

Gaerwen Wind Farm
Environmental Statement

Chapter 4: Site Selection and Design Strategy

May 2025

RWE Renewables UK Onshore Wind Ltd

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FS566056
EMS566057
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Chapter 4
Site Selection and Design Strategy

Introduction

4.1 This chapter provides details of the iterative approach taken to designing Gaerwen Wind Farm (the 'Proposed Development') within the EIA process. It also outlines the site selection process undertaken by RWE Renewables UK Onshore Wind Ltd ('the Applicant') in identifying the Site as a suitable location for a wind farm. The chapter therefore considers the 'reasonable alternatives' which were considered by the Applicant in designing the Proposed Development, as required by The Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017 (as amended). The chapter should be read with reference to the Design and Access Statement and Planning Statement, which form part of the application for the Proposed Development.

Site Selection and Design Strategy

Site Characteristics

4.2 The key characteristics of the Site that make it suitable for a wind farm include the following:

- Over half (52%) of the Site (7 out of 9 turbines in the final design) is within a Pre-Assessed Area as defined in Future Wales. The suitability of the Site for wind development with respect to the planning policy framework is described in more detail in the Planning Statement accompanying the Development of National Significance (DNS) application for the Proposed Development.
- The Site has an excellent wind resource and is available for wind energy development.
- There are no international or national statutory designations for landscape, nature conservation or cultural heritage within the Site. A candidate Site of Special Scientific Interest is being progressed to the south of Coed Gaerwen within the Site. There has been

no formal notification relating to this site at present, and in the event that it is designated in the future it will be avoided by the Proposed Development. In principle, therefore, it could be excluded from the Site boundary and has only been retained within this boundary because habitat management interventions relating to it are proposed as part of the Proposed Development (see **Appendix 7.7: Outline Habitat Management Plan**).

- Relative to upland sites in Wales in general that meet other suitability criteria for wind development, the Site has a relatively limited peat resource.
- There are no planning policies which, in principle, preclude wind energy development at the Site.
- The Proposed Development has a viable grid connection and offer from National Grid (which will be subject to a separate application in due course).
- The Site is accessible for construction traffic and turbine deliveries from the trunk road network (see ES **Chapter 10: Traffic and Transport**).

Site Selection

4.3 The Applicant has a well-established process for selecting sites and identifying land for wind farm development, especially within Wales. Their overall approach to wind farm site selection is to identify areas of land where the siting of a wind farm would be free from overriding technical and environmental impediments and lead to a level of energy generation sufficient to render the wind farm deliverable, thereby contributing to Wales' net zero target[1]. This initial site identification exercise involved:

- A review of current and emerging planning policy (at the national and local level);
- Geographical Information System (GIS) analysis of key environmental constraints (in line with those listed below within the design strategy) and an analysis of wind speed data; and
- A review of suitable site access points and related transportation issues.

[1] https://www.gov.wales/climate-change-targets-and-carbon-budgets

4.4 The Applicant identified the Gaerwen Site as favourable for wind farm development via this process. It subsequently sought to realise the opportunity to develop the Site when the landowners' representative brought the Site to market through a tender process.

4.5 Future Wales sets out a series of Pre-Assessed Areas (PAA) for wind energy, within which the principle of developing large scale wind farms (i.e. turbines of up to 250 m to tip height) is supported subject to assessment of the proposals against the policy direction in Future Wales Policy 18. Indeed, the case for wind energy development across the whole of Wales, even outside the PAAs, is also much stronger under Future Wales than previous superseded policies such as TAN 8.

4.6 Future Wales stipulates that in areas outside National Parks and Areas of Outstanding Natural Beauty (AONB) *"Proposals for renewable and low carbon energy projects (including repowering) qualifying as Developments of National Significance will be permitted"*, subject to having no unacceptable landscape impacts (if outside the PAAs) and no unacceptable impacts on the various criteria for protecting visual amenity, ecological sites, heritage assets, surrounding amenity (noise, shadow flicker, etc), defence interests or transport and that materials for construction are sustainably sourced, suitable decommissioning and taking account of cumulative effects. Given the Proposed Development's location within and immediately adjacent to PAA No.2, the Site was considered to be a good candidate for further assessment of its potential for wind farm development.

4.7 A number of specific aspects of the site selection process have been subject to questions or comments during the Pre-Application Consultation (PAC) process. The matters raised are considered primarily to be relevant to the Proposed Development's design evolution and impact assessment rather than Site selection; they are discussed in this respect from Paragraph 4.8 below and in the relevant topic chapters. They are also considered with respect the site selection rationale within the Pre-Application Consultation (PAC) Report submitted alongside this ES.

The Design Strategy

4.8 The design strategy for the Proposed Development has aimed to achieve the best balance between energy yield and effects on the local and wider environment, whilst creating a layout

that relates sympathetically to the landform and scale of the Site and surrounding area and that is well-composed from key views.

4.9 Energy yield is an important design consideration for wind farm design in environmental terms because the chief environmental benefit of the development – mitigation of climate change via low carbon, renewable energy generation – can only be maximised by realising the energy generation potential of the Site to the greatest feasible extent. Where a site is generally suitable for development, it is important to avoid, to the extent commensurate with other constraints and effects, the 'opportunity cost' of failing to deliver the Site's fullest renewable energy generation potential.

4.10 The design objectives for the Proposed Development evolved through the design process, as environmental baseline information became available sequentially through desk and field-based surveys. In addition to maximising the energy generation potential of the Site, the final design objectives included, but were not limited to, the following:

- Avoiding turbines dominating views from the Dee Valley via their placement on the Site's southern and eastern slopes. A 'constrained area' for turbine placement was defined early in the design process on this basis.
- Avoiding breaching the 'residential visual amenity threshold' at nearby properties, beyond which these properties could be widely regarded to be unattractive places to live. This included implementing a 700 m buffer to nearby properties.
- Limiting noise at nearby properties to acceptable levels in accordance with established guidance.
- Minimising impacts on the Site's peat resource to the greatest feasible extent.
- Minimising effects upon curlew at and around the Site, to the greatest feasible extent.
- Avoiding loss to ancient woodland within the Site.
- Minimising loss of woodland within the Site.
- Minimising effects upon ecologically important habitats to the greatest feasible extent: in particular, 'Annex 1' and 'Section 7' habitats (including those associated with peat) and GWDTEs.

- Minimising potential effects upon bats to the greatest feasible extent.
- Protecting the Site's hydrological regime, including peatland hydrology, and the interaction of this with the hydrological regime of the Site's surroundings, including identification and consideration of Private Water Supplies (PWS).
- Minimising effects on surrounding Scheduled Monuments via changes to their setting to the greatest feasible extent.
- Avoiding compromising the access and recreation opportunities provided by the Public Rights of Way (PRoW) network and common land within the Site.
- Ensuring an evenly spaced layout of turbines in closer views. This objective intended particularly to reduce 'stacking' of turbines from these views, as stacking can result in increased incongruity of the turbines as features in views, with a consequently greater level of visual effect[2].

4.11 Consultation with stakeholders has been undertaken by a variety of means throughout the design process and has also informed the approach to design. It has included written engagement and meetings with statutory consultees as well as public consultation events. The consultation process and outcomes are described in full in the Pre-Application Consultation (PAC) report provided alongside this ES.

4.12 The detailed design process involved acceptance that delivery of a viable wind farm with an appropriate degree of benefit via renewable energy generation would have some degree of environmental impact. Viability and renewable energy benefits therefore were taken into account when professional judgements needed to be made concerning whether to limit, or entirely avoid, environmental effects in the design process. This is what is meant by the use of the wording 'to the greatest feasible extent' above, and in the remainder of this chapter.

Project Design Evolution

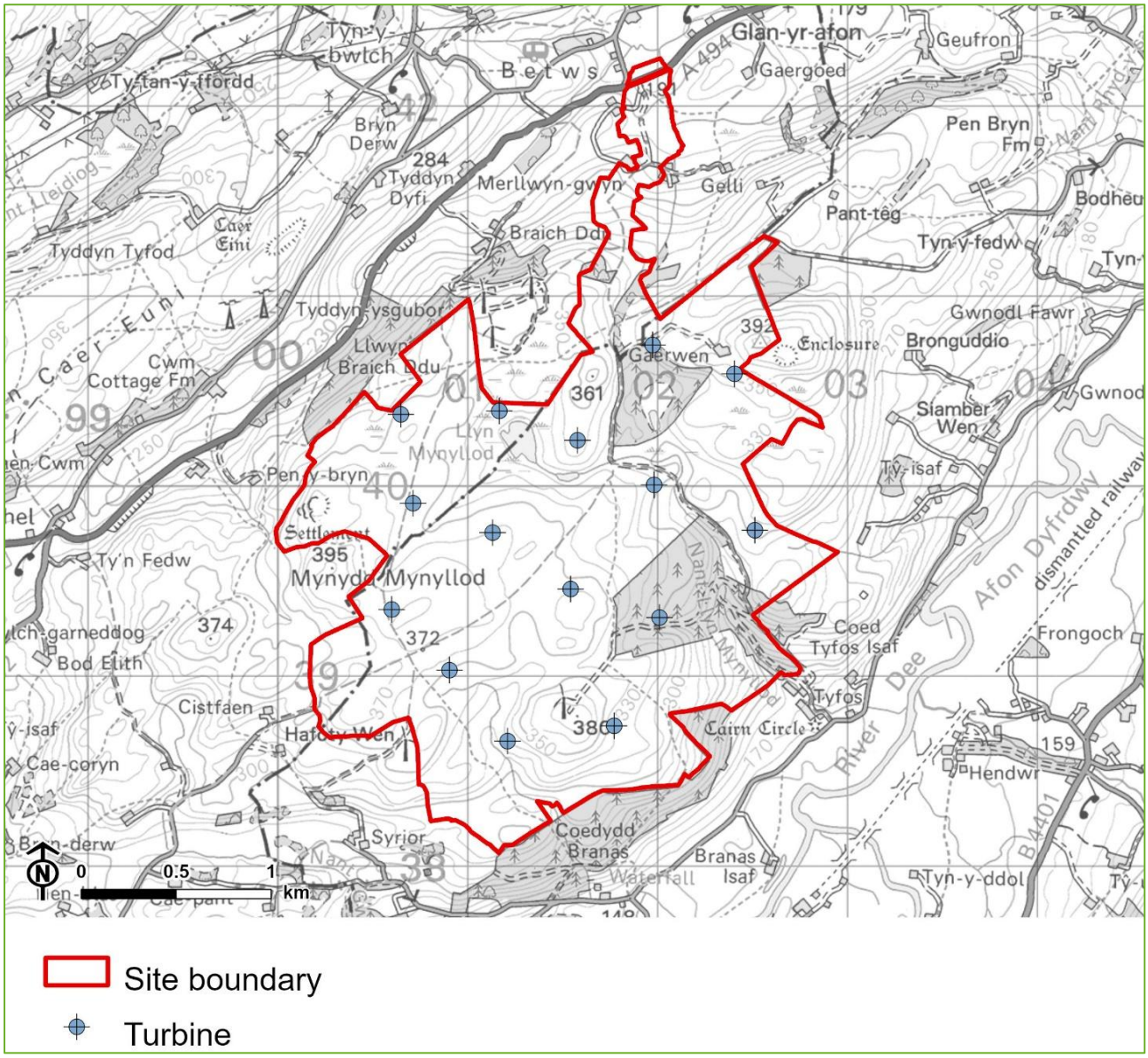
4.13 Ten layout iterations were identified and appraised before the layout was finalised. These are described in 'key groups' below.

[2] See for example Scottish Natural Heritage (2017) Siting and Designing Wind Farms in the Landscape

Layout V0: Scoping

4.14 This 15-turbine layout presented a 'maximum development' scenario, allowing identification of the full potential type and extent of environmental effects of the Proposed Development for the purposes of EIA Scoping. It was largely based on consideration of the standard rules for the spacing/separation of turbines and the overall Site boundary. This layout is presented in **Insert 4.1: Scoping layout**.

Insert 4.1 Scoping layout



Layouts V1-2 (turbines only)

4.15 These layout iterations intended to refine the scoping layout using desk-based data so as to inform the scope of subsequent field surveys. They took account of constraints including the following:

- Landscape and Visual:
  - A 1 km separation distance from properties, reduced where preliminary inspection of property view orientations and/or preliminary wireframe visualisations indicated that a lower separation distance might be acceptable.
  - Views from the Dee Valley. Consideration of effects in this respect resulted in turbines being moved or removed from parts of the Site to the south and south-east.
- Ecology and Hydrology:
  - A 50 m separation distance between turbines and watercourses/waterbodies.
- Peat:
  - Avoidance of the areas of peat resource indicated in the Peatlands of Wales map.
- Cultural Heritage:
  - Avoidance of Scheduled Monuments plus a 50 m separation distance.
  - Avoidance of non-designated historic assets as indicated in the relevant Historic Environment Records (HER).
- Recreation:
  - Avoiding oversail of PRoW with turbine blades.
- Energy yield:
  - Maintaining a separation distance between turbines of five times the rotor diameter in the prevailing wind direction and three times the rotor diameter in the cross-wind direction.

4.16 Consideration of these constraints resulted in a reduction of the number of turbines from 15 to 13. This ‘V1’ layout was tested for noise effects, considered against the initial findings of the

first year of breeding bird surveys and subject to a design workshop, on the basis of which it was decided to remove two further turbines to the northwest, reducing the number of turbines further from 13 to 11, and reduce the site boundary. This resulted in the area within the former Site boundary to the west of Llyn Mynyllod being removed from further consideration for all development. The key drivers for these changes were:

- Ornithology:
  - Avoidance of curlew breeding territories to the north-west of Mynydd Mynyllod within an area forming part of the Braich Ddu Wind Farm Habitat Management Plan.
- Noise:
  - Compliance with noise levels required by accepted guidance and policy.

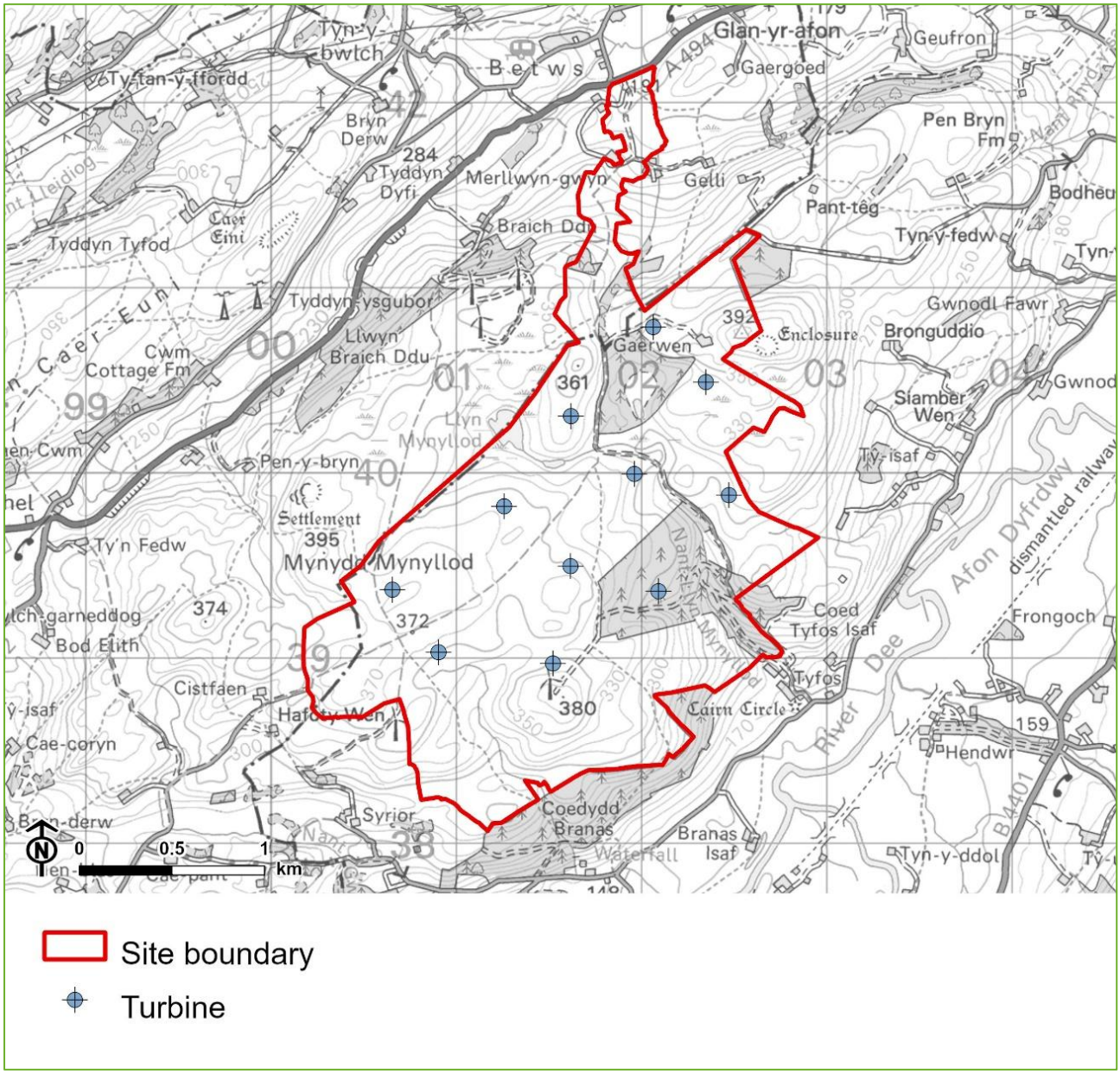
4.17 The modifications were also considered to be beneficial with respect to potential effects on Scheduled Monuments in relation to potential changes to their settings, due to the removal of turbines retaining sightlines between designated historic assets.

4.18 The removal of the area west of Llyn Mynyllod was also considered to be beneficial given that this area was identified as likely to have large areas of long undisturbed soils and hence any impact on these was to be avoided.

4.19 The resulting 'V2' layout is shown in **Insert 4.2: Layout 'V2'** and was used as a basis for subsequent site surveys including 'Phase 1' peat survey[3].

[3] Peat survey, following standard accepted practice, was undertaken in two different 'phases' for the Proposed Development – Phase 1 being of lower intensity but greater spatial coverage (site-wide) and Phase 2 being of higher intensity but focussed on infrastructure locations. The survey methodology is detailed further in **Chapter 9: Hydrology, Hydrogeology, Geology and Peat**.

Insert 4.2 Layout ‘V2’



Layouts V3-7 (full infrastructure)

4.20 This stage of the design took place following Phase 1 peat survey, hydrological walkover and completion of ecological surveys, including a second year of breeding season bird surveys, in 2022. The key additional design principles applied to these layout iterations were:

- Peat:

  - Avoid all peat where possible as a starting point for this and all future design iterations.
  - Where some encroachment on peat was unavoidable, avoid all development on peat of 1 m depth and above.
  - Avoid permanently excavated infrastructure (i.e. turbines and hardstandings) on peat of 0.5 m depth and above and tracks on peat of 0.5 m depth and above if possible.
  - Avoid all development on 0.3-0.5 m peat depth with overlying sensitive habitat (recognising that optimal habitats can occur on marginal peat depths).
  - Layouts were then to be improved iteratively where feasible.
- Peat/Ecology:
  - Avoid all development on Annex 1 and Section 7 habitats and minimise development on any wetland habitats identified during the habitat survey i.e. those included in UKHab Level 2 Code ‘f’, where feasible. This corresponds to all types of bog, fen, marsh, swamp and rush pasture. Particular efforts were made to avoid these habitats where they were situated on or near identified peat resource (peat of 0.3 m depth and above).
- Ecology/Hydrology:
  - Avoid GWDTEs.
  - Avoid infrastructure with excavations deeper than 1 m within 250 m of GWDTEs where feasible.
  - Avoid infrastructure components (any excavation depth) within 100 m of GWDTEs where feasible.
  - Avoid infrastructure components within 100 m of PWS where feasible.
- Ecology:
  - Avoid ancient woodland, with sufficient separation to protect tree roots.
  - Avoid all Annex 1 and Section 7 habitats, plus veteran trees, where feasible.
  - Avoid Local Wildlife Sites (LWS) where feasible. However, it was recognised at this stage that total avoidance would not be possible given the extent of LWS at this site,

other technical and environmental constraints and the need to deliver a viable development.

  - Achieve a 50 m separation between turbine tips and bat foraging habitat, identified as areas of broadleaved woodland noted via the habitat survey and watercourses noted in the Ordnance Survey (OS) Master Map (any more minor watercourses not shown in this map were not anticipated to support substantive foraging activity). The wooded areas included Coed Gaerwen and a smaller area of woodland to its north-east; and an area of broadleaved trees along the margins of the Nant Llyn Mynyllod watercourse to the east of the otherwise coniferous Coed y Fron.

- Ornithology:
  - Avoid turbines within 800 m distance of as many curlew breeding territories as possible at/around the north-west Site boundary, recognising the total avoidance of all curlew territories would not be possible given their extent, other technical and environmental constraints and the need to deliver a viable development.
- Cultural Heritage:
  - Retain lines of sight between contemporary designated historic assets.
- Construction:
  - Infrastructure layouts took into account the existing terrain and side slopes within the site, with access tracks and crane hard standings needing to avoid slopes that were too steep to allow turbine components to be delivered to turbine locations and erection cranes being able to install the turbines, or an excess of earthworks or interaction with environmental constraints being required in order to achieve viable gradients. Where possible all hardstandings are designed to run parallel to the existing contours to provide a balanced cut and fill at each location. Gradients above 15% are shown across the site in **Figure 4.1**.
- Wind Resource and Energy Generation:
  - Achieve separation distances between turbines that would allow viable performance for each of them. It became apparent during this design phase that standard separations

(as detailed above) would not be achievable bearing in mind the environmental constraints on the turbine layout. Layout iterations were therefore tested for performance by the Applicant's specialist engineers. The final turbine layout arrived at during this design phase is considered to be at the maximum tolerance in terms of reduction of separation distances between turbines, with no feasible scope to position turbines closer together.

4.21 Constraints applied to layouts V1-2 in relation to hydrology/ecology (watercourses/waterbodies), ornithology, landscape and visual effects, recreation and energy yield (turbine separation) continued to be taken into account. Supplementary watercourse data was added to the constraints based on hydrological walkover survey (see ES **Chapter 9: Hydrology, Hydrogeology, Geology and Peat**.

4.22 The updated constraints resulted in a revised developable area that was constrained both to the north-west and south-east by curlew separation distances and views towards the Site from the Dee Valley respectively. Turbine numbers were reduced from 11 to 9 in response to these and other constraints.

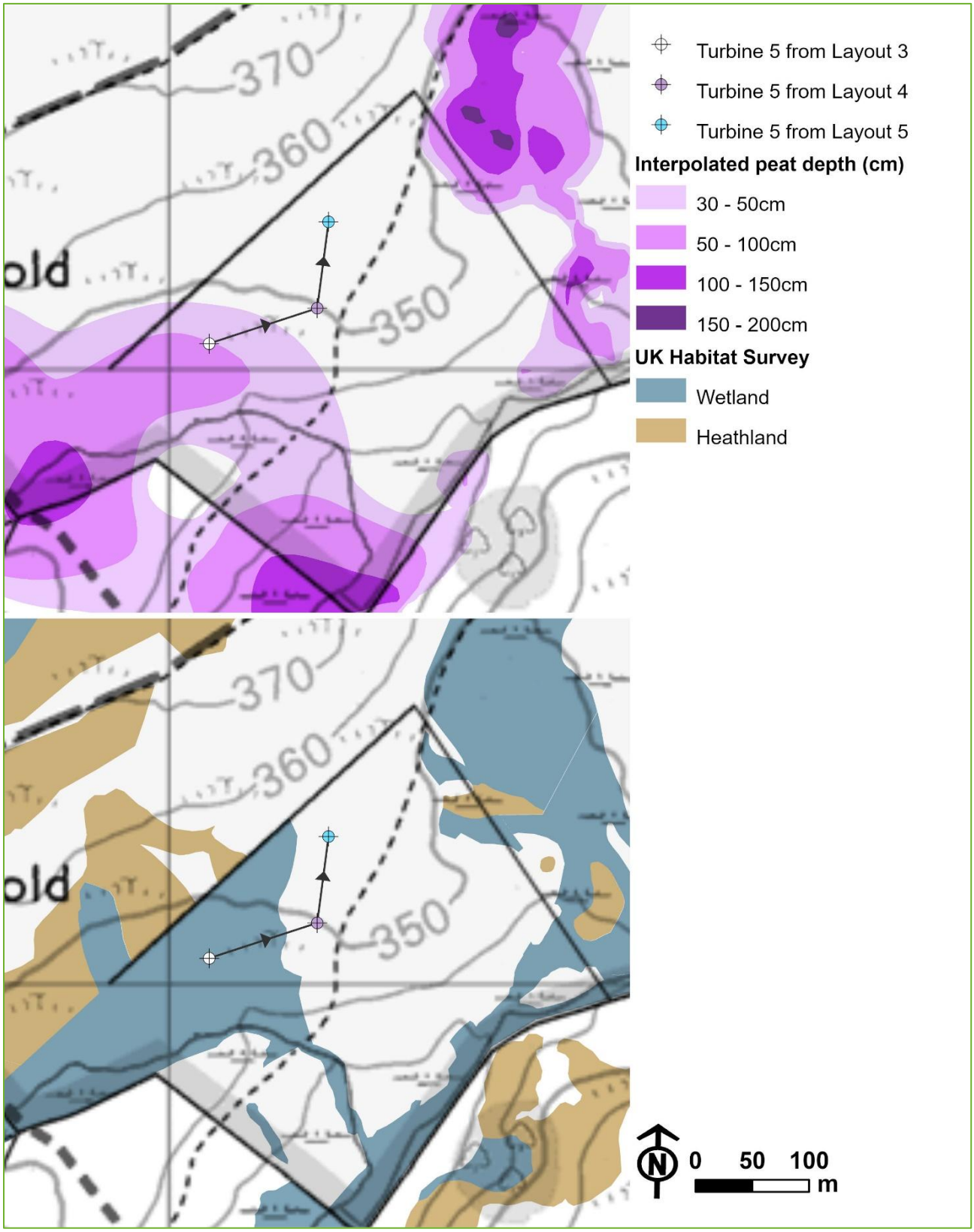
4.23 Layout V3 was the subject of a design workshop and then subject to a number of detailed iterations prior to Phase 2 peat survey[4] being undertaken on layout V7 ('design chill'). The iterative design modifications included:

- Peat:
  - Movement of the westernmost turbine (final Turbine 7) out of peat of 0.3-05 m depth. This occurred over layout iterations 3-5 and is shown in **Inset 4.3: Movement of Turbine 7, layouts 3-5**.
  - Re-orientation of access tracks (layouts 3-5) to reduce interactions with peat. This is shown in **Figure 4.2**. It is important to note that the area of peat to the north of the main Site does not in fact extend into Coed Gaerwen, with the Phase 1 interpolation misrepresenting peat presence in this area. This can occur where peat depths change abruptly, with interpolation algorithms tending to 'smooth out' the transition from peat to

[4] See the footnote above on peat survey methodology.

other soils; and in this case, the relevant part of the interpolation was derived from a single peat depth measurement, as no development had been considered for the area in question, (it fell outside the main part of the Site, within land to be used for access to the main development area only). Field observations indicated the likelihood of peat in this location being truncated on the northern boundary of Coed Gaerwen, with the decision being made therefore to explore the option of an access track along this northern boundary and verify peat absence in this location via Phase 2 survey.

Insert 4.3 Movement of Turbine 7, layouts 3-5



- Other Soils:
  - The newly published Chapter 6 of PPW12[5] references ‘long undisturbed soils’ as irreplaceable habitats which should be safeguarded. Although no definition of long undisturbed soils has been provided, it has been taken for the purposes of this Environmental Statement (ES) that, in addition to the Site’s peat resource, the majority of soils beneath the LWSs within the Site are long undisturbed (see **Figure 9.10**). Although this provision of PPW postdates the Proposed Development’s design process, it is noted that realignment of tracks to follow the current trackway where Nant Llyn Mynyllod is crossed on the approach to final Turbine 3 has resulted in avoidance of long undisturbed soils and associated LWS habitat. Long undisturbed soils other than peat are also avoided by the Proposed Development in other respects also.
- Ecology (including peatland habitats):
  - Over the course of these layout iterations, it became evident that it would not be feasible to entirely avoid all important habitats (as described above) in all locations. In particular, it was considered whether final Turbine 7 could be approached from the south so as to avoidcrossing the wetland to the east of this turbine. This was found not to be feasible due to the steep gradients to the southeast of Turbine 7 (these would also have resulted in a requirement for substantial earthworks within Purple Moor Grass and Rush Pastures at the watercourse in this location). The approach taken from this stage of the design process onwards was therefore to:

    a. Move the final Turbine 7 position into an area of neutral grassland to reduce impacts to areas of purple moor grass and rush pasture habitat. This is shown in **Insert 4.3**.

    b. Optimise the final Turbine 2 position with respect to bat habitat at, and to the north of, Coed Gaerwen (broadleaved woodland).

    c. Move the final Turbine 3 position away from Nant Llyn Mynyllod LWS and the important wetland habitats to the south of Coed Gaerwen (layouts 3-4).

[5] https://www.gov.wales/sites/default/files/publications/2024-07/planning-policy-wales-edition-12.pdf

d. Locate and minimise the footprint of an access track through the northernmost part of Coed Gaerwen (see further below) based on the overall balance of environmental considerations (see further details below). The portion of access track within Coed Gaerwen was minimised commensurate with this balance and technical requirements.

e. Minimise the interactions between access tracks and important wetland habitats, via fine adjustments to track orientation to reduce crossing extents.

Environmental Effects and Interactions Following Design Modifications

GWDTEs and Water Course Buffers

4.24 It became clear over the course of these layout iterations that it would not be feasible to entirely avoid all provisional GWDTE 'buffers' in all locations. These buffers were taken from Scottish guidance, in the absence of Welsh guidance or policy, and development within them does not entail adverse impacts upon GWDTEs; it is instead a trigger for more detailed assessment of potential effects and identification of embedded or other forms of mitigation to avoid adverse effects, if required..

4.25 The approach taken from this stage of the design process onwards with respect to GWDTE was to:

- Minimise interaction with the provisional buffers to the greatest extent feasible, taking into account the hydrological dynamics (e.g. flow paths) noted via the hydrological field survey;
- Avoid any encroachment into the provisional GWDTE buffers where this would result in compromise to the GWDTE following mitigation; and
- Focus on ensuring that the chosen design enables the delivery of suitably robust embedded design mitigation, of which there is confidence in delivery through use of standard cut & fill earthworks and drainage design.

4.26 The assessment of effects on GWDTEs is set out in **Chapter 9** of the ES and associated appendices, taking into account detailed GWDTE characteristics and mitigation options.

4.27 In addition to watercourse crossings, this stage of the design involved a minor reduction in the separation distance between the earthworks associated with Turbine 2's temporary

hardstand and associated track and a single watercourse and small pond to the northeast of final Turbine 2, in the interests of achieving appropriate separation distances between the turbine and woodland bat habitat. The final separation distance between proposed infrastructure and surface water features in this general location is approximately 34m at minimum. Effects in this respect, and their mitigation, are described in **Chapter 9** of the ES and its associated appendices.

Woodland (Coed Gaerwen)

4.28 A general design objective for these iterations, and the design process as a whole, was avoidance of loss of woodland or trees. However, as described above, it was decided during this design phase that the optimum infrastructure layout would include a small portion of access track (leading to final turbine 2) passing through a mixed woodland plantation at the northernmost part of Coed Gaerwen. This was primarily due to the presence of peat and associated habitats immediately to the north of the woodland in this location. Alternative access track alignments passing to the south of Coed Gaerwen were considered but were found not to be feasible due to the combination of gradients, peat and water feature presence. The balance of considerations was judged to be in favour of the final design choice due to:

- The importance afforded to peatland protection by the Welsh Government and national policy.
- The comparatively lower importance of the mixed woodland plantation habitat in the location in question.
- The possibility of mitigating and compensating for the tree loss within Coed Gaerwen. Proposals in this respect are set out in **Appendix 7.7**.

4.29 The interaction between the track and woodland was minimised, commensurate with turning arc requirements for the portion of access track in question. As detailed in other parts of this ES (**Chapter 3: Proposed Development** and **Appendix 3.3: Forestry**), the final felling requirements will be agreed post-consent when the detailed access orientation has been determined (applying micrositing if required to take account of ground conditions). If possible, trees along the northernmost boundary of Coed Gaerwen will be retained, due to both

landscape and visual and ecological considerations. However, this ES is based on the assumed removal of these boundary trees as a 'maximum impact' scenario.

4.30 This stage of the design also involved identification of optimal locations for the substation (including battery storage), borrow pits and construction compounds. Five alternative substation sites were considered against all onsite constraints and in relation to potential landscape and visual and other effects (constraints were generally as noted above in relation to other development components). These options are shown in **Insert 4.2**. Due to slopes within the site, combined with other constraints, a number of options were in relatively prominent locations on higher ground and were rejected on landscape and visual grounds. The final location (see, for example, **Figure 3.1**) was judged to perform best when taking into account all environmental considerations, for example:

- Located away from peat;
- Avoiding important habitats (i.e. located within recently felled and replanted woodland); and
- Avoiding interactions within Public Rights of Way (as was the case with other options).

Layouts 8,8a and 9 (final design)

4.31 Layout 7 was used as a basis for Phase 2 peat survey and a site walkover for civil engineering purposes. The changes made in response to these surveys were as follows:

- Civil Engineering:
  - The walkover identified challenging microtopography and ground conditions to the east of final Turbine 1 (steep slopes and shallow bedrock with outcrops). The track alignment was therefore moved further east in this location to provide access which would permit abnormal load deliveries whilst minimising earthworks (cut and fill) on the approach to the turbine.
- Ecology/Peat:
  - A minor movement was undertaken to final Turbine 3 to avoid a wet habitat to the west (Upland Flushes, Fens and Swamps). The turbine location had previously been influenced by the Phase 1 peat interpolation, with the Phase 2 peat data finding that a movement eastward was feasible without encroaching on peat. In other respects, the

Phase 2 peat data confirmed that the layout already avoided interactions with peat and peatland habitats to the greatest extent feasible. In particular, the narrow peatland crossing to the east of final Turbine 7 was found to be in the optimal location at the smallest extent of the peat resource, with interactions with this resource therefore being minimised to the greatest feasible extent via the location of infrastructure. As noted in **paragraph 4.20** above, options to approach Turbine 7 from the south, which would have avoided this area of peat, were found not to be feasible due to gradients and the resulting earthworks, some of which would have been required within important wetland habitats. Design measures that will be taken to minimise the effects of the final layout on the surrounding peat resource and its hydrological regime in this location are described further in **Chapter 9** of this ES and associated appendices.

- In its consultation response as a result of the PAC, the Welsh Government's Land Quality Advice Service (LQAS) noted that the turning head for Turbine 7 overlapped with an area of mixed Upland Acid Grassland and Purple Moor Grass and Rush Pastures over shallow organic-rich soils (not peat, as the depths were less than 30cm in all cases). For the final design, the turning head was moved to be located to the south of the turbine hardstand rather than to the west, which removed the interaction with the area of habitat in question.

Turbine Heights

4.32 Maximum blade tip heights throughout the majority of design iterations were assumed to be 180 m in all cases. However, following the reduction in turbine numbers, it was decided to evaluate whether any turbines could be increased to 200 m maximum blade tip height to increase renewable energy generation without substantively altering the predicted effects of the Proposed Development. It was judged that this would be the case for Turbines 3 and 5, which were therefore raised to a maximum 200 m blade tip height for the final design. Making this change was not considered to have substantive implications for environmental effects across any topic, including landscape and visual and cultural heritage. Evaluation in this respect included comparative use of Zone of Theoretical Visibility (ZTV) maps and wireline visualisations. The lack of substantive additional effects was influenced by the relatively central position of the two turbines in question within the site, away from slopes within key views.

Effects and Interactions Following Design Modifications

Soils: Best and Most Versatile (BMV) Agricultural Land

4.33 Predictive mapping (The Welsh Government's 'ALC 2') indicated the potential interaction of part of the main site access track near the A494 with land of Agricultural Land Classification (ALC) subgrade 3a. At this design stage, a soil survey was therefore undertaken.

4.34 The soil survey results are presented in **Appendix 9.2: Agricultural Land Quality Considerations** of the ES**.** The survey identified that less than 0.1 ha of subgrade 3a land would interact with the proposed access track alignment: a small part of a paddock to the east of the existing access from the main road, and a narrower strip of land further to the south (see **Insert 4.1** of **Appendix 9.2**). The amount of BMV land to be affected overall is negligible, and the introduction of the wind farm access track would not have any substantive implications for agricultural land use or productivity at the holding in question. Notwithstanding this, an alternative wind farm access track alignment was explored to the east of the identified BMV land.

4.35 The alternative alignment to the east would require a fresh breach to a native hedgerow (priority habitat) as against the widening of an existing breach. There was therefore a need to balance ecological and agricultural land effects for this part of the design. As the agricultural effects of the original alignment would be negligible; this alignment was considered preferable overall.

Conclusions

4.36 The final design for the Proposed Development is shown in relation to key onsite constraints in **Figures 4.3a-c**.

4.37 The design of the Proposed Development has evolved over multiple iterations to achieve the best feasible balance of renewable energy benefits and other environmental effects. A summary of the modifications made to the design layout is provided in **Table 4.1: Modifications to design** below. These modifications have been made in response to the design strategy and site-specific design principles discussed. It is considered that the final design, as described in **Chapter 3** presents the optimum design scenario for this Site.

Table 4.1 Modifications to design

Layout	Details	Changes to Previous Layout and Outcome
Layout V0 (Scoping Layout)	Turbines: 15 Blade Tip Height: 180 m	Maximum development scenario based on standard principles concerning the spacing of turbines and the overall Site boundary.
Layout V1	Turbines: 13 Blade Tip Height: 180 m	Variation to Scoping Layout – reduction to 13 turbines based on early desk-based design considerations: ■ Separation from properties; ■ Separation from watercourses; ■ Avoidance of peat; ■ Avoidance of scheduled monuments; and ■ Avoiding oversail of PROW with turbine blades.
Layout V2	Turbines: 11 Blade Tip Height: 180 m	Variation to Layout V1 – two turbines dropped from the north-west due to several environmental considerations including: ■ Noise; and ■ Curlew breeding territories to the north-west of Mynydd Mynyllod. This layout was used to inform subsequent site surveys including Phase 1 peat survey.
Layout V3-7	Turbines: 9 Blade Tip Height: 180 m	Iterative variations to Layout V2. Additional constraints were derived from field survey, including: ■ Phase 1 peat survey; ■ Hydrological Walkover; and

Layout	Details	Changes to Previous Layout and Outcome
		■ Ecological surveys. Modifications included: ■ Movement of Turbine 7 to avoid peat and reduce interactions with important habitats; ■ Optimisation of final Turbine 2 with respect to bat habitat; ■ Movement of Turbine 3 away from Nant Llyn Mynyllod LWS and wetland habitats to the south of Coed Gaerwen (Layouts 3-4); ■ Reorientation of access tracks to reduce interactions with peat and important wetland habitats; and ■ Identification of optimal locations for the substation (including battery storage), borrow puts and construction compounds. Layout 7 was the basis for Phase 2 peat survey and site walkover for engineering purposes.
Layout V8-9	Turbines: 9 Blade Tip Height: 180-200 m	Variation to Layout 7. Changes were: ■ Maximum turbine heights of T3 and T5 increased to 200 m, to increase renewable energy generation without substantively altering the predicted effects of the Proposed Development;

Layout	Details	Changes to Previous Layout and Outcome
		■ Track alignment of T1 moved east due to unsuitable ground conditions following an engineering walkover; ■ T3 moved slightly to avoid wet habitat to the west; and ■ Turning head for T7 moved out of area of mixed Upland Acid Grassland and Purple Moor Grass and Rush Pastures.