual", above, could provide a new and improved route for decommissioning/construction traffic to the Development site. This would avoid Newtown, hence reducing potential noise and vibration effects from construction traffic on receptors in Newtown. The change will make the assessment reported in the ES more conservative, therefore.

Chapter 12: Geology, Hydrology and Hydrogeology

The walkover survey sought to identify any substantive changes to the baseline by reviewing habitats within the Development site. All bog, wetlands and flushes previously identified in the ES were confirmed to be present in the walkover survey. Overall, site observations provided no cause to consider that the geological, hydrological and hydrogeological baseline reported in the ES had changed.

Chapter 13: Land use, Recreation and Socio-EConomics

Observations during the walkover survey were consistent with land use at the Development site, including accessibility of public rights of way, remaining as reported in the ES. Overall, site observations provided no cause to consider that the land use, recreation and socio-economic baseline reported in the ES had changed.

Chapter 14: Other Issues

This chapter covered carbon emissions saved by the Development, air quality, electromagnetic interference, ice throw and shadow flicker.

Carbon Emissions Savings

This assessment considered the "embodied" carbon emissions associated with the Development, principally from the manufacture and construction of the Development and from the use of imported electricity during periods of low wind speed. These emissions are not likely to have changed substantially.

The assessment then considered the baseline carbon emissions associated with generating electricity from sources other than the Development, on the basis that these emissions would be replaced with emissions associated with the Development. Baseline carbon emissions depend on the technologies used to generate electricity connected to the same grid network as the Development, principally the UK electricity network. These technologies, and the mix of them comprising the UK generation as a whole, have changed

substantially since the assessment was last updated in 2013. This is principally as a result of the decrease in coal-fired power station usage, and the increase in onshore wind, offshore wind and ground-mounted solar electrical generation capacity. The change in baseline conditions could lead to altered significant effects associated with the Development.

Because of this change in baseline conditions, the carbon savings assessment presented in the ES has been updated, and is reported in a document provided alongside this, titled "Climate Change Impact Assessment".

Air Quality

No cause has been identified to consider that the air quality baseline has substantially changed since the ES.

Electromagnetic Interference

No cause has been identified to consider that the air quality baseline has substantially changed since the ES. Television has switched from analogue to digital signal transmission, which substantially reduces the potential for interference by structures such as wind turbines. The change will make the assessment reported in the ES more conservative, therefore.

Ice Throw

No cause has been identified to consider that the air quality baseline has substantially changed since the ES.

Shadow Flicker

The only potential for changes to shadow flicker relates to new residential properties developed within ten rotor diameters of the Development site. No such new developments were observed during the walkover survey.

The Section 36 Consent for the Development should have prevented planning permission being granted for new residential properties that could experience unacceptable levels of shadow flicker from the Development, and hence there is good reason for the baseline not to have substantially changed in respect of shadow flicker.

2.2 Conclusions of the Baseline Review

A review of the baseline conditions set out in the ES (2008, 2011 and 2013) has been undertaken, and, aside from carbon emissions savings, no cause has been identified to consider that the baseline has substantially changed since that time.

The carbon emissions savings baseline, which comprises the carbon emissions associated with electricity generation across the UK, has changed substantially since 2013, and an updated assessment of this aspect is presented in an assessment of effects on climate change, provided in Section 4 of this document.

Overall, there is no evidence to suggest that, in the time since the previous baseline update (2013), the change in baseline is such as to lead to a change in assessment of significant adverse effects.

3 CUMULATIVES DEVELOPMENT UPDATE

This section provides commentary on the changes, since 2013 when the ES was last updated, to other windfarm developments that may have the potential to lead to cumulative effects when considered in combination with the Development.

3.1 Cumulative Developments – Review of Changes

A desk-based search for cumulative windfarm developments was carried out within 35 km of the Development site, in early June 2019. The results of this search are shown in Figure 2. This figure is a direct update of Figure A2-1 in Volume 1 of the 2013 Supplementary Environmental Information (SEI) update to the ES.

This section summarises the main changes to cumulative developments based on their development stage. Single turbines at a distance of more than c. 5 km from the Development site are not detailed here, as they have minimal potential to lead to significant cumulative effects.

A visit to the Development site was carried out in good weather and clear atmospheric conditions on 21st and 22nd May 2019, as noted in Section 2.1 of this document. Notes were made on the number of turbines visible at cumulative windfarm sites.

3.1.1 Operational

All windfarms that were operational in 2013 remain operational in 2019.

Tirgwynt Windfarm was an "application granted" development in 2013, which became operational in 2017 and has 12 wind turbines with a height to tip of 116 m. Tirgwynt Windfarm is located c. 15 km north of the nearest Development turbine.

Garreg Lwyd Hill Windfarm was an "application submitted" development in 2013, which became operational in 2017 and was consented with 23 turbines with a height to tip of 137 m. Garreg Lwyd Hill Windfarm is located c. 9 km east of the nearest Development turbine. Only 17 turbines have been erected, however, as evidenced at the site visit and the project website[5].

Bryn Cwmyrhiwdre single turbine was not referenced in 2013, and is now operational. It lies c. 400 m south of the Development access route from the A483, and c. 3 km east of the nearest Development turbine. The application was for a turbine with height to tip of 34.2 m.

3.1.2 Under Construction / Application Granted

There have been five changes in windfarms under construction or with an application granted since 2013 and 2019.

Bryn Blaen Windfarm was not shown on the cumulatives figure in 2013, however an application was submitted in 2014, and it was consented at appeal. Informal evidence[6] suggests that it has been constructed but is not yet commissioned. Bryn Blaen Windfarm is located c. 10 km west of the Development site, with 6 wind turbines and a height to tip of 100 m.

Hendy Windfarm was not shown on the cumulatives figure in 2013, however an application was submitted in 2014. Informal evidence[7] suggests that it was under construction in January 2019. Hendy Windfarm is located c. 23 km south of the Development site, with 7 wind turbines and a height to tip of 110 m.

Carno 3 Windfarm was at "application submitted" stage in 2013, and was consented in 2016. The site will have 13 wind turbines with a height to tip of 126.5 m. Carno 3 Windfarm is c. 14 km northwest of the Development site.

[5] RES (2019). Garreg Lwyd Hill Windfarm. http://www.garreglwydhill.com/

[6] BBC (2019). Bryn Blaen wind farm 'not generating electricity'. https://www.bbc.co.uk/news/uk-wales-46826710 [accessed on 06/06/2019].

[7] Powys County Times (2019). Hendy Wind Farm: Powys County Council is investigating claims of planning breaches at the site near Llandrindod Wells. https://www.countytimes.co.uk/news/17346603.hendy-wind-farm-powys-county-council-is-investigating-claims-of-planning-breaches-at-the-site-near-llandrindod-wells/ [accessed on 06/06/2019].

Gwern Y Bwlch single turbine was not referenced in 2013, and now has a consent granted. It lies c. 4 km north-west of the nearest Development turbine. The application was for a turbine with height to tip of 34.2 m.

Tirgwynt Windfarm was at Application Granted stage in 2013, and is now operational, as set out above.

3.1.3 Application Submitted / Appeal

No new windfarm developments are at "Application Submitted" stage that were not in 2013.

Of the sites (excluding single turbines at more than 5 km from the Development) that were at "Application Submitted" stage in 2013:

- Garreg Lwyd Hill is now operational, as set out above;
- Carno 3 has been consented, as set out above;
- Hirddywel, Esgair Cwmowen and Bryngydfa appear to remain as "application submitted", although there must be doubt as to whether they are realistically likely to progress given the applications were submitted in 2010, 2010 and 2009, respectively;
- Llanbrynmair, Carnedd Wen, Llaithddu and Llanbadarn Fynydd were all refused at the same Public Inquiry at which the Development was consented. The applicants for Llanbrynmair and Carnedd Wen submitted a legal challenge to the decisions, however, and this challenge was upheld and the decisions were rescinded. The Secretary of State will therefore reconsider the decisions, so the status of these is shown on Figure 2 as "Appeal";
- Cenmaes 3, Neuadd Goch Bank and Llanbadarn Fynydd have been refused; and
- Mynydd Waun Fawr has been withdrawn.

3.1.4 Scoping

Scoping is a pre-application stage of developments that may require EIA.

Only one development is in this category currently, Llandegley A and B, a two-turbine development c. 25 km south-east of the Development site. Scoping was submitted for this in 2013, although there must be doubt as to whether it is realistically likely to progress given the time that has elapsed since.

Of the sites (excluding single turbines at more than 5 km from the Development) that were at "Scoping" stage in 2013:

- Dyfnant and Rhyd Ddu have been withdrawn; and
- One windfarm, Mynydd y Gwynt, has been refused by the Secretary of State.

3.2 Discussion

There has been a small increase in the number of operational windfarms since 2013, with both of the non-single-turbine schemes being assessed in the ES as being at an earlier development stage.

There are four consented/under construction windfarms in 2019 that were not in 2013, with two of those being new schemes, and two being schemes that were assessed in the ES as being at a different development stage. The two new schemes are c. 10 km west and 25 km south of the Development site. There is one windfarm that was at Application Granted stage in 2013, and is now operational.

Of the thirteen schemes that were at Application Submitted / Appeal stage in 2013, only five remain, and there are no new schemes at this stage. Of the three that remain at "Application Submitted" stage, it is likely that none will progress, given it is 9 or 10 years since the applications were submitted. Of the two that are now at "Appeal" stage, these

have been previously refused at appeal, and are being reconsidered by the Secretary of State as a result of previous errors in application of the correct legal process.

Of the three schemes that were at Scoping stage in 2013, all have been withdrawn or refused. There is only one new scheme at this stage, although it was scoped in 2013 and there must be doubt as to whether it is realistically likely to progress given the time that has elapsed since.

Overall, excluding single turbines at more than 5 km from the Development site, there is a large reduction in the number of cumulative windfarms and in the number of turbines within those cumulative windfarms since 2013.

It is expected, therefore, that cumulative effects from other windfarm developments overall will have decreased since 2013.

3.3 Conclusions of the Cumulatives Development Update

Data describing the existing and proposed windfarm developments within 35 km of the Development site has been updated.

Overall, there is no evidence to suggest that, in the time since the previous cumulatives development update (2013), the change in cumulative developments would to lead to a change in assessment of significant adverse effects. Indeed, given the reduction in proposed cumulative developments, the conclusions drawn in the ES are now likely to be overly conservative.

4 ASSESSMENT OF EFFECTS ON CLIMATE CHANGE

Since 2013, the revised Environmental Impact Assessment (EIA) Regulations[8] state that an EIA must identify, describe and assess the significant effects of the Development on climate, including greenhouse gas emissions, impacts relevant to adaptation, and the vulnerability of the development to climate change.

This section evaluates how the Development is likely to interact with a changing climate and whether any significant effects could arise.

4.1 Assessment Methodology and Significance Criteria

4.1.1 Scope of Assessment

The following assessment areas are considered in terms of the Development:

- The vulnerability of the Development to climate change;
- The influence of the Development on climate change; and
- A summary of effects on environmental receptors sensitive to climate change.

The assessment of the vulnerability of the Development to climate change considers effects on the Development as a receptor. In contrast the other two assessments consider effects on environmental receptors as a result of the Development.

4.1.2 Study Area

The study area considered for the assessment of vulnerability of the Development to climate change consists of the infrastructure within the site boundary (the Site), looking at changes over the planned lifetime of the project. Information on climate trends and projections at the Welsh and local scale (where available) are utilised.

[8] The Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2017. SI 2017/580. Available at: http://www.legislation.gov.uk/uksi/2017/580/contents/made [accessed on 04/06/2019].

The study area for the assessment of the influence of the Development on climate change considers greenhouse gas (GHG) emissions (current levels and targets), along with renewable energy generation and grid mix within the Welsh and UK spatial scale.

The study area for the assessment on future baseline for environmental receptors is outlined in individual technical chapters from the ES. Climate projections on a Welsh and local scale (where available) are utilised for this chapter.

4.1.3 Baseline Study Methodology

Following its publication on 26 November 2018, UKCP18[9] now provides the most up to date assessment of how the climate of the UK may change over this century.

UKCP18 uses scenarios for future greenhouse gas emissions called Representative Concentration Pathway (RCP) scenarios. Scenario RCP 2.6 estimates a global average temperature increase of 1.6°C by 2100 and represents a scenario where greenhouse gas emissions are significantly reduced. RCP 4.5 estimates a global average temperature increase of 2.4°C and assumes that no further emission reductions are achieved by 2030, but emissions do not increase further. RCP 6.0 estimates a global average temperature increase of 2.8°C, and assumes varying levels of mitigation are implemented with some further increase in concentrations. RCP 8.5 estimates a global average temperature rise of 4.3°C by 2100 and is a scenario whereby greenhouse gas emissions continue to increase.

The four RCP scenarios attempt to capture a range of potential alternative futures and outcomes linked to global temperature increases and include a wide variety of assumptions on socioeconomics development and commitment to emissions reductions. The sensitivity of the scenario responses is much more pronounced in the second half of the 21st century, where the responses diverge more rapidly than in the first half of the century. Over the anticipated operational lifetime of the Development, the choice of scenario is therefore not as influential on the outcome of the assessment. Where a scenario must be chosen to determine the future baseline, the medium scenario RCP 6.0 is used where it is available.

Projections are reported for 20-year time periods through to 2100. The 2020-2039 and 2040-2059 periods provide the most relevant projections covering the majority of the expected operational phase of the Development.

Projected climatic changes at the 50% probability level (central estimate) are utilised, unless otherwise indicated. This is the level where there is as much evidence pointing to a lower outcome as a higher one.

The UK Climate Projections User Interface tool has been used unless otherwise stated. The Land projections: probabilistic projections (25 km) have been used to determine temperature and cloud cover whilst wind speed has been calculated using the Land projections: probabilistic projections (12 km). A bounding box to cover the site area has been used, with the following coordinates:

- North – 196012.50
- South – 279612.50
- East – 294200.00
- West – 312500.00

4.1.3.1 Vulnerability of the Development to Climate Change

This section identifies aspects of the Development which are potentially vulnerable to the effects of climate change. Where identified, these vulnerabilities can then be mitigated through embedded mitigation or the application of other measures.

[9] The Met Office (2019). UK Climate Projections 2018 (UKCP18). Available at: https://www.metoffice.gov.uk/research/collaboration/ukcp [accessed on 06/06/2019].

Taking into account the nature and location of the Development, the following climate related parameters are considered to have the potential to impact upon the operation of the Development:

- Wind (speed, direction and gustiness);
- Temperature; and
- Precipitation.

The decommissioning/construction and future decommissioning stages of the Development are not considered to be vulnerable to climate change and are excluded from further consideration.

4.1.3.2 Influence of the Development on Climate Change

The methodology used in the 2013 update of the ES was repeated using updated information from the 2018 Digest of UK Energy Statistics (DUKES)[10].

4.1.3.3 Effects on Environmental Receptors Sensitive to Climate Change

This section identifies where climate change has the potential to significantly affect the findings of assessments undertaken and reported in the ES. Reference is made to the specific assessment chapters, where the baseline state and sensitivity of receptors is discussed, and assessments are not repeated here.

4.1.4 Methodology for the Assessment of Effects

To determine whether effects are significant under the EIA Regulations, it is appropriate to consider the sensitivity (value and resilience) of the receptor and the magnitude of the effect, taking into account uncertainty. This is based on the professional judgement of the assessor.

Table 2 details the criteria for determining the sensitivity of receptors.

Table 2 Criteria for Determining Sensitivity of Receptors

Sensitivity of Receptor	Definition
Very High	The receptor has little or no ability to absorb change without fundamentally altering its present character, is of very high environmental value, or of international importance.
High	The receptor has low ability to absorb change without fundamentally altering its present character, is of high environmental value, or of national importance.
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, has some environmental value, or is of regional importance.
Low	The receptor is tolerant of change without detriment or benefit to its character, is low environmental value, or is of local importance.
Negligible	The receptor is resistant to change and is of little environmental value.

The criteria for assessing the magnitude of an effect are presented in Table 3.

Table 3 Criteria for Determining Magnitude of Change

Magnitude of Change	Definition

[10] Office of National Statistics (2018). Digest of UK Energy Statistics. Available at: https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes [accessed on 06/06/2019].

High	A fundamental change (positive or negative) to the baseline condition of the receptor, leading to total loss or major alteration of character.
Medium	A material change (positive or negative) leading to partial loss or alteration of character.
Low	A slight, detectable, alteration of the baseline condition which may be positive or negative.
Negligible	A barely distinguishable change from baseline conditions.

The IEMA guidelines for Climate Change Impact Assessment CCIA[11] state the following with regards to the assessment of significance:

"*This guidance is not proposing changes to the significance criteria used in the EIA process. However, the susceptibility or resilience of the receptor to climate change must be considered as well as the value of the receptor.*

Therefore, a high-value receptor that has very little resilience to changes in climatic conditions should be considered more likely to be significantly affected than a high-value receptor that is very resilient to changes in climatic conditions.

The uncertainty of the combined effect needs to be taken into account. If uncertainty about how a receptor will adapt to a changing climate is high, then it is recommended that a conservative threshold of significance is adopted within the evaluation".

Table 4 outlines the framework for the assessment of significance of effects.

Table 4 Framework for Assessment of the Significance of Effects

Magnitude of Effect	**Sensitivity of Resource or Receptor**				
	Very High	**High**	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

The categories of significance are described in Table 5.

Table 5 Categories of Significance of Effect

Significance	**Definition**
Major	A fundamental change to location, environment, species or sensitive receptor.

[11] IEMA (2015). Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation. Available at: https://www.iema.net/assets/templates/documents/iema_guidance_documents_eia_climate_change_resilience_and_adaptation%20(1).pdf [accessed on 06/06/2019].

Moderate	A material, but non-fundamental change to a location, environmental, species or sensitive receptor.
Minor	A detectable but non-material change to a location, environment, species or sensitive receptor
Negligible	No detectable or material change to a location, environment, species or sensitive receptor.

Effects assessed can be both beneficial (positive) and adverse (negative). Those predicted to be of major or moderate significance are considered to be 'significant' in the context of the EIA Regulations, and are shaded in light grey in the above table. Whilst receptors may be considered "high-value", a non-material magnitude of the impact would result in any effect being considered not significant.

4.1.5 Assessment Limitations

The climate change projections are based on global models for a range of Green House Gases (GHG) emissions scenarios and generally consider regional responses to climate change rather than local responses. This is based on best scientific knowledge at this time and judgements on datasets and future socioeconomic drivers.

Downscaling adds another level of uncertainty. There may be more detail, but the uncertainty of the science may be higher. As understanding of the climate system and ability to model it improves it is likely that future projections will be refined.

The probabilities presented and the estimated ranges are based on a set of modelling, statistical and dataset choices with expert judgement playing an important role. However, as some potential influences on future climate are not yet known some choices may change as the science develops[12].

Specifically, in relation to wind, the UKCP18 Wind Fact sheet[13] states that local variations due to the land surface are hard to model, particularly in very exposed or sheltered locations. This can be particularly relevant in high wind speed situations where local gusts can result from small scale weather events such as thunderstorms.

4.2 Embedded Mitigation

As detailed in Chapter 3: Site Selection of the original ES, the design of the Development has been driven by the key objective of capturing the maximum energy possible, while balancing environmental and technical constraints. The design choices made as a consequence of the key constraints are considered to be mitigation which is 'embedded' in the design; the following are most relevant for the assessment of effects on climate change:

- Development infrastructure is built to withstand strong windspeeds and to harness energy;
- Turbine spacing is sufficient to reduce turbulence effects on turbines downwind;
- The turbines are located to maximise energy generation while minimising environmental effects;
- The Development design aims to reduce effects on peat – e.g., through use of existing track layout where possible and avoiding areas of deep peat;
- Implementation of a Construction Environmental Management Plan (CEMP), Peat Management Plan (PMP), etc., during construction to minimise environmental effects and peat disturbance; and
- Buffers from watercourses incorporated in layout design, protecting water quality and also protecting Development infrastructure from flooding.

[12] Lowe *et al* (2018) UKCP18 Science Overview Report

[13] UKCP18 (2018) Factsheet: Wind. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-fact-sheet-wind.pdf

4.3 Baseline Conditions

4.3.1 Current Climate Baseline

Climate Projections show that the trends over the 21st century in the UK are towards warmer and wetter winters and hotter, drier summers, with an increase in frequency and intensity of extremes.

The State of the UK Climate 2017[14] provides the latest report on observed climate data for UK. Key findings are as follows:

- The decade 2008-2017 has been on average 0.3°C warmer than the 1981-2010 average and 0.8°C warmer than 1961-1990. Nine of the ten warmest years have occurred since 2002 and all since 1990;
- In the last few decades there has been an increase in annual average rainfall of 8%. Also, seven of the wettest years for the UK have occurred since 1998;
- In context of seasonal changes, of note is that two recent winters (2013/14 and 2015/16) have the highest rainfall in the existing dataset. There has also been a run of recent wet summers with only 2013 in the last ten being below the 1981-2010 average. UK summers for the last decade have been on average 20% wetter than 1961-1990 (17% than 1981-2010);
- There is no compelling evidence for trends in storminess as determined by maximum gust speeds over the last four decades; and
- In terms of extremes the amount of rain from extremely wet days has increased by 17% for the decade 2008 to 2017 compared with the 1961-1990 period. The hottest day of the year for the last decade has been on average 0.8°C above the 1961-1990 reference. The lowest temperature of the year has increased by 1.7°C, a much larger increase than the equivalent change in the mean UK temperature.

The climate parameters considered most relevant to the assessments referenced within this chapter are wind speed, temperature and precipitation.

The UK Climate Projection Report: The Climate of the UK and Recent Trends[15] provides observed climate data for UK Regions. Table 6 indicates the observed changes in climatic variables between 1961 and 2006 (reported at the 95% confidence level) for Wales where the Development is located.

Table 6 Observed Changes in Climate Variables for Wales (1961-2006)

Climate Variables	Annual Observed Change (1961 – 2006)
Daily mean temperature	+ 1.33 degrees Celsius (°C)
Daily maximum temperature	+ 1.52 °C

[14] International Journal of Climatology, volume 38, Number S2 (July 2018) ed. Radan Huth. Wiley

[15] Jenkins et *al.*, (2008). The Climate of the UK and Recent Trends. Met Office, Hadley Centre, Exeter, UK.

Daily minimum temperature	+ 1.19 °C
Change in days of air frost	- 22.4 days
Change in cooling degree days	+ 11.1 days
Change in heating degree days	- 16.0 days
Change (days) in days of rain > 1mm	+ 5.7 days
Percentage change in total precipitation	+ 13.6 %
Change in mean sea-level pressure (hectopascal (hPa))	- 0.3 hPa
Change in relative humidity	- 2.4 %

4.3.2 Future Baseline – Climate Projections Relevant to the Assessment

The climate parameters considered relevant to the assessments referenced within this section are temperature, wind speed, and precipitation. In addition to these, changes in temperature could potentially affect environmental receptors considered elsewhere in this ES, although not directly considered to inform the assessment of effects on climate change. It should be noted that climate change does not necessarily mean warming of the climate at a specific location. Changes in local climate depend in a complex way on global temperature rise, and in the UK are expected to include a rise in the frequency of more extreme weather events, average or long-term statistics would not capture this.

4.3.2.1 Temperature

Observations show an annual warming in the UK in recent decades with more warming predicted in the summer than in the winter. In summer there is a pronounced north/south contrast, with greater increases in maximum summer temperatures over the southern UK.

For the period 2020-2039, changes to annual mean temperature (relative to 1981-2000) are projected at +1°C (50% probability level) for scenario RCP 6.0[16].

For the period 2040-2059, changes to the mean annual temperature in Wales (compared to 1981-2000 baseline) are projected at 2°C (50% probability) for scenario RCP 6.0.

Key observations are that:

- Both winters and summers will be warmer, with more warming in the summer; and
- In summer there is a pronounced north/south divide with greater increases in maximum summer temperatures over the southern UK compared to Northern Scotland.

4.3.2.2 Wind Speed

The global projections over the UK show an increase in near surface (10 metre [m] height) wind speeds over the UK in the second half of the 21st century, in the winter season when higher wind speeds are generally experienced. The increase is modest when compared to inter-annual variability. This would be accompanied by an increase in frequency of winter storms over the UK[17]. There are no significant changes forecast in the wind speeds over the first part of the century.

[16] Climate Change statistics were evaluated using a bounding box with the following geographic boundaries: northern extent - 296012.5. southern extent - 279612.5, eastern extent - 312500.0, and western extent - 294200.0.
[17] UKCP18 (2018) Factsheet: Wind.

These projections are in line with earlier findings by Pryor and Barthelmie (2010)[18] who concluded that in the near-term (i.e., until the 2050s) there will be no detectable significant change in the wind resource of northern Europe.

This section is based on the UK Climate Projections Science Report: Probabilistic Projections of Wind Speed[19] which has predicted summer and winter wind speeds for 2040 – 2069 and 2070 – 2099. For Wales, predicted summer wind speeds for 2040 – 2069, at the 50% probability level (under the medium emissions scenario), are slightly skewed towards as small reduction in wind speed, with changes predicted between 0 – 0.2 m/s which equates to around 0.4 knots. This is a minimal change compared with the typical magnitude of summer mean wind speeds for Wales which is between 7 – 14 knots. Predicted summer wind speeds for 2070 – 2099, at the 50% probability level (under the medium emissions scenario), are -0.2 m/s which equates to roughly 0.4 knots. Similarly, to the 2040 – 2069 projection period, this is a minimal change compared to the typical magnitude for winter mean speeds for Wales.

Predicted winter wind speeds for 2040 – 2069 in Wales at the 50% probability level (under the medium emissions scenario) are between -0.1 m/s to 0.1 m/s which equates to roughly 0.4 knots and is a relatively small changed compared to the mean observed winter wind speed value of between 10-14 knots over Wales. Predicted winter wind speeds for 2070 – 2099, at the 50% probability level (under the medium emissions scenario), are -0.1 m/s which equates to roughly 0.4 knots which is also a relatively small change compared to the mean observed winter wind speeds over Wales.

4.3.2.3 Precipitation

Rainfall patterns over the UK are not uniform and vary on regional and seasonal scales, which will continue in the future. Future changes are uncertain but point to wetter winters and drier summers in general. Drying in summer will be strongest in the South of England, whilst Northern Scotland is associated with greatest wetting in winters[20].

Over the UK, the changes to precipitation projected for 2041-2060 (compared to 1981-2000) for RCP 8.5 (unmitigated scenario) are:

- Winter precipitation – increase of 12%. Results for the 10th to 90th percentile range are between -2% and +29%; and
- Summer precipitation – decrease of 15%. Results for the 10th to 90th percentile range are between -33% and +2%.

UKCP18 shows that for the period 2020-2059 changes to annual average precipitation (relative to 1981-2000) are projected at -10 to +10% (50% probability level) for scenario RCP 6.0[21].

4.3.3 Greenhouse Gas Emissions

The central aim of the Paris Agreement is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C.

A substantial reduction in greenhouse gas emissions is imperative to avoid irreversible damage caused by the impacts of climate change. "*When it comes to rises in global average*

[18] Pryor, S.C. and Barthelmie, R. J. (2010) Climate Change Impact on Wind Energy: A Review. Renewable and Sustainable Energy Review, 14(1): 430-437

[19] Sexton and Murphy (2010) UKCP09: Probabilistic Projections of Wind Speed [Online] Available at: http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87876&filetype=pdf

[20] Lowe *et al* (2018) UKCP18 Science Overview Report

[21] Climate Change statistics were evaluated between grid reference space: N- 296012.5 S- 279612.5 E- 312500.0 W- 294200.0

temperature, every fraction of a degree matters" was stated in a recent publication providing analysis for the Global Carbon Budget 2017[22].

The recent Intergovernmental Panel on Climate Change (IPCC) Special Report[23] highlighted that to limit global warming to below 1.5°C by the end of the century, emissions would need to decline by about 45% by 2030 and reach net zero around 2050. This is the temperature rise when a variety of increasingly severe effects are felt and the IPCC identifies that rapid and far-reaching transitions are required in all sectors including energy. Action is required now, with barely a decade left to take unprecedented action to reduce emissions in half by 2030. Recent figures from the Global Carbon Project, however, report that after three years of nearly no growth (2014-2016), emissions rose by 1.6% in 2017 and predicted to rise again by 2.7% in 2018.

With the continued development of onshore windfarms in the planning and pre-construction phases, it is anticipated that onshore windfarms will continue to make a sizeable contribution to the energy generated from renewable energy technologies within the UK.

A substantial reduction in greenhouse gas emissions is imperative to avoid irreversible damage caused by the effects of climate change. The UK Government has introduced a number of policies aimed at reducing greenhouse gas emissions and meeting renewable energy targets set at a UK, European and international level.

The Climate Change Act 2008[24] is legally binding legislation that creates a statutory framework for reductions in greenhouse gas emissions. A target reduction of 80% had been set for 2050 with two interim targets: a 34% reduction in emissions by 2030 and a 57% reduction in emissions by 2032. This Act includes a requirement for the UK secretary of state to ensure that the "*net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline*." This Act also requires local authorities to act in a way that contributes and helps deliver these emission targets. Additionally, the IEMA 'EIA Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance' assists greenhouse gas emissions assessment and mitigation in statutory and non-statutory EIA.

Table 5.3 of the Digest of United Kingdom Energy Statistics (DUKES) 2018[25] provides details of the sources used in generation of electricity throughout 2017 by major power producers. Of a total of 52.79 million tonnes of oil equivalent generated in 2017 within the UK, 27.9 million tonnes of oil equivalent were generated by natural gas, oil and coal, and 7.7 million tonnes of oil equivalent were generated from renewable resources. These numbers demonstrate that fuels which emit high levels of carbon emissions are generating the majority of electricity within the UK.

[22] Earth System Science Data (2017) Global Carbon Budget [Online] Available at: https://www.earth-syst-sci-data.net/10/405/2018/essd-10-405-2018.pdf (Accessed 06/06/2019)

[23] IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp [Online] Available at: https://www.ipcc.ch/sr15/ (Accessed at 06/06/2019)

[24] UK Government (2008) Climate Change Act 2008 [Online] Available at: https://www.legislation.gov.uk/ukpga/2008/27/contents (Accessed 06/06/2019)

[25] Department for Business, Energy & Industrial Strategy (2018) Digest of United Kingdom Energy Statistics 2018 [Online] Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/736148/DUKES_2018.pdf (Accessed 25/10/18)

4.4 Assessment of Potential Effects

4.4.1 Vulnerability of the Development to Climate Change

As a large energy generation asset with capacity in excess of 50 Megawatts (MW), the Development can be classed as an asset of regional importance and classed as Medium sensitivity for the following assessments.

4.4.1.1 Wind

As the energy content of the wind varies with the cube of the average wind speed[26], small increases in wind speed can result in large increases in wind power. This has implications for energy generation, e.g., if wind speed is twice as high it contains eight times as much energy available for conversion to electricity. But there is also a higher risk of damage from strong winds; winds associated with major storm events can be some of the most damaging and disruptive events for the UK with implications for infrastructure.

Wind turbines are designed to capture wind energy, and built to withstand extreme conditions associated with exposed locations. However, wind energy developments could potentially be sensitive to significant changes in variables, including atmospheric circulation and land cover changes as well as changes in the frequency of extreme events (e.g., storms), which could damage wind turbines or alter their efficiency.

Over the lifetime of the Development, UKCP18 shows the change in wind speeds and storms is limited to well within the limits of current inter-annual variability. These changes will have a negligible magnitude of effect on energy projections and on the efficient operation of the Development.

Given the negligible magnitude of the effect and the medium sensitivity of the Development as a receptor, the significance of effect is assessed as Negligible and there is no significant effect in terms of the EIA Regulations predicted as a result of increased wind speeds during the operational phase of the Development.

4.4.1.2 Temperature

Wind energy developments are sensitive to cold weather events and ice forming on blades, although in the UK this has rarely been an issue. With the projected trend to warmer conditions the predicted magnitude of effect is negligible. The significance of effect is negligible and not significant in terms of the EIA Regulations.

4.4.1.3 Precipitation

The risk from increased precipitation is the potential for flooding, particularly if it is associated with extreme events. For the Development this increases the risk for potential destruction/disruption of infrastructure, e.g., loss of watercourse crossing, flooding to the control building. Buffers from watercourses are embedded in the design of the Development, as are best practice drainage design and a CEMP. As such the Development has medium sensitivity to increase in precipitation.

UKCP18's report shows that the annual precipitation in this area of Wales is projected to change from -10 to +10% at the medium estimate (see Section 4.3.2.3: Precipitation). Given the embedded mitigation, the magnitude of effect on the operation of the Development is assessed as low and the overall significance of effect is minor and not significant.

[26] UKCP18 (2018) Factsheet: Wind.

4.4.2 Influences of the Development on Climate Change

4.4.2.1 Carbon Savings, Carbon Loss, and Expected Payback Time

This section updates Section 14.4 of the SEI 2013, where parameters have changed since that time. This is restricted to the counter factual emissions set out in Table 7.

Table 7 Revised Parameters used in CO_2 emission calculations since the 2013 SEI

Parameter	Comment	Value	Units
Coal- fired plant emission factor	Value provided in Energy and Climate Change (DECC) Digest of United Kingdom energy statistics (DUKES) 2018. Chapter 5 Electricity. Table 5D for 2017.	0.918	te CO_2 MWh^{-1}
Grid- mix emission factor	Value provided in Energy and Climate Change (DECC) Digest of United Kingdom energy statistics (DUKES) 2018. Chapter 5 Electricity. Table 5D for 2017.	0.225	te CO_2 MWh^{-1}
Fossil fuel- mix emission factor	Value provided in Energy and Climate Change (DECC) Digest of United Kingdom energy statistics (DUKES) 2018. Chapter 5 Electricity. Table 5D for 2017.	0.460	te CO_2 MWh^{-1}

Table 8 shows the carbon payback time of the development for each baseline generation scenario.

Table 8 Carbon Payback Time (using CO_2)

Parameter		Min Value	Max Value
CO_2 loss during construction		135,375	198,310
CO_2 savings during operation	- Coal-fired electricity generation (te CO_2/yr)	157,215	220,101
	- Grid-mix of electricity generation (te CO_2/yr)	38,533	53,946
	- Fossil fuel- mix (te CO_2/yr)	78,779	110,290
Expected payback time	- Coal-fired electricity generation (years)	0.62	1.26
	- Grid-mix of electricity generation (years)	2.51	5.15
	- Fossil fuel-mix (years)	1.23	2.52

The carbon payback time for the Development is thus between 0.62 years and 5.15 years, depending on the counterfactual grid scenario used. This is higher than in 2013, principally because the carbon emissions associated with the grid mix are now more heavily influenced by renewable energy generation, which has lower embodied carbon emissions.

Overall, as calculated payback periods are short and as the development provides a renewable source of electricity generation, this is considered to be a moderate, and significant benefit. As set out in the ES, when considered cumulatively with UK-wide renewable energy deployment, the effect of these carbon savings is a major (and significant) positive effect.

4.4.3 Effects of Future Climate Change Scenario on Environmental Receptors Sensitive to Climate Change

The potential for environmental receptors to be impacted by the Development is assessed in Chapters 6-14 of the ES. Of these, ecological, ornithological and hydrological receptors are the most sensitive to climate change and are discussed further in Table 9. Effects

assessed in other chapters of the ES are not expected to be affected by future climate change.

Table 9: Climate Change Effects on Environmental Receptors

ES Chapter	Receptor	Climate Change Effect	Effect on Receptor
7	Ornithology	Temperature – up to + 2°C Shift to wetter winters and dryer summers Negligible change in wind speeds	A rise in temperature has the potential to impact on habitats which in turn may affect the behaviour of bird interests. As noted above in Section 4.1.5: Assessment Limitations, uncertainties are high and the type and the significance of effects identified from the Development are not anticipated to alter as a result.
8	Ecology – Habitats, Protected Species	Temperature – up to + 2°C Shift to wetter winters and dryer summers Negligible change in wind speeds	While changes in temperature could affect the composition and growth rates of plant communities and invertebrates, and hence protected species and habitats, the uncertainties are high and it is not clear that the effect of the Development on those receptors would alter substantially as a result.
12	Geology, Hydrology and Hydrogeology	Shift to wetter winters and dryer summers	Limited change to future baseline and to the identified effects of the Development.

In conclusion, no additional significant effects will occur as a result of climate change during the operational phase of the Development.

4.5 Mitigation Measures and Residual Effects

This section identified that negative effects are of such limited and negligible nature that they are not significant and therefore no mitigation is required under the EIA Regulations other than that already incorporated into the Development and recommended as best practice. An iterative design approach was taken for the windfarm layout to avoid siting infrastructure in deep peat where possible to minimise disturbance of peat soils and associated carbon losses. Further micro-siting will be informed by detailed pre-construction ground investigations.

4.6 Conclusions of the Assessment of Effects on Climate Change

As a result of design measures, the predicted future climatic baseline conditions are highly unlikely to affect the operation of the Development.

The Development will have a moderate (and significant) beneficial effect on carbon emission savings, and a major (and significant) beneficial effect when considered cumulatively with UK-wide renewable energy deployment.

No significant effects on receptors considered in other chapters of this ES, additional to those already identified, will occur as a result of climate change during the operational phase of the Development.

Table 10 provides a summary of the effects detailed within this section.

Table 10 Summary of Effects

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
Vulnerability of Development to Climate Change				
Development infrastructure and generation capacity.	Changes to generation capacity through changes in wind speed.	Negligible	None Mitigation is embedded in design	None
Development infrastructure and operational efficiency.	Damage to infrastructure or operation due to changes in temperature.	Negligible	None	None
Development infrastructure and operational efficiency.	Potential for flooding of Site and impact on operation through changes to precipitation.	Minor	None Mitigation is embedded in design (e.g. watercourse buffers) and good practice measures as outlined in the CEMP.	None
Influence of the Development on Climate Change				
Climate - average temperature predictions as linked to GHG emissions.	Reduction in GHG emissions through offsetting of existing conventional generation.	Moderate, and Major cumulatively.	None Embedded mitigation has reduced payback period and maximise positive impact.	Significant contribution cumulatively to regional emissions and renewable energy generation targets.
Effects on Environmental Receptors				
Environmental receptors assessed in individual chapters of EIAR.	Change to future baseline of receptors and assessment results.	Negligible. Little change over time period to baseline condition of receptors.	None Mitigation as identified in individual assessment chapters	None

5 ASSESSMENT OF EFFECTS ON HUMAN HEALTH

Since 2013, the revised Environmental Impact Assessment (EIA) Regulations[27] state that an EIA must identify, describe and assess in an appropriate manner, the expected effects deriving from the vulnerability of the Development to risks, so far as relevant to the Development, upon health and safety, including natural disasters and major accidents.

The sections below summarise the human health effects on potential receptors identified in the relevant technical assessments referenced within Section 5.1: Scope.

5.1 Scope

Limited interactions of the Development with human health are possible, and this document considers the findings of the following assessments:

- Vulnerability of the Development to Natural Disasters;
- Potential for the Development to Cause Major Accidents;
- Traffic and Transportation (Chapter 9 of the ES);
- Noise and Vibration (Chapter 11 of the ES);
- Residential Amenity (Chapter 6 of the ES);
- Shadow Flicker (Chapter 14 of the ES); and
- Health and Safety at Work.

5.2 Vulnerability of the Development to Natural Disasters

The Site is not located within an area known for natural disasters such as hurricanes, tornadoes, volcanic eruptions, earthquakes or tsunamis.

One natural disaster that does occur in the UK is flooding. Effects associated with flood risk are assessed within the hydrological assessment, Chapter 13 of the ES. The probability of flooding is low, as the Development site lies within a Flood Zone 1, meaning the site has a low flood risk with the probability of flooding each year less than 0.1%. The Development is also located at the top of a hill, at an elevation of c. 500 m above sea level. The Development is therefore not at risk from flooding.

Due to the exposed nature of windfarm sites, wind turbines are designed to withstand extreme weather conditions. Brake mechanisms installed on turbines allow them to be operated only under specific wind speeds and, should severe wind speeds be experienced, then the turbines would be shut down.

No other natural disasters are considered to have the realistic potential to occur and therefore, natural disasters are not considered further within this document.

5.3 Potential for the Development to Cause Major Accidents

In this section the potential for the windfarm to cause major accidents is reviewed.

A possible but rare source of danger to human or animal life from a wind turbine would be the loss of a piece of the blade or, in the most exceptional circumstances, of the whole blade from an operational turbine. Many blades are composite structures with no bolts or other separate components. Even for blades with separate control surfaces on or comprising the tips of the blade, separation is highly unlikely. Wind turbines have an exemplary safety record with no recorded instances of fatalities to any member of the

[27] The Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2017. SI 2017/580. Available at: http://www.legislation.gov.uk/uksi/2017/580/contents/made [accessed on 04/06/2019].

public anywhere in the world. The turbines are also designed to shut down automatically during high wind speed conditions, typically in excess of 60 mph.

There is a risk of ice accumulation on turbine blades, nacelles and towers under certain conditions such as periods of very cold weather with high humidity. In those instances where icing of blades occurs, fragments of ice might be released from blades, particularly when the machine is started. The wind turbines would be fitted with vibration sensors to detect any imbalance which might be caused by icing of the blades. This enables the operation of machines with iced blades to be inhibited to minimise the risk of ice throw.

The possibility of attracting lightning strikes applies to all tall structures, and wind turbines are no different. Appropriate lightning protection measures are incorporated in wind turbines to ensure that lightning is conducted harmlessly past the sensitive parts of the nacelle and down into the ground.

Normal good practice, such as The Scottish Government Online Advice (2014) is to achieve a set-back from roads and railways of at least the height of the turbine proposed, to assure safety. The distance between the nearest proposed turbines and public roads is well in excess of tip height. In respect of footpaths, many wind farms in the UK are open access and allow members of the public to walk close to the turbine towers.

No other major accidents are considered to have the realistic potential to occur and therefore, major accidents are not considered further within this document.

5.4 Traffic and Transportation

The potential effect that traffic and transportation associated with the Development has on human health has been considered in Chapter 9: Traffic, Access and Transport of the ES.

Mitigation measures for traffic effects during the decommissioning/construction phases are embedded in the design of the Development as discussed in Chapter 3: Site Selection and Design Evolution, and further mitigation measures are set out in Chapter 9: Traffic, Access and Transport, in order to reduce the traffic effects arising from the Development. The Traffic Management Plan in ES 2008 Volume 1, Section 9.5.6, provides additional measures that would be agreed with consultees and implemented to further reduce traffic effects.

Traffic during the operational phase will consist of movement by staff that will supervise the operation of the Development and visit the Development to conduct routine maintenance. This is unlikely to involve HGVs and would be of negligible magnitude, and hence any related effects will not be significant.

The effects associated with levels of traffic anticipated during the decommissioning/construction phases of the Development were also found to be not significant, as were the cumulative effects, despite the worst-case assumptions made within the assessment.

The original ES identified that no significant residual effects were identified on traffic, transport or access due to the Development.

It is assessed that, if the mitigation measures referenced in the original ES are implemented for the duration of the initial decommissioning/construction phases, then the effect of increased traffic on human health and safety will be low and not significant in terms of the EIA Regulations.

5.5 Noise and vibration

A full assessment of the potential effects of noise and vibration is provided in Chapter 11: Noise and Vibration of the ES.

Noise and vibration effects during the initial decommissioning/construction phases are proposed to be managed by a set of best practice measures to minimise effects. The

decommissioning and construction works include both moving and static sources of noise. The analysis of construction noise impact has been undertaken in accordance with BS 5228.

It is anticipated that some rock extraction from borrow pits by means of blasting operations could be required in some instances. The transmission and magnitude of ground vibrations associated with blasting operations at borrow pits are subject to many complex influences. Any estimation of such conditions is subject to considerable uncertainty, thus limiting the utility of predictive exercises. The mitigation of this impact is best achieved through onsite testing processes carried out in consultation with the local authorities.

The ES 2008, Volume 1, Table 11-5: Distances at Which Vibration May Just be Perceptible, sets out that vibration may be perceptible up to c. 20 m from decommissioning/construction activities. Given that the closest works will be more than 700 m from the nearest residential buildings, it is highly unlikely that vibration will be an issue.

The decommissioning and construction noise assessment has determined that associated levels are expected to be audible at various times throughout the decommissioning and construction programme, but remain within acceptable limits.

It has been demonstrated that both the quiet day-time and night-time criterion limits can be satisfied at all properties across all wind speeds during operation of the Development. At some locations under specific wind conditions the windfarm noise may be audible however it will still be at an acceptable level according to the ETSU-R-97 guidance.

The cumulative effect of other existing or proposed windfarms in the area was also considered, and it was shown that satisfaction of the noise criterion limits could be maintained. Worst case cumulative construction traffic on existing roads would correspond to a minor effect when assessed in line with standard methodologies and criteria.

Overall, the effect of noise and vibration on human health and safety, during all phases of the Development, will be low and not significant in terms of the EIA Regulations.

5.6 Residential Amenity

An assessment of residential visual amenity has been undertaken in Chapter 6: Landscape and Visual Assessment of the ES. An examination of the likely sources of potential impacts on landscape and visual amenity in the study area identified that the operational turbines would be the most likely source of effect.

Although the Development would consist of less than half off the number of existing turbines (34 compared to 103), they would be considerably taller and more widely spaced (up to 121.2 m compared to 45.45 m to blade tip). Consequently, from most viewpoints the horizontal extent of the visible Development turbines would be similar to or greater than that occupied by the existing turbines. The ZTV analysis conducted identified that the Development would be visible from around 942 km^2, approximately 29% of the overall study area; the extent of the predicted visibility largely matching that of the existing turbines at Llandinam. As such, the change in setting of local properties would be slight, consisting of views that already contain other wind turbines, a negligible magnitude of change. The effect on residential amenity is therefore considered to be negligible which is not significant in terms of EIA Regulations.

The Development would, by nature, be visible from a widespread area, largely synonymous with the area from where the existing Llandinam windfarm is visible. The selected turbines are of simple form and layout and would be rendered in a pale grey colour to reduce their prominence when viewed against the sky. The borrow pits, whenever possible, will be constructed at locations with minimal visibility in order to further minimise potential effects on landscape and visual amenity.

Significant visual change does not mean a significant effect on amenity. Application of the standard test, of whether the visual change would be such to render a property an

unattractive place to live, found that no properties would be described as this, during any phase of the Development.

Overall, the visual effects on residential amenity, and their consequent effects on human health and safety, during all phases of the Development, will be low and not significant in terms of the EIA Regulations.

5.7 Shadow Flicker

An assessment of the potential effects of shadow flicker is provided in Section 14.6 of Chapter 14: Other Issues of the ES.

No shadow flicker effects will occur during the initial decommissioning/construction phases.

The effect of shadow flicker has been assessed using appropriate guidance, on the one residential property within 10 rotor diameters of the proposed turbine locations. With regards to the property Waen Cwm Yr Ynys, which is 9.3 rotor diameters from proposed Turbine 25, it was not deemed necessary to conduct a shadow flicker assessment following analysis of the terrain profile between the turbine and the property using ReSoft's WindFarm software, which shows that this turbine is not visible to the property. It is therefore not possible for the turbine to cast a shadow over any part of the property, for any location of the sun. The property will not suffer any shadow flicker effects from this turbine, and all other turbines are more than 10 rotor diameters distance from this receptor.

The Development is therefore not anticipated to cause any shadow flicker at nearby properties, and consequently there would be no shadow flicker effects on human health and safety, during all phases of the Development.

5.8 Health and Safety at Work

There are various health and safety considerations particularly for workers during the initial decommissioning/construction phases of the Development. Workers are in the closest proximity to the Development and as a result are considered to be the most at-risk group.

Comprehensive health and safety assessments and safe working practices are an essential part of the construction process and would be carried out prior to the initial decommissioning/construction phases in accordance with legislation.

A Construction, Design and Management (CDM) co-ordinator will be appointed and be responsible for the provision of a pre-decommissioning/construction phase information pack, as required under the Construction (Design and Management) Regulations 2015. The appointed main contractor will be required to provide a construction phase plan.

The construction of the Development would be managed in accordance with the Health and Safety at Work 1974 and would comply with all other relevant Regulations, including:

- Construction (Health, Safety and Welfare) Regulations 1996;
- The Construction (Design and Management) Regulations 2015; and
- The Electricity Safety, Quality and Continuity Regulations 2002 (as amended).

Following the adoption of these measures, the risk to human health of decommissioning/ construction workers is low and not significant in terms of the EIA regulations.

5.9 Conclusions of the Assessment of Effects on Human Health

Key determinants to the protection of human health, including mental health aspects associated with changes to amenity as a result of the Development, have been considered as part of this assessment of effects on Human Health. The outcome of the assessment indicates that the Development is unlikely to negatively affect people's health and wellbeing in its widest sense. There are no effects that:

- Cause potentially severe or irreversible negative effects;
- Affect a large number of people to an unacceptable level; or
- Specifically, may affect groups of people who already suffer poor health or are socially excluded to an unacceptable level.

As a result, no significant effects are predicted for any phase of the Development.

It has also been assessed that the Development is not vulnerable to natural disasters, and is not likely to cause major accidents.

6 AUTHORSHIP OF THIS DOCUMENT

The EIA Regulations[28], in para 17, clause (5), set out that "*In order to ensure the completeness and quality of the EIA report … the developer must ensure that the EIA report is prepared by competent experts*". Whilst this requirement does not strictly apply to information to inform an EIA screening decision, it is nonetheless relevant.

This document has been prepared, on behalf of CeltPower, by Arcus Consultancy Services Ltd (Arcus). Arcus has over 13 years of delivering windfarm EIA projects for a wide range of developers, and has co-ordinated and submitted over 60 windfarm EIAs in this time, as well as EIAs in other sectors. Arcus has a reputation for high quality work. David Hardy, a solicitor at Eversheds at the time, stated in relation to Arcus ESs that he had reviewed:

"*I consider the Arcus EIA chapters to be of a very high standard overall. The Arcus documents are coming across at the top end of the range of what I see so well done. I have very few comments to make. Certainly, in terms of passing the test for whether these chapters satisfy the EIA Regulations, I have no hesitation in saying they do.*"

This document, providing information to inform an EIA Screening Opinion, has been co-ordinated and overseen by Dr Paul Phillips. Paul is an experienced EIA Project Manager, a member of the Institute for Environmental Management and Assessment (IEMA) and is an IEMA Registered EIA Practitioner.

Both Arcus as a whole, and Paul as the individual responsible for this document, are therefore competent to prepare this document.

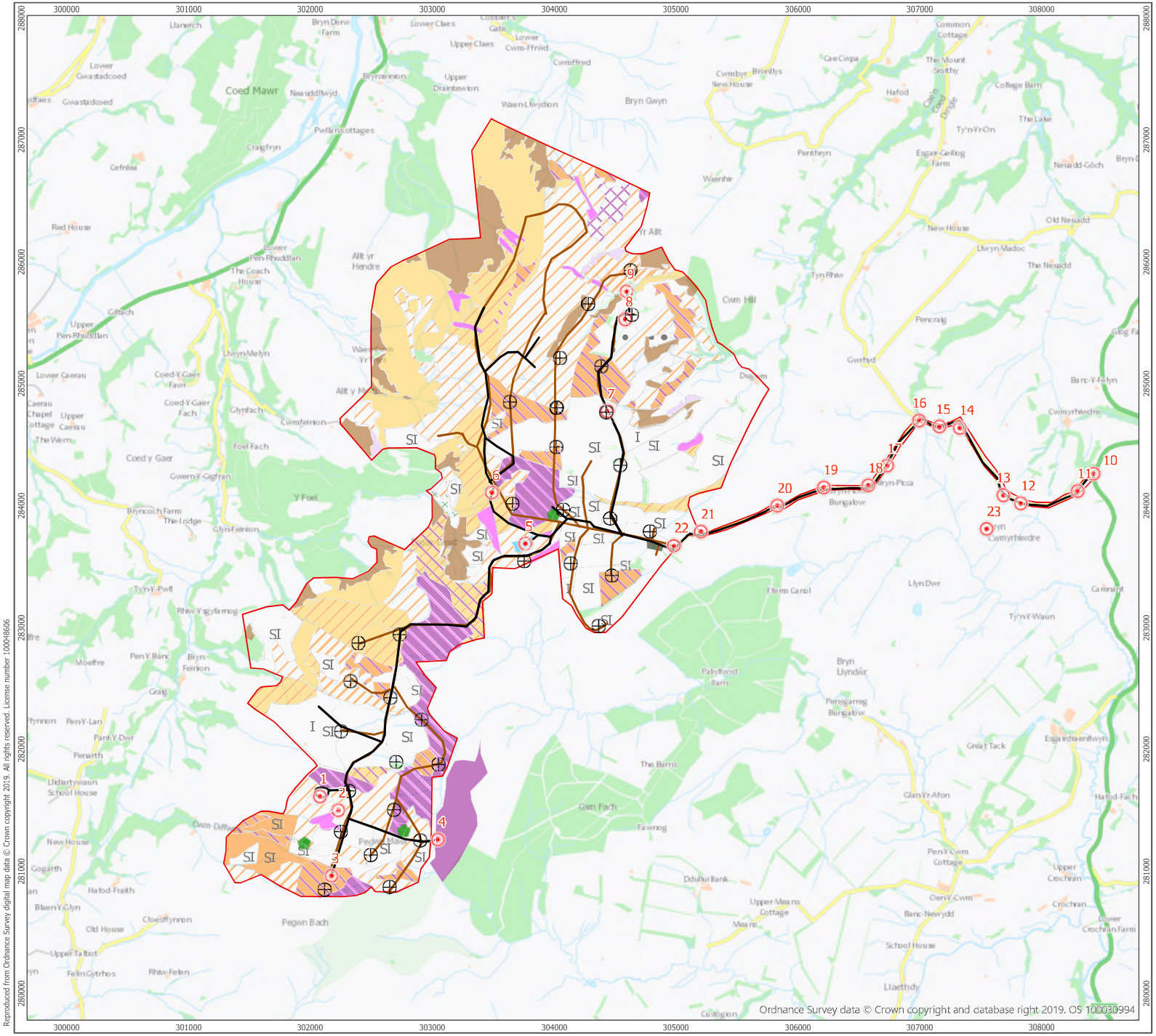
7 CONCLUSIONS

CeltPower are the holders of a Section 36 Consent for the Development. The consent was granted in September 2015, and it specifies that construction must begin within 5 years of the grant of consent. CeltPower is applying to extend this period for a further 5 years in order to allow sufficient time for prerequisites.

The EIA Regulations state that, if no EIA Report accompanies the application for the change to the consent, then the application should be screened to see if EIA is required, by consideration of whether the change would bring about significant adverse effects.

It is the opinion of the principal author of this document, based on the evidence set out in this document, that the change will not have significant adverse effects on the environment, and hence the conclusion of the screening process should be that the application does not require EIA.

[28] The relevant EIA Regulations are The Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2017, as amended. SI 2017/580. Available at: http://www.legislation.gov.uk/uksi/2017/580/contents/made [accessed on 6/6/19].



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Phase 1 Habitat Map
Figure 01

Llandinum Windfarm Repowering Screening Report

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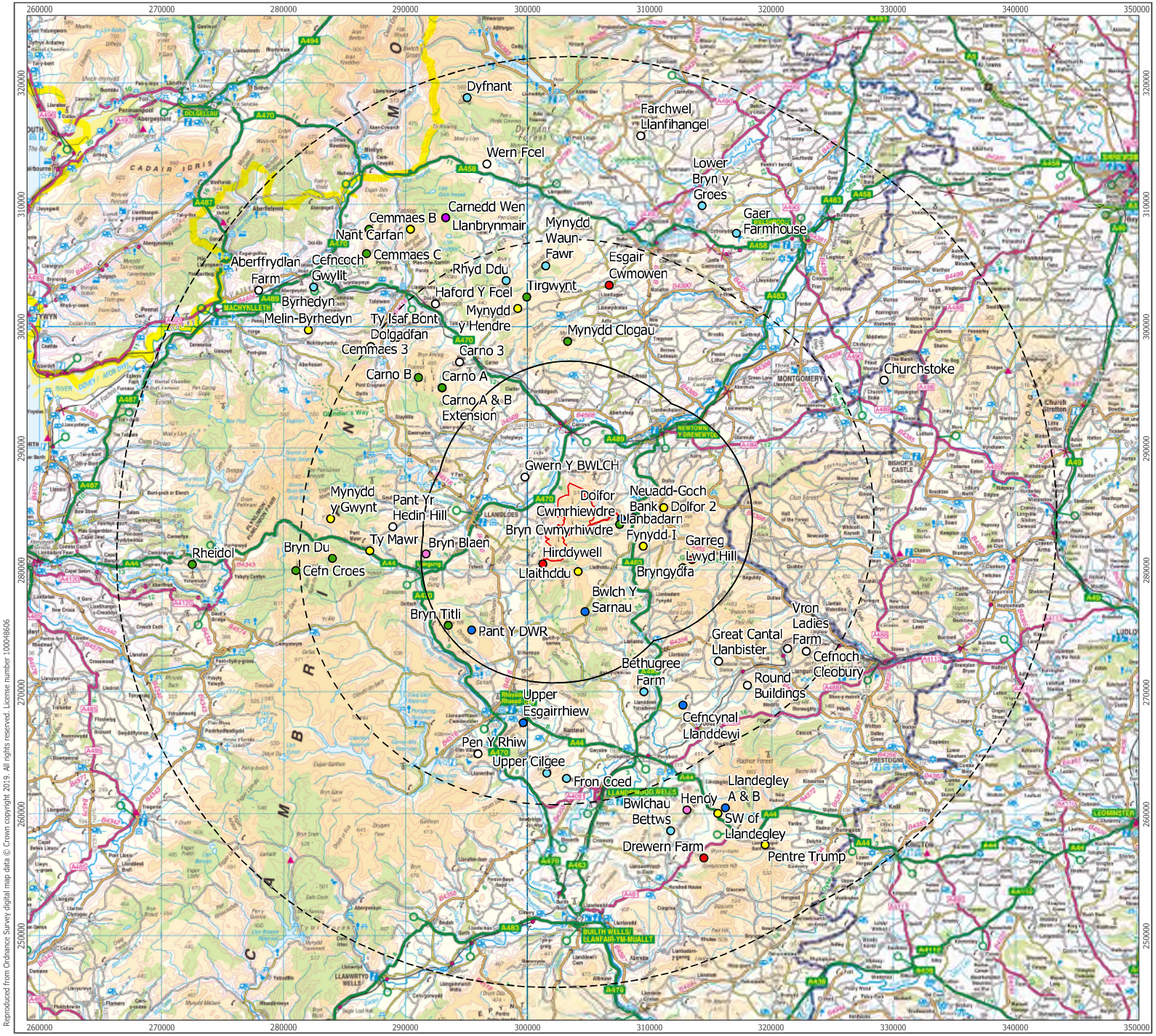

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Checked By: SC	Date: 13/06/2019

Cumulative Windfarm Developments
Figure 2

Llandinam Windfarm Repowering Screening Report

N:\Projects\3296 Llandinam Section 36C Consent Application\3296 Llandinam Section 36C Consent Application.aprx\3296-REP-002 Fig. 02 Cumulative Windfarms