Galileo 05 Limited

Lynemore Wind Farm

Environmental Impact Assessment Report (Volume 1)

Chapter 02 – Proposed Development

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GALILEO EMPOWER

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2 THE PROPOSED DEVELOPMENT

2.1 Introduction

2.1.1 The purpose of this chapter is to give a description of the proposed Lynemore Wind Farm (hereafter the "Proposed Development"). It outlines the need for the Proposed Development, describes the Site and context, and discusses layout and design considerations. This chapter also considers how the design evolved for the Proposed Development.

2.1.2 This Chapter explains how potential environmental effects which have emerged early in the EIA process, and through the studies by the EIA team, have informed the design of the Proposed Development.

2.2 Need for the Development

Climate Change and Net Zero Targets

2.2.1 The science behind the climate emergency is well established and demonstrates the need to phase out fossil fuels in order to avoid negative economic, environmental, and social effects. International European and United Kingdom (UK) commitments to reducing CO2 and tackling the climate crisis have been made by all major economies. In response to these issues the UK has made significant, legally binding commitments to increase the use of renewable energy. The Highland Council has set a Route Map to Net Zero with key interim targets to reduce emissions by at least 75% by 2030 and at least 90% by 2040.The Proposed Development relates directly to those commitments.

2.2.2 The Scottish Government published the Onshore Wind Policy Statement (OWPS) in December 2022. The OWPS states that onshore wind is a cheap and reliable source of zero carbon electricity. The Statement is the culmination of an extensive consultative process with industry, statutory consultees and the public.

2.2.3 The Onshore Wind Sector Deal (September 2023) sets out commitments from the Scottish Government and the onshore wind industry to deliver 20GW of onshore wind in Scotland by 2030, delivering maximum benefit to Scotland.

2.2.4 The Proposed Development will contribute to this target by providing renewable electricity generation in Scotland and providing an opportunity to reduce CO_2 emissions from our electricity use.

2.2.5 The EIA Report will include information on the Proposed Development's contribution to renewable energy targets and climate change, through the carbon calculation. Further details are in included in **Technical Appendix 13.2** presented in **Chapter 8: Hydrology, Geology, Hydrogeology and Peat**.

Chapter 3: Planning and Renewable Energy Policy Context outlines the local, Scottish, UK and international climate change, renewable energy and planning policies that are considered relevant to the Proposed Development. Legislation, planning policy

and industry guidance specific to each technical discipline are outlined in their relevant technical chapters (Chapters 4 to 13).

Benefits of the Proposed Development

2.2.6 The proposed operational life of the Proposed Development is 50 years from the date of commissioning. The Proposed Development accords with NPF4 and demonstrates compliance with the key principles set out in the Scottish Draft Energy Strategy and Just Transition Plan relating to jobs, skills and economic opportunities, communities, people and equity; and adaptation, biodiversity and the environment:

- Generation of enough wind energy to power over 70,000 households annually[1].
- Battery Energy Storage System (BESS) to store energy, providing stability to the electricity supply network, meeting energy demands and providing improved energy security.
- Delivery of a total greenhouse gas (GHG) emission savings of 2,481,469 tCO_2e over its lifespan (against a grid-mix of electricity and based on operational lifespan of 50 years for the wind farm).
- Dividing the net GHG emissions predicted for the manufacture, construction and decommissioning stages of the wind turbines by the predicted annual carbon savings from windfarm operation gives a predicted emissions payback period of 5.0 years against a grid-mix of electricity.
- It was estimated that development and construction contracts could generate £34.3 million GVA and 533.4 job years across Scotland, of which £10.9 million and 183.1 job years would be provided in the Highlands, and £1.9 million GVA and 31.1 years being directly supported in the Inner Moray Firth local area.
- It was estimated that turnover generated by the operation and maintenance of the Proposed Development could support £122.5 million GVA and 1722.4 job years in Scotland, of which £88 million GVA and 1212.1 jobs will be supported within the Highlands and £32.3 million GVA and 442.4 jobs in the Inner Moray Firth.
- Over £46.5 million in non-domestic rates generated over the operational lifetime;
- Significant contribution to improving the security and cost of energy supply taking account the cost-of-living crisis and war in Ukraine.
- Significant contribution to meeting onshore renewable energy generation target of xx GW by 2030 and reduction of greenhouse gases, taking account of the climate crisis.
- £5,000 per MW per year in community benefits for the local area. The community benefit offer from the Proposed Development is equivalent to £0.49 million annually, or £24.5 million during the 50-year operational lifetime of the Proposed Development.

2.2.7 **Chapter 12: Socioeconomics, Land Use, Tourism and Recreation** considers the potential socio-economic impacts associated with the Proposed Development.

[1] RenewableUK, Statistics Explained. Using average domestic household consumption in UK of 3,239kWh. Accessible at: https://www.renewableuk.com/page/UKWEDExplained

2.3 Site Description and Context

2.3.1 The Site is the area within the red line boundary shown on **Figure 1.2** and is located within the Lynemore Estate on the hills 2 km west of the A9 at Moy within the Highland Council area.

2.3.2 The Site is located approximately:

- 10 km south of Inverness
- 6 km northwest of Tomatin
- 4 km east of Farr
- 2 km west of the A9 at Moy
- 2 km northeast of Farr and Glen Kyllachy Wind Farms

2.3.3 The Site is mostly open moorland, managed primarily for stalking and grouse shooting. The named hill of Carn na h-Easgainn (616m) is located within the southern edge of the site boundary. Areas of open deciduous woodland and commercial plantation lie to the north of the Site. The Farr/ Glen Kyllachy Wind Farm complex lies approximately 2km to the southwest of the Site.

2.4 Site Selection

2.4.1 There are several criteria used by the applicant to assess the appropriateness of sites for the development of onshore wind projects. These include:

- suitable wind conditions
- feasibility of access for abnormal indivisible loads (AILs)
- favourable topography and access to enable the construction of projects
- planning policies which support the development of renewable energy
- avoidance of environmental designations (where possible) (see **Figure 2.1**)
- avoidance of the most sensitive landscapes.

2.4.2 A review of the site selection requirements for the Site found the following:

- Initial desk-based assessments and a review of wind resource suggest that there are high wind speeds, and the Site is available for a renewable energy development.
- There are no planning policies which, in principle, preclude wind farm or renewable energy development.

2.5 Layout and Design Considerations

2.5.1 This Section outlines the environmental and technical constraints which were taken into account during the design evolution described in **Section 2.7**.

Legislation

Schedule 9 of the Electricity Act 1989

2.5.2 The applicant does not hold a generation licence in respect of this site and nor is it authorised under an exemption; therefore the statutory duties set out in Schedule 9

paragraph 3 (1) do not apply to the applicant when formulating proposals for consent under section 36 of the Electricity Act. However through the EIA process the applicant has sought to develop a design that is in accordance with the duties set out in Schedule 9 of the Electricity Act. The matters that are raised in Schedule 9 have been considered in the EIA process and the findings are presented in this EIA Report. Scottish Ministers are required, under Schedule 9, paragraph 3(2) (a) to have regard to the desirability of the matters mentioned in paragraph (a) of sub-paragraph (1) and the information provided in the EIA Report enables the Scottish Ministers to carry out this duty.

2.5.3 Nonetheless, the applicant has done what it *"reasonably can do to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects"* as contained under Schedule 9 para 3(1)(b). This is summarised in Sections 2.5.9 to 2.5.23 and considerations during the design process included:

- landscapes and visual impacts
- location of residential properties – proximity to noise-sensitive receptors and potential for shadow flicker effects
- ground conditions (including slope steepness and peat)
- forestry
- access feasibility
- presence of ornithology, protected habitats, including peatland habitats, and species
- area topography, including gradients, exposure, watercourses, hydrology, and land use
- presence of cultural heritage features
- proximity to telecommunications infrastructure
- compatibility with aviation interests
- key recreational and tourist routes.

Key Constraints

2.5.4 Constraints analysis was undertaken using Geographical Information Systems (GIS). A project-specific workspace, based on ArcGIS Online, was developed specifically for the Proposed Development. This allowed base-mapping to be overlaid with spatial data, such as environmental constraints and protected sites, and project-specific data to provide the project team with a means of interrogating environmental and project details in a single place at technical meetings and design workshops.

2.5.5 Onsite constraints can be seen in further detail on **Figure 2.2**. In addition to the application of GIS, Civils 3D (a design software), was used to assist in the constraints mapping and design of the Proposed Development.

Wind Analysis

2.5.6 Wind analysis and efficiency modelling of the wind turbines has been carried out by the applicant from project inception and throughout the design evolution process to identify the areas of the Site likely to produce the highest yields and ensure the commercial viability of the project.

2.5.7 For turbines to work as effectively as possible, they must be suitably spaced relative to the predominant wind direction. If they are too close together in this direction, the wake effects from the wind turbines located on the upwind edge of the array would create turbulent air for the next row and so on through the array, reducing overall energy output. Additionally, turbulent air increases the strain placed on the turbines, which could shorten their operational lifespan. Conversely, if wind turbines are located too far apart, the opportunity to maximise the capacity and, thereby, electricity generation from a site is reduced.

2.5.8 There is no industry standard for spacing, only manufacturer recommendations, computer modelling and professional judgment. Six times rotor diameter on the predominant wind direction against four times rotor diameter cross wind (6D x 4D) is a common starting point. This is understood to provide a reasonable compromise between turbine proximity and site capacity without unduly compromising turbine operation. The Proposed Development may, however, employ turbines which are not yet on the market. Therefore, a more flexible methodology utilising wind yield modelling was used to find the right balance of turbine efficiency and productivity over a wide variety of potential rotor diameters.

Landscape Character and Visual Amenity

2.5.9 The landscape and visual environment of the Proposed Development has been considered as part of the design process. Landscape and visual constraints do not generally constitute technical or 'hard' restrictions to development but are rather 'design considerations' that inform the layout design process. These considerations, many of which are key sensitive landscape and visual receptors, are found both on the Site and within the surrounding study area.

2.5.10 On Site considerations include:

- the landform of the Site, in terms of its scale, elevation, and complexity;
- the topography of the Site, including the patterns of the landscape such as watercourses, field boundaries, and woodland; and
- reducing the vertical extent of the wind farm by micro-siting turbines to lower elevations, away from the summits and ridgeline of Beinn nan Cailleach and Carn na h-Easgainn.

2.5.11 considerations in the wider study area include:

- effects on the landscape character and landform visible from the A9
- effects on visitor attractions; and residents of the area around the Site, whose visual amenity may be affected by the Proposed Development, such as Lynemore Cottage
- reaching a balanced fit in the already existing pattern of wind energy development viewed from the closest part (northern edge) of the Cairngorms National Park.

2.5.12 **Chapter 5: Landscape and Visual Impact Assessment** (LVIA) describes the effects of the Proposed Development in relation to these considerations, and a range of viewpoints that represents the appearance of the Proposed Development from key landscape and visual receptors has been illustrated and described in the LVIA.

Ecology and Ornithology

2.5.13 Ecological surveys have been carried out across the Site and surrounding area from 2023 to 2024, including a Phase 1 habitat survey, a National Vegetation Classification Survey, protected terrestrial mammal surveys, bat surveys and fish habitat survey. Sensitive and protected ecological features and appropriate buffers have been avoided. Sensitive habitats within the Site have been avoided where possible, or where unavoidable the potential impacts reduced as far as practicable. Areas of priority peatland habitat have been avoided where possible, and the recommended habitat standoff distances from blade swept path to key habitat features have been incorporated into the design to reduce collision risk to bats.

2.5.14 Ornithology surveys were carried out across the Site and surrounding area from September 2022 to August 2024, including vantage point watches; black grouse surveys, scarce breeding birds (for raptors and divers listed in Schedule 1 of the Wildlife and Countryside Act 1981 and Annex 1 of the EU Birds Directive), breeding birds (waders, herons and waterfowl) and winter walkovers for non-breeding birds. Suitable buffers were considered during the design evolution process.

Geology, hydrogeology and peat

2.5.15 The inherent characteristics of the Site make it particularly constrained when it comes to hydrogeology and peat. The Site was assessed in different forms, complementing desk based assessments, satellite view data, and surveys.

Noise-Sensitive Receptors

2.5.16 For the purposes of early constraints mapping, avoidance buffers of 1 km were applied to residential properties in the vicinity of the Site. These buffers were further refined during the design process based on expert noise advice.

2.5.17 The study area for the assessment of operational noise comprises noise-sensitive residential properties nearest to the proposed turbines, located at approximate distances of up to 3 km from the turbines of the Proposed Development. The cumulative assessment also considers residential properties closer to the Farr-Kyllachy and Moy Wind Farms.

2.5.18 The difference between measured background noise levels and operational predicted noise levels was assessed according to the guidance described in the ETSU-R-97: 'The Assessment and Rating of Noise from Wind Farms' (Department for Trade and Industry, 1996) to assess the potential effects with a view to ensure that the impact on amenity of all nearby properties was within acceptable limits. The recommendations of the Institute of Acoustics 'Good Practice Guide to the Application of ETSU R 97 for the Assessment and Rating of Wind Turbine Noise' were also considered. Applying this design criteria in accordance with ETSU guidance as part of this assessment ensures that no exceedances of acceptable noise levels would occur from the Proposed Development, or cumulative effects.

2.5.19 The potential noise effects of the Proposed Development are addressed further in **Chapter 11: Noise and Vibration**.

Forestry

2.5.20 No forestry associated impacts are anticipated from any of the proposed wind turbines on the Site, as these are located outwith woodland areas. Nevertheless, the access track for the Proposed Development will impact upon a small area to facilitate construction of the track.

2.5.21 The areas of forestry that would be affected to facilitate the Proposed Development are shown in **Figure 13.5.** Forestry issues including site survey results, photography and compensatory planting requirements are discussed further in **Chapter 13: Other Issues, section 13.4**. Additionally, enhancement measures have been identified and are proposed as part of the habitat enhancement measures reported in **Chapter 6: Ecology and Biodiversity,** and discussed further in the **Outline Habitat Enhancement and Management Plan, Technical Appendix 6.5.**

Telecommunications

2.5.22 Consultation was undertaken with the relevant telecommunication link operators to inform the telecommunications links within the vicinity of the Site and to advise their position with respect to the Proposed Development.

Aviation

2.5.23 Consultation was undertaken with the relevant aviation consultees to identify whether the Proposed Development would have an impact on aviation interests. Aviation is discussed further in **Chapter 14: Other issues**, in the section of Aviation and Radar.

Shadow Flicker

2.5.24 There are no formal guidelines currently available on what exposure would be acceptable in relation to shadow flicker. There is no standard for the assessment of shadow flicker. The Scottish Government's web-based guide relating to onshore wind turbines (Scottish Government, 2013) suggests that shadow flicker should not cause nuisance and annoyance to dwellings beyond a distance of 10 rotor diameters from a wind turbine, which equates to up to 1620 m in this instance. During the design process, a study area of ten rotor diameters was applied to the turbines for proposed design schemes to test for potential shadow flicker effects. Turbines in the final proposed layout would not be within a ten rotor diameter distance of regularly occupied buildings; however, a complete assessment was conducted in any case to ensure a robust assessment. The potential shadow flicker effects of the Proposed Development are addressed further in **Chapter 13: Other Issues**.

2.6 Consideration of Alternatives

2.6.1 With respect to the Proposed Development, the alternatives considered were as follows:

- Different turbine and infrastructure layouts/locations within the Site.
- Different access routes to and from the Proposed Development site in terms of delivery of AIL.

2.6.2 The design and layout of the Proposed Development was adapted and altered in response to environmental constraints and consultation feedback as illustrated in **Figure**

2.3. The Proposed Development went through a series of four design iterations. Each of these layouts is shown on **Figure 2.4** and a summary of the layout iterations is included in **Section 2.7**.

2.6.3 The candidate turbine is the Vestas EnVentus 162, with a maximum turbine tip height of 200 m and rotor diameter of 162 m. For the purposes of assessment, where relevant for each technical assessment, turbine models adhere to the limits of stated dimensions, and conditions that provide the realistic relevant worst-case impact, have been assumed.

2.7 Design Evolution and Development of the Preferred Option

2.7.1 The Proposed Development has undergone four principal iterations of the layout which have been developed at different stages in the project design process:

- **Layout A – Initial layout**. 14 turbine layout with a maximum height of 200 m, representing a wind-optimised layout on the land available.
- **Layout B – Scoping layout.** 10 turbine layout with a maximum height to blade tip of 200 m, informed by preliminary results of on-site surveys, desk-based assessments and consultant inputs. This Layout was used for scoping consultation.
- **Layout C – Constraints led layout.** 14 turbine layout with a maximum height of 200 m informed by an extended application boundary. Several access options were identified running southwest through the site from the A9.
- **Layout D – Final layout.** 14 turbine layout with a maximum height of 200 m informed by an extended application boundary, onsite surveys (inc. peat and NVC) with detailed ancillary infrastructure design, and a preferred access route from the A9.

Design iterations (A to D) are shown in **Figure 2.4**

Layout A – Initial Layout

2.7.2 The first design was developed prior to any detailed site-specific surveys being completed and with limited information on site constraints. The layout was based on information available at the time and collected from desktop studies and sought to make best use possible of the wind resource. In addition, technical constraints were considered such as turbine separation distances of approximately 4 and 3 rotor diameters (with some overlap) in downwind and crosswind directions respectively (based on a 170 m rotor diameter) and the anticipated wind variation over the site with topography.

2.7.3 The layout comprised 14 turbines of up to 200 m tip height, which represented the maximum physical capacity of the turbine area from a wind resource perspective prior to the establishment of detailed constraints and a detailed wind resource assessment.

Layout B – Scoping Layout

2.7.4 The second design was developed following completion of detailed site-specific surveys, which refined the environmental baseline and key constraints and following consultation with technical specialists. The following design principles and buffers were considered during this design iteration:

- A 1,620 m residential buffer was adopted (i.e. ten times the proposed rotor diameter (162 m).

- Turbine separation distances of approximately 5 and 3 rotor diameters in downwind and crosswind directions respectively (based on a 162 m rotor diameter).
- 50 m watercourse buffer.
- Avoidance of areas of deep (peat > 1m depth).
- A set back from landownership boundaries to avoid blade oversailing.
- Avoidance of the most sensitive habitats and protected species.
- Avoidance of cultural heritage assets and buffers for designated and non-designated assets.
- Buffers for telecommunications links.
- Noise buffers from residencies.
- Avoidance of slopes greater than 12 degrees.
- Landscape and visual amenity from A9.
- Lossiemouth radar visibility.

2.7.5 The layout comprised 10 turbines of up to 200 m tip height to improve visual amenity, 4 turbines were dropped from the initial layout. The only other engineering consideration taken was the optimal orientation of the cranepad for purpose of cut and fill. T05 appeared as a notable outlier in numerous distant key viewpoints and so it was moved north. T03 and T06 were moved south to achieve a better visual arrangement, also achieving a greater buffer from forestry.

Layout C – Constraints led layout

2.7.6 The red line boundary changed drastically giving extra terrain to the east. The layout comprised 14 turbines as it included consideration of an additional 4 turbines to the east in the new area available.

2.7.7 A more detailed infrastructure design was completed based on Layout B. The key design principles for the access track network were to utilise the existing forestry tracks and to minimise new watercourse crossings. Following the establishment of this layout a design workshop was held whereby the layout was scrutinised considering site-specific field data from peat and habitat assessments.

2.7.8 The addition of the four turbines to the southeast increased the horizontal field of view of the development, particularly from the closest residences at Lynemore Cottage and game-keeper's Cottage. However, the turbines were better set back with a good degree of intervening screening from residences. The greatest visibility of these four turbines would be from the southeast (on the A9 north of Tomatin and Sustrans NCR7 at Tomatin) and the north and northeast on the A9. Visibility of the additional four turbines from Strathnairn, the Culloden Battlefield Visitor Centre and the A9 further north at Daviot is very limited and largely screened by intervening vegetation.

2.7.9 In addition, several potential access options were identified running southwest through the site from the A9 utilising existing forestry tracks. Potential locations were also identified for the substation and battery storage compound.

2.7.10 An appraisal of potential internal site access routes was considered before selecting the preferred option from the A9.

Layout D – Final Layout

2.7.11 Layout D represents the final stage of design iteration, which included finalisation of turbine locations and siting and design of ancillary infrastructure.

2.7.12 Another design workshop was held following further survey work of the turbine area, access options, cultural heritage and landscape receptors. This was also informed by a review of Layout C by the construction design and management (CDM) principal designer at a further design workshop.

2.7.13 The purpose of the design workshop was to review Layout C in the context of the refined application boundary, updated baseline data and to identify locations for additional ancillary infrastructure, including the substation and battery storage compound, mobilisation compounds, and potential borrow pits.

2.7.14 Individual assessment chapters in the EIA Report will include design input in further detail and respond to specific matters, in particular pertaining to the scale of the proposed turbines and the landscape fit of the scheme.

2.7.15 Layout D has been reviewed against the Landscape and Visual Design Objectives. This has been carried out using wirelines, zones of theoretical visibility of the proposed blade tip and hub heights;

2.7.16 Layout D has:

- Reduced the vertical extent of the 14 turbine layout as far as possible by micro-siting turbines to lower elevations, away from prominent summits and ridgelines.
- Reflected the existing pattern of wind energy development viewed from the northern edge of the Cairngorms National Park.
- Increased the distance between the proposed turbines and the closest residential property, Lynemore Cottage, as far as possible. T12 is the closest proposed turbine to Lynemore Cottage, located approximately 1,545 m south of the property.
- Reduced sequential visibility for road users of the A9.

2.7.17 The final layout including ancillary infrastructure is shown on **Figure 2.5**.

2.7.18 Individual technical assessment chapters in the EIA Report refer to design input in further detail and respond to specific matters.

2.8 The Proposed Development

Key Components

2.8.1 The Proposed Development infrastructure would comprise the following components:

- Fourteen wind turbines of Approximately 7 megawatts (MW) each, with a maximum blade tip height of up to 200 m.
- Hardstanding areas at the base of each turbine, with a permanent area of approximately 3,282.5 m^2 .

- Sub-station/control building with parking and welfare facilities.
- A network of onsite access tracks and up to 6 associated watercourse crossings.
- Transformers and underground cables to connect the turbines to the onsite substation.
- Telecommunications equipment.
- Two temporary construction compounds and laydown area.
- One borrow pit search area, to provide suitable rock for access tracks, turbine bases and hardstandings.
- Battery Energy Storage System (BESS) with a capacity up to 50 MW.

Outline Habitats Management Plan

2.8.2 A number of biodiversity enhancement measures are proposed as part of the Proposed Development's Outline Habitat Enhancement and Management Plan (OHEMP).

2.8.3 This OHEMP provides a mechanism to reduce adverse environmental effects and also to provide demonstrable enhancements for important ecological and ornithological features and biodiversity in general across the Site and surrounding area. This will be achieved through the enhancement of degraded peatland and heath habitat, using the following measures:

- Peat Restoration using Translocated Peat
- Peat Restoration using Traditional Techniques
- Removal and control of regenerating trees; and
- Control of bracken

2.8.4 The OHEMP also aims to deliver native hedgerow creation. This is discussed in greater detail in **Technical Appendix 6.5 Outline Habitat Enhancement and Management Plan.**

Wind Turbines

Turbine Parameters

2.8.5 The turbines would have an approximate rotor diameter of 162 m. The candidate model is Vestas EnVentus 162, with blade tip height of 200 m, although final turbine model to be used might change subject to market availability and the result of a tender process Indicative elevations are shown on **Figure 2.6**. Grid references and height above sea level, above Ordnance Datum (AOD) for the proposed turbines are identified in **Table 2.1**.

Table 2.1: Proposed Turbine Locations

Turbine	Easting	Northing	AOD
T1	274854	833061	517m
T2	274232	833205	470m
T3	273329	833308	512.5m
T4	272803	833373	500m
T5	272779	832737	535m

Turbine	Easting	Northing	AOD
T6	273343	832691	525m
T7	273973	832581	543m
T8	274670	832549	555m
T9	274891	832175	545m
T10	275197	832811	512m
T11	275381	832339	502m
T12	275980	832429	505m
T13	275031	831702	545m
T14	275999	831951	505m

2.8.6 The proposed turbine locations and ancillary infrastructure would be subject to a proposed maximum micrositing tolerance of 50 m in any direction. This tolerance allows for minor changes in turbine or infrastructure location to respond to possible variations in ground conditions across the Site, which will be confirmed following detailed site investigation work carried out prior to construction. In those places where environmental features may be affected by micrositing, tolerance would be constrained to less than 50 m, and such changes would be managed in consultation with an Environmental Clerk of Works (ECoW) for the Proposed Development during its construction phase. The micrositing constraints relevant to the Proposed Development are outlined in each technical chapter. Any movement of turbines or other infrastructure from the Proposed Development layout (shown in **Figure 2.5)**, outwith the micrositing tolerance, would be agreed with the Highland Council (THC) prior to construction, in accordance with the mitigation measures set out in this EIA Report.

2.8.7 A summary of the proposed mitigation commitments relating to each technical discipline are provided in **Chapter 14: Schedule of Environmental Commitments**.

Turbine Design

2.8.8 The turbines would be three bladed, horizontal axis turbines with solid tubular towers. The blades would be made from reinforced composite materials such as fibreglass. The turbine towers would be made of steel.

2.8.9 The wind turbines would be of the same basic appearance and colour. It is proposed that the turbines would be of a matt grey colour finish. Although off-white has been an accepted colour for turbines, more recently constructed wind turbines have been a mid-grey tone, which reduces the distance over which turbines are visible, especially in dull weather or low light conditions. The choice of material and colour for the proposed turbines is an important consideration in terms of visual impact. Finishing would be expected to be agreed by a condition placed on consent.

Turbine Foundations

2.8.10 Turbine foundations would be dependent upon site-specific ground conditions at the turbine locations. However, it is envisaged that installation of the turbines using a steel reinforced concrete base (gravity foundation) would be suitable.

2.8.11 The concrete gravity foundations would be located underground. Therefore, a quantity of earth would need to be removed. The amount of earth to be removed would depend upon site-specific ground investigations at each turbine location. Topsoil, peat and other material would be removed from the foundation area and stored so that it may be used later for reinstatement. Indicative details on construction requirements and metrics are discussed and analysed further **Chapter 13: Other Issues**, and **Technical Appendix 13.2: Carbon Calculator.**

2.8.12 Turbine foundations would be set down to the depth of suitable bearing strata with an approximate diameter of 25 m with a circular or octagonal plan shape (see **Figure 2.7** for indicative turbine foundations). Should geotechnical investigations demonstrate that the required bearing capacities are not achievable, then a piled foundation design would be adopted using the same overall design footprint.

2.8.13 An anchor ring and foundation bolts would be cast into a central column onto which the turbine tower would be fixed. Concrete for the foundations would either be delivered to the Proposed Development in a "ready mix" form or processed in a concrete batching plant located onsite within a construction compound.

2.8.14 For the purposes of this EIA Report, a maximum (worst-case) scenario for turbine foundations of a 3 – 4 m depth and 25 m by 25 m circular or octagonal footprint has been assumed. The concrete bases would be allowed to cure (i.e., reach its design strength) before turbines are fitted.

Turbine Lighting

2.8.15 As discussed in greater detail in **Chapter 13: Other issues**, in the section of Aviation and Radar, the Air Navigation Order Article 222[2] requires turbines with a tip height of or exceeding 150 m to display aviation lighting to indicate their presence. Dispensations for reduced lighting schemes can be agreed with the Civil Aviation Authority (CAA), according to the guidance provided in CAP-764[3].

2.8.16 In response, a reduced lighting scheme has been designed which aims to identify the outline of the wind farm by using 2000 candela visible red lights on 7 of the 14 turbines. In addition, all 14 turbines will be fitted with infra-red lighting. This lighting scheme was approved by the CAA in February 2025. Further information on aviation turbine lighting is provided in **Chapter 13: Other issues**. Further discussion of the way turbine lights would be perceived is provided in **Chapter 5: Landscape and Visual Impact Assessment**.

Turbine Erection

2.8.17 The Turbine components would be delivered to the relevant storage area for each component, whether it be to a specific turbine hardstanding or to a storage area located at one of the construction compounds, until weather conditions are appropriate for turbine

[2] UK Statutory Instruments (2016), The Air Navigation Order Part 8 Chapter 2 Article 222. Available at: https://www.legislation.gov.uk/uksi/2016/765/article/222/made [accessed January 2023].

[3] Civil Aviation Authority (2016), CAP 764: Policy and Guidelines on Wind Turbines. Available at: https://publicapps.caa.co.uk/modalapplication.aspx?catid=1&pagetype=65&appid=11&mode=detail&id=5609 [accessed January 2023].

erection. The bottom turbine tower section would firstly be fixed to the anchor ring and foundation bolts embedded into the central column of the foundations, followed by the upper turbine tower sections, all being lifted into place by two cranes (a heavy lifting capacity crane, and a smaller service crane). The cranes would then lift the nacelle into place on the top section of the turbine tower. Blades would then be fitted individually to the rotor hub.

Turbine Hardstanding

2.8.18 Level hardstanding areas are required adjacent to each turbine base for the operation of a heavy lifting capacity crane, and a smaller service crane, used for assembly of the turbine components. They would also be used as storage areas for the turbine components. The hardstandings would be to the same general specification as the turbine access tracks that they adjoin, but a slightly greater depth of construction is envisaged.

2.8.19 It is anticipated that each permanent hardstanding would be approximately 100 m x 35 m with a 6 m wide track running along the length of the hardstanding as shown in **Figure 2.8**. The cut-and-fill batters required on the hardstandings would be dictated by pre-construction detailed Site Investigation (SI) surveys. In addition to the hardstanding for the main assembly crane, up to three additional temporary crane pads may be required for crane assembly.

2.8.20 The hardstandings would be constructed using suitable surplus material generated from the excavation process elsewhere within the turbine area and from onsite borrow pits where possible. Topsoil and peat would be excavated, and stone laid and compacted to the required depth. The depth of the hardstandings would be dependent on the ground conditions at specific locations.

Onsite Access

Site Entrance

2.8.21 The entrance to the Site for vehicles delivering both construction materials and turbine components, such as tower sections and blades, would be from the A9. The access track would be approximately 2.8 km in length until reaching the first wind turbine. The proposed access route to the site from the A9 (inc. proposed junction design) is shown on **Figures 2.9a** and **2.9b** and are discussed further in **Chapter 10: Traffic and Transportation**.

Internal Access Tracks

2.8.22 The Site tracks would be developed to meet the requirements of appropriate criteria (such as visibility, construction materials, surface water drainage, gradient, and safety of other road users). The following objectives were adopted during the track design:

- Tracks make use of existing infrastructure and track/disturbed ground where suitable.
- Track length is kept to a minimum to reduce construction time, the requirement for stone, land-take, and to reduce associated environmental effects.

- Gradients to be kept to acceptable levels to accommodate the requirements of delivery vehicles, including AIL, and to allow construction plant to move safely around the Site.
- Tracks are routed to avoid sensitive hydrological, ecological and archaeological features as far as practicable and to keep watercourse crossings to a minimum.
- Tracks are routed to minimise tree translocation and/or felling requirements.
- To facilitate safe access to each wind turbine, ground with potential instability and deeper areas of peat has been avoided.
- Tracks are designed to minimise the required cut-and-fill quantities.
- Horizontal and vertical alignments of tracks are designed in such a way as to comply with Turbine Supplier requirements, for example minimum turning radius and vertical curvature on both the tracks and hardstandings.
- To build health and safety aspects into track design from an early stage, including avoiding slopes which would be too steep for access and creating clear definitions between turbine working areas and access track.
- To minimise watercourse crossings.
- To avoid disturbance to public access.

2.8.23 Internal tracks would have a length of 13.1 km, of which 3.7 km would be floating tracks once past the access area, in order to minimise potential excavation and to avoid disruption of surrounding peatland. Tracks would be a width of 6 m with a graded running surface. If necessary, tracks are bordered by a drainage ditch. The typical structure of a floating track is shown in **Figure 2.10**

Underground Cabling

2.8.24 The Proposed Development will include buried electric cables which will connect the wind turbines to the substation and control building compound. The majority of the underground power cables would run along the side of the access track in trenches to the proposed control building compound. The trench route would be clearly marked above ground with identification posts, spaced evenly along the length. The cables would be buried to a depth of approximately 0.9 m – 1.0 m. Indicative cable trench arrangements are provided in **Figure 2.11**.

Watercourse Crossings

2.8.25 As part of the access track construction and associated hardstanding works, 7 new watercourse crossings would be required, of which two already have temporary tracks to allow vehicle movement. Locations identified in **Technical Appendix 8.5: Watercourse Crossing Inventory**. The watercourse crossing locations have been carefully designed to cross watercourses where channel sections are straighter and narrower, avoiding meanders and areas of erosion, and at angles perpendicular to the water flow where possible. Water cross typical structure is shown in **Figure 2.12**.

2.8.26 The watercourse crossings will be subject to registration under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR). Further consultation with SEPA will be undertaken prior to commencement of construction by the applicant, to ensure compliance with CAR.

Borrow Pit

2.8.27 The Proposed Development would require crushed stone to construct new tracks, create hardstanding areas for the cranes and lay the turbine foundations.

2.8.28 The total estimated required quantity of aggregate is approximately 68,100 cubic metres, which is expected to be won from one onsite borrow pit, as shown on **Figure 2.5.** However, for purposes of assessing the worst-case scenario, **Chapter 10: Traffic and Transportation** assessment will consider the scenario where 50% of the track and hardstanding aggregate would be brought in from off-site sources, such as local quarries. Details are presented in **Technical Appendix 8.8: Borrow Pit Assessment**.

2.8.29 Locations for one borrow pit search area have been carefully sited in an area with low peat measurements and rock exposure so as to minimise peat disturbance. As a result, the volume of topsoil/peat that would need to be removed in order to access the stone from borrow pits is limited.

Substation and Energy Storage Compound

2.8.30 The Proposed Development would have one compound comprising the Substation and Battery Energy Storage System. The Substation would host a range of electrical grid equipment, including but not limited to:

- Transformers
- Heating, ventilation and air conditioning (HVAC) coolers
- Electrical cabling
- Other electrical equipment. The control building would be used to contain the supervisory control and data acquisition (SCADA) facilities.

2.8.31 The compound structure will be 150 m by 100 m and will be internally divided in four spaces 75 m by 50 m, that will hold separately all the components. The indicative layout of the Substation and BESS is shown in **Figure 2.13**

Construction Phase

2.8.32 Construction of the Proposed Development is anticipated to take approximately 24 months from mobilisation to completion.

2.8.33 An indicative construction programme is set out below. Many of these construction activities would be carried out concurrently, although predominantly in the order set out in **Table 2.2**. A more detailed construction plan would be prepared prior to construction.

Table 2.2: Indicative Construction Programme

Activity	Month																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Site Establishment																								
Forestry Felling and Timber Export																								
Construction of New Access Tracks and Crane Hardstandings																								
Turbine Foundation Construction																								
Substation, Energy Storage and Electrical Works																								
Cable Trenching and Installation																								
Crane Delivery																								
Turbine Delivery, Erection and Commissioning																								
Site Re-Instatement																								

Construction Workforce

2.8.34 A detailed construction workforce schedule, i.e., employee numbers throughout the construction programme, and likely shift patterns, would not be known until the contract for building the Proposed Development has been awarded; however, the maximum number of staff likely to be onsite at any one time would be 50.

Construction Compounds

2.8.35 During the construction period, a construction compound would be required that would include a laydown area for wind turbine components, and dimensions would be approximately 30 m x 50 m. The typical construction compound is shown on **Figure 2.14**.

2.8.36 The main construction compound would include temporary cabins, to be used for the site offices, the monitoring of incoming vehicles and welfare facilities for site staff including toilets; parking for construction staff visitors and construction vehicles; secure storage for tools and small parts; a receiving area for incoming vehicles; and temporary security fencing around the compound.

2.8.37 The compound would be used as a storage area for the various components, fuels and materials required for construction. Typically, the major structural components of the turbines would be delivered directly to the turbine hardstandings. Temporary lay-down areas, forming part of the crane hardstandings, would be provided for parking and unloading vehicles, including Abnormal Indivisible Load (AIL).

Construction Traffic

2.8.38 The largest volume of traffic is anticipated during the construction phase of the Proposed Development, when vehicles are likely to be travelling from major centres and ports to deliver materials to the Site. The origins of materials and goods are expected to be from the Highlands with traffic using major roads and avoiding residential areas where possible. Further detail is provided in **Chapter 10: Traffic and Transportation** and the proposed AIL route is shown in **Figure 10.2**.

Construction Hours

2.8.39 It is anticipated that the main construction hours for the Proposed Development would be between 07:00 and 19:00 hours Mondays to Fridays, and 07:00 to 13:00 hours on Saturdays, unless otherwise agreed with THC. Certain activities, such as electrical works in the substation, or turbine erection in the event of delays due to high winds, may require to be undertaken outside of these hours.

2.8.40 Construction hours generally also apply to the delivery of materials to the Proposed Development; however, abnormal loads may be delivered outwith these hours, when the road network is at its quietest, to reduce traffic disturbance. Delivery of the nacelles, towers and blades to the Site would require the use of abnormal sized and slow-moving trucks. These trucks would require a police escort and the timing of these deliveries may be dictated by the police. More details can be found in **Chapter 10: Traffic and Transportation** and in **Technical Appendix 10.1 Abnormal Load Route Assessment.**

Operational Phase

Turbine Monitoring and Control

2.8.41 All turbines are controlled by a Supervisory Control and Data Acquisition (SCADA) system, which would gather data from all the turbines and provide the facility to control them from a remote location. The SCADA system would gather data from all the turbines via communications cables connecting to each turbine (the cables being buried in the electrical cable trenches).

2.8.42 In the case of any fault, including over-speed of the blades, overpower production, or loss of grid connection, the turbines shut down automatically through integrated braking mechanisms. They are also fitted with vibration sensors so that, if, in the unlikely event a blade was damaged, the turbines would again be automatically shut down.

Meteorological Effects

2.8.43 Turbines, like any tall structure, can be susceptible to lightning strike and appropriate measures are included in the turbine design to conduct lightning strike down to earth and minimise the risk of damage to the structure. In the case of a lightning strike on a turbine or blade, the turbine would be automatically shut down.

2.8.44 In cold weather, ice can build up on blade surfaces when operating. The turbines can continue to operate with a thin accumulation of snow or ice, but would be shut down automatically when there is a sufficient build up to cause aerodynamic or physical imbalance of the rotor assembly. Many models now include de-icing technology.

Turbine Servicing and Repair

2.8.45 Each manufacturer has specific maintenance requirements; however, it is anticipated that routine servicing of the turbines would typically be undertaken twice a year, with a full annual service and a minor service every intervening six months. In the first year, there would likely be an initial three-month service post-commissioning. Individual turbines would be switched off when servicing is ongoing. Maintenance and servicing would include activities such as changing of gearbox oils and individual turbine components.

2.8.46 Blade inspections would be likely to be required between every two and five years. Traditionally, these would be undertaken using a cherry picker or similar, but may also be performed with a 50-tonne crane and a man-basket, or using drones. Repairs to blades would use the same equipment. Light winds and warmer, dry conditions are required for any blade repairs, hence summer (June to August) would be the most appropriate period for this work.

2.8.47 Operational waste would generally be restricted to small volumes of waste generated from machinery repair and maintenance. Maintenance contractors would dispose of any such waste off-site, in line with Scottish waste management regulations and duty of care.

Track Maintenance

2.8.48 Once the Proposed Development is operational, the volume of traffic using the access tracks would be low. Correspondingly, the need for any track maintenance works is

anticipated to be low and infrequent. Any such works required would generally be undertaken during the drier conditions in the summer months.

Operational Workforce

2.8.49 A team of several staff including engineer fitters would supervise the operation of the wind turbine installation and would visit the Proposed Development to conduct routine maintenance. The frequency of these visits would depend on the turbine manufacturer.

Decommissioning Phase

2.8.50 It is proposed that the Proposed Development will have an operational life of 50 years, after which it would be decommissioned, and the turbines would be dismantled and removed.

2.8.51 During decommissioning the turbines would be dismantled and removed, along with any associated above ground electrical equipment. This decommissioning work would be the responsibility of the applicant, or any subsequent owners of the Proposed Development. Underground cables and access tracks would be left in place and foundations would be removed to a depth of 0.5 m below ground level to avoid environmental impacts from deeper removal. A decommissioning and restoration plan will be prepared and agreed with THC prior to decommissioning. The Proposed Development would be decommissioned and the site restored in accordance with the decommissioning and restoration plan.

2.9 References

Civil Aviation Authority (2016), CAP 764: Policy and Guidelines on Wind Turbines. Available at: https://publicapps.caa.co.uk/modalapplication.aspx?catid=1&pagetype=65&appid=11&mode=detail&id=5609, [accessed January 2023].

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