2 Design Evolution & Alternatives

2.1 Introduction

2.1.1 This chapter provides a description of the site selection process and design strategies that were adopted in arriving at the final layout of the proposed development, as described in **Chapter 3: Proposed Development Description** of this Environmental Impact Assessment (EIA) Report. The final layout of the proposed development is shown in **Figure 1.3**.

2.1.2 It describes the site selection process, outlines the key constraints, reviews the considered alternatives and details the design evolution adopted that allowed the applicant to arrive at the final layout of the proposed development.

2.1.3 This chapter draws on issues considered in more detail in the relevant technical chapters (Chapters 6 to 14). However, it does not pre-empt the conclusions of the later chapters. Instead, it explains how potential environmental effects which have emerged early in the EIA and through the studies by the EIA team have informed the layout design of the proposed development.

2.2 Current Land Use and Site Context

2.2.1 The site covers an area of approximately 1,290ha and includes hills locally known as Hogs Law, Hunt Law, Peat Law and Riddel Law.

2.2.2 It is currently used predominately for hunting sport, including grouse shooting, and sheep & cattle grazing. There is extensive evidence of land management practices associated with grouse shooting, including regular heather burning, planted shelterbelts used for the rearing of game, and other evidence of shooting activity.

2.2.3 There are a number of wind farms within 45km of the proposed development (see **Figure 6.8**). Operational and consented wind farms include Fallago Rig, Dun Law I & II, Pogbie I & II, Keith Hill, Toddleburn, Longpark & Crystal Rig I, II & III Wind Farms all within 15km of the site.

2.3 Policy Considerations

National Policy

2.3.1 National Planning Framework 4 (NPF4) was adopted by the Scottish Government on 13 February 2023 and sets out the overarching spatial strategy for Scotland to 2045. The foundations for the spatial strategy as a whole are the global climate emergency and the nature crisis. NPF4 supports a large and rapid increase in electricity generation from renewable sources to meet Scotland's net zero emissions targets. It identifies that onshore renewable energy development proposals will be supported in principle, except for onshore wind farm developments in National Parks and National Scenic Areas.

2.3.2 As detailed in **Chapter 4: Climate Change, Energy & Planning Policy**, NPF4 identifies that there are significant opportunities to capitalise on the natural assets of the South Area (which includes the proposed site) to significantly reduce greenhouse gas emissions through increased renewable energy generation, as outlined in NPF4 National Development Statements of Need, Section 3 Strategic Renewable Electricity Generation and Transmission Infrastructure. In addition to tackling climate change, NPF4 identifies that such development also has the potential to bring opportunities to strengthen local communities, build community wealth and secure long-term sustainability in the region.

2.3.3 Regulation 5(2)(d) of the EIA Regulations 2017 requires that an EIA Report should include: *"a description of the reasonable alternatives studied by the developer, which are relevant to the development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment."*.

2.3.4 Alternative sites have not been considered in the case of the proposed development and so the matter is not considered further in the EIA Report. The rationale for the selection of the site is set out in this chapter.

2.3.5 The main alternatives including design, wind turbine specification, location, size and scale have been considered for the site. This chapter explores these options and explains how the final layout of the proposed development has evolved.

Local Policy

2.3.6 In addition to NPF 4, the Development Plan applicable to the proposed development at the time of the EIA comprises:

- Scottish Borders Local Development Plan (LDP) (2016); and
- Relevant Supplementary Guidance, including:
  - Renewable Energy Supplementary Guidance (July 2018);
  - Local Biodiversity Action Plan (September 2018);
  - Wind Energy Landscape Capacity and Cumulative Impact (July 2013);
  - Local Landscape Designations (August 2012);
  - Landscape and development (March 2008);
  - Biodiversity (December 2005); and
  - Visibility mapping for windfarm development (October 2003).

2.3.7 The LDP was adopted on 12 May 2016 and sets out the Scottish Borders' policies on development and land use within the region. The LDP is focussed around a number of 'Key Outcomes' which are specifically identified to assist in meeting the associated challenges in the region.

2.3.8 Key Outcome 10 seeks to support the *"development of the area's full potential for electricity and heat from renewables sources, in line with national climate change targets, giving due regard to relevant environmental, community and cumulative impact considerations"* (page 14).

2.3.9 Policy ED9, 'Renewable Energy Development' also seeks to *"support proposals for both large scale and community scale renewable energy development including commercial wind farms…where they can be accommodated without unacceptable significant adverse impacts or effects, giving due regard to relevant environmental, community and cumulative impact considerations"*.

2.3.10 Policy ED9 specifically refers to the associated Scottish Planning Policy (SPP) Spatial Framework for onshore wind developments which is now replaced by NPF 4. There is also a list of environmental and land use effects criteria within the policy which will be used to consider wind energy proposals.

2.3.11 Policy ED9 is supported by a spatial framework for Renewable Energy which is established in the Renewable Energy Supplementary Guidance (July 2018). The site is identified as an 'Area for potential windfarm development' in this guidance.

2.3.12 The site is also partly within an established Special Landscape Area (SLA) (Lammermuir Hills) and as such Policy EP5, 'Special Landscape Areas' will be a primary consideration. The policy states that, *"Proposals that have a significant adverse impact will only be permitted where they landscape impact is clearly outweighed by social or economic benefits of national or local importance"*.

Local Development Plan 2 (2020)

2.3.13 The Scottish Borders' proposed LDP ('LDP2') which sets out land use proposals and planning policies which are intended to guide development and inform planning decisions within the Scottish Borders over the next ten years was submitted to Scottish Ministers on 14 July 2022.

2.3.14 The site remains within the same SLA in LDP2, as established through the Local Landscape Designations Supplementary Planning Guidance. Proposed Plan EP5 Special Landscape Areas therefore remains applicable and largely reflects the extant Policy EP5.

2.3.15 The proposed Policy ED9 largely reflects the extant Policy ED9 on Renewable Energy Development and again refers to the Scottish Planning Policy spatial framework which is now superseded by NPF 4.

2.3.16 On 7 July 2023, the Scottish Government's Planning and Environmental Appeals Division provided a Report of Examination on LDP2 with recommendations on a number modifications to the proposed plan.

2.3.17 No modifications are recommended with respect to proposed Policy EP5.

2.3.18 With regard to the proposed Policy ED9, the Report of Examination highlights that NPF 4 encourages local development plans to *"realise their area's full potential for electricity and heat from renewable, low carbon and zero emission sources by identifying a range of opportunities for energy development"*.

2.3.19 The Report of Examination also recommends that the wording of the proposed Policy ED9 with the following:

"Development proposals for all forms of renewable, low-carbon and zero emissions technologies will be supported. These include:

i wind farms including repowering, extending, expanding and extending the life of existing wind farms;

ii enabling works, such as grid transmission and distribution infrastructure;

iii energy storage, such as battery storage and pumped storage hydro;

iv small scale renewable energy generation technology;

v *solar arrays; vi. proposals associated with negative emissions technologies and carbon capture; and*

vi *proposals including co-location of these technologies. Development proposals will be assessed in accordance with NPF4 Policy 11 paragraphs b) to f) and other relevant provisions of NPF 4".*

2.3.20 Following the adoption of LDP2, it is the Council's intention to adopt the existing Renewable Energy Supplementary Guidance (July 2018) as Supplementary Planning Guidance and as a result it will no longer have the status of the Development Plan. The Report of Examination recommends that this Guidance *"may be used to assist in the assessment of renewable energy proposals. However, as the national policy context within which these were prepared has now been superseded, some aspects of the guidance will no longer be applicable. These documents will be of less relevance on matters where there are inconsistencies with NPF4 and the adopted Local Development Plan."*

2.3.21 The principles of the EIA process require that site selection and design of the proposed development be iterative and constraint-led, to ensure that potential environmental impacts as a result of the proposed development are avoided or minimised, as far as reasonably possible. Schedule 4 (2) of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (the 'EIA Regulations'), requires the consideration of reasonable alternatives in terms of site location and characteristics of the proposed development. Regulation 40 (2)(c) of the EIA Regulations requires that an EIA Report should include (in respect of alternatives studied by an applicant): *"The main alternatives studied by the applicant and the main reasons for his choice taking into account the effects on the environment"*. Alternative layouts are discussed further in Section 2.6 and 2.7 below.

2.3.22 This EIA Report does not make any judgements regarding the acceptability of the proposed development. A separate **Planning Statement** is provided which presents an appraisal of the proposed development with reference to the energy and planning policy framework and relevant material planning considerations.

2.4 Site Selection Considerations

2.4.1 The applicant maintains a sophisticated Geographic Information System (GIS) model for site selection which seeks to mirror planning, environmental, technical and commercial constraints. The GIS model is updated regularly when new data becomes available or when other factors change. Where available and appropriate, the GIS model incorporates published advice from statutory consultees. The applicants use of the GIS model enables objective and consistent treatment of the whole country to assist with site selection.

2.4.2 The GIS model is based upon a combination of generalised and graded suitability layers covering environmental, economic and technical aspects, known as 'key layers'. All key layers are assessed using a 0% – 100% suitability scale, represented by a 0 – 1 score, where 0 represents unsuitable and 1 represents 100% suitability.

2.4.3 The key layers included in the GIS model are as follows:

- wind speed;
- proximity to housing;
- natural and built heritage constraints; and
- slope constraint.

2.4.4 In addition, for each site, a visual sweep of the following 'informative layers' is carried out:

- national and local planning policy / development plans / spatial frameworks (as discussed above in Section 2.3);
- MOD tactical training areas;
- electromagnetic links and utilities;
- proximity to other wind farm sites (pre-planning, consented and operational); and
- other information gleaned from maps or knowledge of the area such as masts, undesignated parks, tourist attractions, etc).

2.4.5 These informative layers are included in the GIS model for information, but not scored and combined into the results.

2.4.6 The applicant undertook an analysis of its GIS model and after having scored with medium to excellent preferability on all inputs, the combination of the scored layers results in a good score for the site.

2.4.7 Warmer colours from brown, orange, yellow through to green represent suitability for wind farm development whereas areas of no colour are less suitable. **Figure 2.1** shows that the site scores a maximum suitability score of 100%< and is therefore considered to be capable of accommodating a wind farm development.

2.5 Key Issues and Constraints

2.5.1 Once the site was identified, key issues and constraints for consideration in the design process were established through a combination of desk-based research, extensive field survey and consultation (through the EIA scoping process). The design process considered the following key issues and constraints:

- landscape designations and visual amenity;
- archaeological and cultural heritage assets;
- sensitive fauna;
- sensitive habitats;
- watercourses, private water supplies and sensitive surface water features;
- topography and ground conditions;
- public road accessibility;
- recreational and tourist routes;
- proximity of residential properties;
- aviation and defence constraints; and
- presence of utilities.

2.5.2 Information in respect of the survey work to identify various key issues and constraints and how they have contributed to the layout design has been investigated in greater detail in the technical chapters of this EIA Report (Chapters 6 to 14).

2.5.3 The key issues and constraints gleamed from the assessments within the technical chapters has allowed for the careful placement of the proposed development within the site. This allowed the applicant to facilitate effective mitigation, with potentially significant effects avoided or minimised as far as reasonably practicable through the design process. A summary of the potential effects addressed through the design process and the issues remaining following the selection of the final design is provided in **Table 2.1**.

Table 2.1 – Summary of Mitigation by Design.

Issue	Environmental Constraint / Potential Effect	Mitigation by Design	Issues Remaining
Landscape and Visual	The following key landscape and visual sensitivities were identified in the vicinity of the site: • potential effects on local landscape character and regional and local landscape designations including Lammermuir Hills SLA; • potential effects on visual receptor groups including local roads, residents and core paths between the A68 and A697, and on Lauder, Oxton, local core paths and hills. • potential visibility from nearby dwellings, settlements and transport routes as noted above; • changes in the experience of recreational users on the long distance and local walking paths including the Southern Upland Way near Lauder; • potential effects on the night time environment arising from the lighting of wind turbines. • potential cumulative effects in combination with Ditcher Law, Fallago Rig and Dunside Wind Farms on the Lammermuir Hills SLA. • potential effects on the night time environment in combination with Ditcher Law, Fallago Rig and Dunside Wind Farms on the Lammermuir Hills SLA.	The final layout of the proposed development has adopted the following design measures: • the proposed development has been designed to be read as a balanced, evenly spaced scheme that relates positively to the context of the nearby operational wind farms. The scale of the proposed wind turbines has been carefully considered such that they relate well with the adjacent Fallago Wind Farm from key views and so fits in with the existing pattern of consented and proposed wind energy development in the local area; • wind turbines set back over 1,190m from the closest third party residential properties; • agreement of a reduced aviation lighting scheme with the CAA, which removes the requirement for tower lighting, and requires only T1, T3, T6, T8, T11, T13, T15, T17 and T19 to be lit with medium intensity 2000 candela steady red light (with a second back up light). The 2000 candela lights can be dimmed to 10% of peak intensity when the lowest visibility as measured at suitable points around the wind farm by visibility measuring devices exceeds 5km. • Throughout the design evolution of the proposed development, a key driver has been the consideration of potential landscape and visual effects on receptors including how the proposed development would relate to the existing landscape character as well as existing wind farms in the landscape. • Care has been taken to evaluate the scale and number of proposed wind turbines cumulatively with existing wind farms in the area, in particular with the operational site of Fallago Wind Farm directly to the north-east of the site. The landscape and visual effects potentially caused by the proposed development have been considered extensively from key receptors during the layout design of the proposed development.	The landscape and visual effects of the proposed development are addressed further in **Chapter 6: Landscape and Visual Impact Assessment** and **Technical Appendix 14.1**.
Archaeology and Cultural Heritage	Within the site there are two designated heritage assets; • Glenburnie Fort (SM4473); and • Longcroft Homestead (SM4480).	The proposed development has been designed to be located at least 500m from the assets.	The archaeological and cultural heritage effects of the proposed development are addressed further in **Chapter 7: Cultural Heritage & Archaeology.**
	The following key archaeological and cultural heritage sensitivities were identified in the vicinity of the site: • potential direct effects on cultural heritage assets within the site. • potential effects on the settings of designated heritage assets in the wider landscape. • cumulative effects on the settings of designated heritage assets in the wider landscape.	Non-designated heritage assets were identified within the site, which mainly relate to agricultural settlement and movement during the medieval period. These features have been avoided, apart from the enhancement of the access track to SLR16 and SLR18.This was done in conjunction of a 0.5km buffer to the Scheduled Monuments within the site.	
Ecology	The following key ecological sensitivities were identified in the vicinity of the site:	The proposed development has been designed to reduce the potential for ecological effects by avoiding more sensitive ecological interest features including:	The ecological effects of the proposed development are addressed further in **Chapter 8: Terrestrial Ecology.**

Issue	Environmental Constraint / Potential Effect	Mitigation by Design	Issues Remaining
	• potential effects on sensitive habitats through habitat loss, fragmentation and degradation, including peat forming habitats. • potential effects on protected species e.g. mammals, fish, etc.; • cumulative effects as arising from the addition of the proposed development in combination with other relevant projects; and • potential effects on statutory sites within 5km designated for ecological interests	• avoidance of areas of deeper peat - this has reduced the habitat loss of more sensitive higher quality habitats such as blanket bog; • avoidance of watercourses – these have been buffered by 50m, apart from locations where access tracks unavoidably need to cross watercourses. • avoidance of bat preferred habitat features adopting a buffer of 150m between wind turbine blade tips and the nearest woodland edge, as set out in current NatureScot guidance (NatureScot et al. 2021), and which was also adopted as the buffer to woodland for wind sector wake management; and • avoidance of Annex I and Priority habitats as far as practicable, or through implementation of a hierarchy of avoidance where not possible (i.e. locating in degraded blanket bog instead of blanket bog).	In addition, an outline Biodiversity Enhancement and Restoration Plan is available in **Technical Appendix 8.6**.
Ornithology	The following key ornithological sensitivities were identified in the vicinity of the site: • short-term reduction in breeding or wintering bird populations due to construction disturbance (affecting breeding or foraging behaviour and potentially resulting in a reduction in productivity or survival); • long-term reduction in breeding or wintering bird populations due to the loss/fragmentation of habitat critical for nesting or foraging; • long-term reduction in breeding or wintering bird populations due to collision mortality; • cumulative effects with other projects or activities that are constructed during the same period, and/or with projects or activities which pose either a potential collision risk or loss of habitat by displacement; and • potential effects on statutory sites within 20 km designated for ornithological interests.	The proposed development has been designed to avoided more sensitive ornithological habitats. Neither cumulative disturbance nor cumulative collision risk would represent an adverse effect on the integrity of the SPAs assessed. No significant ornithological effects are expected as a result of the proposed development either during construction or operation. Nonetheless, best practice mitigation during construction would be followed through the appointment of an ECoW and the production of a CEMP, a Breeding Bird Protection Plan and a Habitat Management Plan.	The ornithological effects of the proposed development are addressed further in **Chapter 9: Ornithology**. In addition, an outline Breeding Bird Protection Plan and outline Biodiversity Enhancement and Restoration Plans are available in **Technical Appendix 9.6** and **Technical Appendix 8.6** respectively.
Peat and Soils	Potential impacts of excavated peaty soils. Potential impacts of sliding of peatlands. Potential effects on peatland habitats through habitat loss, fragmentation and degradation.	The proposed development has been designed to avoided areas of deeper peat reducing the habitat loss of more sensitive higher quality habitats such as blanket bog wherever possible. The proposed development has been designed to avoid any areas of ground which may be subject to peat slide risk where possible. The ground condition factors that were considered in the design of the proposed development were: • identification of peat depths in excess of 0.0m – to minimise incursion, protect from physical damage, minimise excavation and transportation of peat, reduce potential for peat instability and minimise potential soil carbon loss; • identification of slope angles greater than 4˚- to minimise soil loss and potential instability; and • avoidance of areas where initial peat stability concern was identified where possible – to avoid areas with possible instability issues and associated indirect effects on surface water.	The potential effects on peat and soils due to the proposed development are addressed further in **Chapter 10: Hydrology, Hydrogeology & Geology** and **Technical Appendix 10.2: Peat Landslide Hazard and Risk Assessment**.

Issue	Environmental Constraint / Potential Effect	Mitigation by Design	Issues Remaining
		Proposals for peatland restoration have been included in the outline Biodiversity Enhancement and Restoration Plan, seeking to restore areas of degraded peatland habitats.	
Hydrology	The following key hydrological sensitivities were identified in the vicinity of the site: • potential effects on designated sites due to potential changes in surface and/or groundwater quality and quantity; • potential effects on the catchments due to changes in surface and/or groundwater quality and quantity; • potential localised increase in flood risk due to watercourse crossings; • potential effects on GWDTE through changes to site hydrogeology; • potential effects on Public or Private Water Supply (PWS) abstractions due to potential changes in surface and/or groundwater quality and quantity; and • potential for peat slide risk.	The proposed development has been designed to reduce the potential for hydrological effects by avoiding more sensitive ecological interest features including: • avoidance of watercourses – these have been buffered by 50m, apart from locations where access tracks unavoidably need to cross watercourses; • minimising the number of watercourse crossings through the layout design process, with the locations of watercourse crossings selected to avoid damage; • avoidance of private water supply catchments – these have been buffered by at least 1,000m to the nearest wind turbine locations. • avoidance of any high dependency GWDTEs identified on the site - these have been buffered by at least 250m to the nearest wind turbine locations. The proposed development incorporates good practice drainage design during construction and operation adopting a sustainable drainage system (SuDS) approach to control the rate, volume and quality of runoff from the proposed development.	The hydrology and hydrogeology effects of the proposed development are addressed further in **Chapter 10: Hydrology, Hydrogeology & Geology.** In addition, an outline Pollution Prevention Plan is available in **Technical Appendix 3.3**.
Topography	The following key topographical sensitivities were identified in the vicinity of the site: • potential for peat slide risk; • potential for deep cut / fill slopes around infrastructure; and • potential for safety risks to personnel during construction and operation of the proposed development.	The proposed development has been designed to reduce the potential for topographical effects by minimising: • areas of the site where the topography is greater than 12% slope gradient for wind turbine and adjacent crane hardstand positioning; • positioning the crane hardstand downslope of the proposed wind turbine location where other site constraints allow it; • positioning the access track, adjacent to the crane hardstand at wind turbine locations, downhill to the crane hardstand when aligning parallel to the contours where other site constraints allow it; • aligning access tracks perpendicularly to slope gradients greater than 14% where other site constraints allow it; • areas where slope stability was identified as an area of high peat slide risk have been avoided at all turbine and infrastructure locations.	**Technical Appendix 10.2: Peat Landslide Hazard and Risk Assessment** undertakes a thorough review of risk at each of the infrastructure locations and provides additional mitigation where required.
Traffic and Transport	The following key transport sensitivities were identified in the vicinity of the site: • severance; • driver delay; • pedestrian delay and amenity; • fear and intimidation; and • accidents and safety.	The proposed development has been designed to reduce the potential for transport effects by avoiding positioning wind turbines within the public roads buffer of 242m (tip height + 10%).	The traffic and transport effects of the proposed development are addressed further in **Chapter 11: Traffic & Transport.** It is proposed that a Construction Traffic Management Plan (CTMP), AIL Transport Management Plan are prepared post-consent to further mitigate any effects of the proposed development.
	Within the site there are four public paths: • Core Path – 16 • Permissive Paths:	The proposed development has been designed to reduce the potential for effects by avoiding positioning wind turbines within the 242m (tip height + 10%) of a public path.	Further information on the outdoor access management across the site is provided in the outline Outdoor Access Management Plan in **Technical Appendix 3.4**.

Issue	Environmental Constraint / Potential Effect	Mitigation by Design	Issues Remaining
	○ OXCH/LMC269/0007/1 and OXCH/FGO/1 (both the same path); ○ OXCH/FGO/2; and ○ OXCH/FGO/3.		
Noise	Potential effects at nearby properties due to operational and construction noise with potential for cumulative impact.	The proposed development has been designed to reduce the potential for noise effects by avoiding locating wind turbines within 1,190m of residential properties.	The noise effects of the proposed development are addressed further in **Chapter 12: Acoustic Assessment**.
Shadow Flicker	Potential effects of shadow flicker on residential receptors.	The proposed development includes a shadow flicker assessment to assess the impact. Should it be required, mitigation can be provided, including shutting down individual wind turbines during periods when shadow flicker could theoretically occur.	The shadow flicker effects of the proposed development are addressed further in **Chapter 14: Aviation, Radar & Other Issues.**
Utilities	Potential effects on existing utilities within the site.	The proposed development has been designed taking into consideration the location of the following existing utilities: • SPEN 400kV OHL – An overhead line runs north of the site. A buffer of 510m has been applied for wind turbines. • Northumberland Estates VHF Radio Mast – A Northumberland Estates owned VHF Mast is located to the eastern edge of the site. A buffer of 242m (tip height + 10%) has been applied for wind turbines.	See **Figure 2.3** for further details.

2.6 Design Principles and Alternatives

2.6.1 The principles of the EIA process require that site selection and layout design be iterative and constraint-led, to ensure that potential environmental impacts as a result of the proposed development are avoided or minimised, as far as reasonably possible.

2.6.2 Schedule 4 (2) of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (the 'EIA Regulations'), requires the consideration of reasonable alternatives in terms of site location and characteristics of the proposed development. Regulation 40 (2)(c) of the EIA Regulations requires that an EIA report should include (in respect of alternatives studied by an applicant): *"The main alternatives studied by the applicant and the main reasons for his choice taking into account the effects on the environment"*.

2.6.3 This section will review the principles of the layout design and alternatives options for the proposed development.

Design Principles

2.6.4 As part of the iterative approach adopted by the applicant, a number of design principles have been incorporated into the proposed development as standard practice, including the following:

- consideration to the underlying landscape and its scale;
- consideration to operational, consented and proposed wind turbines neighbouring the site;
- consideration to the size and scale of the proposed development appropriate to the location and proximity to residential properties;
- sensitive siting of the proposed infrastructure incorporating appropriate buffer distances from environmental and archaeological receptors to avoid or reduce effects;
- maximising the re-use of existing tracks as much as possible to access proposed wind turbine locations;
- optimising the alignment of new access tracks and hardstands taking due consideration to the topography of the site, to minimise cut and fill, minimise the impact on sensitive peatland habitats and reduce landscape and visual effects;
- adoption of floating access tracks to minimise disturbance of peat where appropriate;
- minimising watercourse crossings and encroachment on watercourse buffers;
- consideration to inclusion of borrow pit search areas to minimise the volume of the stone required to be imported to the site;
- using the latest wind turbine technology, consisting of more efficient and larger turbines where these can be reasonably accommodated within the landscape, as supported by the Onshore Wind Policy Statement (OWPS); and
- maximising the potential energy yield of the site through the employment of co-located technology in optimal locations (wind and battery storage).

Alternative Sites

2.6.5 The applicant uses a range of criteria to select sites for the development of renewable energy projects. As part of the growth plans for the development of renewable energy projects, the applicant is continually assessing potential sites. The pipeline of potential sites is commercially sensitive and are not considered to be alternative sites to the proposed development. Alternative sites are therefore not considered further in the EIA Report.

Do Nothing

2.6.6 The "do nothing" scenario is a hypothetical alternative conventionally considered in the EIA Report as a basis for comparing the development proposal under consideration. This scenario is considered to represent the current baseline situation as described in the individual chapters of this EIA Report.

2.6.7 In the absence of the proposed development, it is anticipated that the site would continue to be managed as a combination of grazing livestock and commercial forestry. These land uses would continue on the site whether or not the proposed development proceeds.

Infrastructure & Technologies

2.6.8 Onshore wind continues to be the lowest cost of new renewable energy generation and the site has been predominantly selected for its potential to generate electricity from wind turbines.

2.6.9 Advances in wind turbine technology mean that larger, more efficient wind turbines are now being deployed and it is recognised that wind turbines will continue to increase in tip height and rotor diameter in order to maximise the generation of electricity. To ensure optimal capture of wind energy and associated generation of electricity, spacing between wind turbines increases with wind turbine size usually leading to fewer, more productive wind turbines across any given site.

2.6.10 Larger wind turbines are needed if onshore wind development is to continue making a contribution to both the UK and Scottish Government's renewable energy targets, particularly the recent announcement commitment to net zero CO2 emissions by 2045 (Scottish Government, 2019).

2.6.11 The necessity for larger wind turbines is also recognised in paragraph 23 of the Scottish Government Onshore Wind Policy Statement (OWPS, 2017), which states that the Scottish Government "*acknowledge that onshore wind technology and equipment manufacturers in the market are moving towards larger and more powerful (i.e. higher capacity) turbines and that these by necessity will mean taller towers and blade tip heights*". Paragraph 25 of the OWPS continues that the Scottish Government "*fully supports the delivery of large wind turbines in landscapes judged to be capable of accommodating them with significant adverse impacts.*"

2.6.12 The newer OWPS (2022) states that "*Meeting our climate targets will require a rapid transformation across all sectors of our economy and society. This means ensuring the right development happens in the right place. Meeting the ambition of a minimum installed capacity of 20 GW of onshore wind in Scotland by 2030 will require taller and more efficient turbines. This will change the landscape.*"

2.6.13 The use of larger but fewer wind turbines across any given site allows for greater efficiencies with respect to the civil infrastructure required per wind turbine and hence per megawatt produced. A site with large wind turbines requires fewer wind turbine foundations, crane hardstands and lengths of access track in comparison to the same site that adopted a greater number of smaller wind turbines.

2.6.14 Furthermore, the supply of smaller wind turbines across Europe is already reducing, due to lack of demand. Manufacturers are recognising the world market is shifting to larger machines with development work focussing on larger wind turbines to maximise the generation of electricity. The onshore wind industry has experienced a reduction in supply of smaller wind turbines due to lack of demand from mainland Europe, where the tendency is to install wind turbines with tip heights of 180m – 250m to blade tip. Therefore, it is highly unlikely that a range of smaller wind turbines (e.g. 150m to blade tip) would be available at competitive prices by the time the proposed development is ready to be constructed, should it be consented.

2.6.15 For these reasons, the final selection of the wind turbine tip height of 220m was considered to represent the best balance of tall wind turbines and design in the landscape. These considerations and the final selection of wind turbine height are described in Section 2.7 of this chapter.

2.6.16 There is a national requirement to balance the peaks and troughs associated with electricity supply and demand to avoid strains on transmission and distribution networks and to keep the electricity system stable. A battery energy storage system (BESS) is therefore proposed as part of the proposed development to support the flexible operation of the national grid and decarbonisation of electricity supply.

2.6.17 The BESS would store electrical energy through the use of batteries, contained alongside inverters (to convert the direct current (DC) from the batteries to alternating current (AC), suitable for exporting to the grid), within a self-contained building adjacent to the substation compound to allow easy connection to the grid and minimise energy losses.

2.7 Design Evolution

2.7.1 With consideration to the key issues and constraints, up-to-date wind turbine technology and the design principles set out above, the final layout of the proposed development was the result of several iterations as outlined below:

- the scoping stage;
- the design chill stage; and
- the design freeze stage.

Scoping Stage

2.7.2 The 'scoping layout' for the proposed development was included in the Scoping Report as a useful focus for discussions with consultees and interested parties. This layout comprised 24 wind turbines of up to 220m to blade tip. This was based largely on future wind turbine availability, technical acceptability, and operational efficiencies (as outlined in Section 2.5). However, it was informed by preliminary landscape and visual analysis and high-level site constraints gathered from available desktop data sources.

2.7.3 The 'scoping layout' is presented on **Figure 2.2**.

Design Chill Stage

2.7.4 Following consideration of consultee responses, included in the Scoping Opinion, and the completion of initial on-site surveys, allowing the site constraints to be more accurately defined, an informed layout design was undertaken in order to produce a 'design chill layout'.

2.7.5 Consideration to the adjacent wind turbines in Fallago Rig Wind Farm, was incorporated into the wind turbine layout to ensure energetic losses caused by the neighbouring wind turbines was minimised. In doing so, the proposed development would, in turn, not overly compromise the operation of Fallago Rig Wind Farm.

2.7.6 SLR Consulting carried out an initial site visit to conduct an initial assessment of the cultural heritage assets across the site, including the designated heritage. This initial visit confirmed the setting and points of significance which contribute to the assets, as such a 500m buffer was applied to mitigate any direct impacts from the proposed development and to mitigate against impact on the intervisibility between assets both within the site and externally. As a result, two wind turbines (namely T3 and T5), located on the western edge of the valley above Whalplaw Burn were removed from the 'scoping layout'. In addition, to reduce impact on setting and the intervisibility between the forts (namely Addinston (SM362), Longcroft (SM372) and Glenburnie (SM4472)), the potential stacking was addressed by moving three wind turbines (namely T8, T18, T21 (renamed to T4, T9 &T10 in the 'design freeze layout') out of the background behind Glenburnie (SM4472). This was primarily to reduce distraction from the appreciation of Glenburnie (SM4472) from Longcroft (SM372) which contribute to Glenburnie's (SM4472) significance.

2.7.7 The applicant uses AddressBase dataset provided by Ordnance Survey to locate residential properties in and around the site. Following a review of aerial imagery, cross-referencing this dataset, a number of structures that had the potential to be inhabitated were identified for on-site verification. Confirmation of one additional residential property near the western edge of the site required the removal of two further wind turbines from the wind turbine layout.

2.7.8 Following the removal of five wind turbines due to cultural heritage and acoustic buffers (as mentioned in paragraphs 2.7.6 & 2.7.7), the applicant's technical analysts optimised the wind turbine spacing prior to review by the applicant's civil engineers.

2.7.9 While wind turbine location is a key consideration, refinement of the wind turbine layout needs to take consideration of the locations of required infrastructure surrounding the wind turbines. As such, some wind turbine locations are dictated by environmental constraints pertaining not only to the wind turbine but also the adjacent crane hardstand and access track.

2.7.10 Following the completion of the initial on-site surveys, including the phase 1 peat depth survey, the applicant's civil engineers reviewed the wind turbine layout, taking due consideration of the required infrastructure surrounding wind turbines. After adopting the design principles set out in Section 3.6, changes to the wind turbine layout were proposed for further technical analysis, including avoiding the limited areas of deep peat, GWDTEs and other sensitive habitats found on the site.

2.7.11 LDA Design carried out a secondary landscape and visual analysis. This analysis took into account views from key viewpoints around the site. In particular, the visibility of wind turbines from the conservation area of Lauder was a key consideration, along with views from Oxton. The areas of focus were on any outlier wind turbines, along with any stacking.

2.7.12 The applicant has developed a sophisticated wind turbine layout optimisation tool. This tool essentially iteratively repositions wind turbines across the site, with due cognisance of the site constraints, with the aim to maximise capture of wind energy and associated generation of electricity.

2.7.13 Following the refinement of the wind turbine layout as outlined above, the applicant's technical analysts ran the layout optimisation tool to optimise the wind turbine layout.

2.7.14 Once the wind turbine layout was optimised, the applicant's civil engineers carry out a site visit to confirm suitability of the proposed wind turbine layout and ancillary civil infrastructure.

2.7.15 The 'design chill layout' is presented on **Figure 2.2** and consists of 19 wind turbines of up to 220m to blade tip,

Design Freeze Stage

2.7.16 Following a review and the applicant's internal approval of the 'design chill layout', secondary on-site surveys were carried out allowing the site constraints to be fully defined. This would enable the applicant to complete the layout design and produce a 'design freeze layout'.

2.7.17 With the phase 2 peat depth survey completed, it was identified that T9 was located in an area of peat greater than 0.5m. It was subsequently moved away into an area of less than 0.5m.

2.7.18 With due cognisance of the fully defined site constraints and the movement of T9 to avoid an area of deep peat, a second run of the layout optimisation tool was carried out. The applicant's technical analysts proposed minor movements to seven more wind turbines (namely wind turbines T1, T2, T4, T8, T10, T16 & T17) to optimise the energy yield and layout of the proposed development.

2.7.19 Furthermore, the location of the proposed substation and battery energy storage system was changed due to potential noise issues on nearby residential properties.

2.7.20 LDA Design carried out a tertiary landscape and visual analysis reviewing the key viewpoints around the site as previously assessed. Given the minimal changes between the 'design chill layout' and 'design freeze layout' no further changes were proposed with respect to landscape and visual effects.

2.7.21 The 'design freeze layout' is presented on **Figure 2.2** and in more detail on **Figure 1.3** consisting of 19 wind turbines of up to 220m to blade tip.

Micrositing

2.7.22 In order to address any localised environmental sensitivities, unexpected ground conditions or technical issues that are found during detailed intrusive site investigations and construction, it is proposed that 100m micrositing allowance around the wind turbine locations all other infrastructure is allowed. The technical assessments (presented in Chapters 6 to 14) have considered the potential for micrositing.

2.7.23 During construction, the need for any micrositing would be assessed and agreed with the on-site Environmental Clerk of Works (ECoW).

2.8 Summary

2.8.1 The proposed development was the result of extensive iterative design work, to sensitively locate the wind turbines and the infrastructure required to facilitate construction and operation of the wind turbines.

2.8.2 In summary, the final layout of the proposed development presented achieves the following:

- minimises impact on the underlying landscape and is largely in accordance with NPF4;
- visually accommodates operational, consented and proposed wind turbines neighbouring the site;
- minimises the proximity to and visibility from residential properties as well as the settlements surrounding the site as far as possible;
- sensitively locates infrastructure incorporating appropriate buffer distances from environmental and archaeological receptors to avoid or minimise direct effects;
- maximises the use of existing access tracks;
- optimises the alignment of new access tracks and hardstands to minimise cut and fill, minimise the impact on sensitive peatland habitats and reduce landscape and visual effects;
- minimises watercourse crossings and protects watercourses from the potential impacts of constructing the proposed development;
- Includes three borrow pit search areas to minimise the volume of the stone required to be imported to the site;
- adopts of the latest wind turbine technology;
- maximises the potential for electricity generation through the adoption of wind turbines and energy storage technologies; and
- can be constructed and operated safely.

2.8.3 The final layout of the proposed development overlain with the site constraints as described above has been presented in **Figure 2.3**. The potential effects of the resulting layout are addressed throughout Chapters 6 to 14 of the EIA Report.