2 SITE SELECTION AND DESIGN

2.1 Introduction

2.1.1 This Chapter of the Environmental Impact Assessment Report (EIA Report) contains a description of the land within the Site, consideration of alternatives, site selection process and the design evolution that led to the final layout of the Torrance Wind Farm Extension II (the Proposed Development). The Proposed Development is located approximately 600 metres (m) north of the centre of Harthill, North Lanarkshire and 1 km south of Blackridge, centred on National Grid Reference (NGR) 289988, 665071 (the Site).

2.1.2 The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017[1] (the EIA Regulations) state in Schedule 4, Paragraph 2 that an EIA Report must include:

2.1.3 "A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects."

2.1.4 This Chapter details the reasons for selecting the Site, as shown in **Figure 1.2**, and summarises the layout options that were considered by the Applicant during the evolution of the Proposed Development.

2.1.5 This Chapter of the EIA Report is supported by the following figures provided in Volume 2 - EIA Report Figures excluding Landscape and Visual Impact Assessment (LVIA):

- Figure 2.1 (a – d) - Site Design Evolution.

2.1.6 This Chapter is accompanied by the following Technical Appendix documents provided in Volume 4 – EIA Report Technical Appendices:

- A2.1 – Scoping Report (November 2020); and
- A2.2 – Scoping Opinion (December 2020).

2.2 Site Description

Overview

2.2.1 The Site is located on the edge of an area of distinctive upland moorland and more settled farmland which lies to the north of the M8 transport corridor, between Edinburgh and Glasgow. Five turbines have already been installed adjacent to the Site as part of the Torrance Farm Wind Park and its Extension. The land within the Site which contains the turbines, associated infrastructure and proposed recreational path covers an area of 106.2 hectares (ha).

[1] Scottish Government (2017) the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 [Online] Available at: http://www.legislation.gov.uk/ssi/2017/102/contents/made (Accessed 24/01/2023)

2.2.2 The Site is entirely within the North Lanarkshire Council (the Council) administrative area; however, the administrative boundary with West Lothian Council (WLC) is adjacent to the northern boundary of the Site.

2.2.3 The Proposed Development is situated in an area which is predominantly used for agricultural purposes, specifically livestock farming. The immediate locality of the Proposed Development is rural and commercial forestry, although there are a number of small towns within the local area including Blackridge and Harthill.

2.2.4 The land cover on the Site consists of improved and semi-improved grassland, with areas of coniferous plantation. There are stretches of degraded hedgerow, hedgerow trees and post and wire fences demarcating field boundaries. The lower topography to the south and southeast of the Site is dominated by coniferous woodland with smaller areas of neutral grassland to the south-east near Netherton Farm.

2.2.5 The Site is adjacent to the original Torrance Wind Park and Torrance Extension, and occupies undulating farmland and a commercial forestry area in the south, rising between approximately 175 to 200 m Above Ordnance Datum (AOD). The existing on-site farming and forestry operations will continue throughout the construction and operation of the Proposed Development.

2.2.6 In addition to wind farms, there are a number of telecommunications masts and pylons located within the landscape surrounding the Site. The land cover on site consists of improved and semi-improved grassland, with some areas of coniferous plantation. There are stretches of degraded hedgerow, hedgerow trees and post and wire fences demarcating field boundaries.

2.2.7 There are a number of wind farm developments both, existing and proposed, within the wider area surrounding the Site. Table 2.1 provides details of wind energy developments with turbines over 40 m in height that are in operation, consented, or at the planning stage within a 10 km radius of the Site at the time of preparing this application (May 2022).

Table 2.1: Wind Energy Developments within 25 km of the Site

Wind Farms	Status of Wind Farm	Number of Turbines	Height to blade tip of Turbines (m)	Direction of Cumulative Site from the Proposed Development
Torrance I	*Operational*	*3*	*120*	*East*
Torrance II	*Operational*	*2*	*125*	*East*
Southrigg 1	*Operational*	*1*	*125*	*East*
Wester Hasockrigg	*Operational*	*1*	*78*	*South West*
West Benhar Wind Farm	*Operational*	*8*	*150*	*South*
Drumduff Wind Farm	*Operational*	*3*	*120*	*North*
Burnhead Wind Farm	*Operational*	*13*	*127*	*North*
Nether Bracco Farm	*Operational*	*1*	*100*	*North West*
Black Law Wind Farm Extension Phase 1	*Operational*	*23*	*127*	*North*
Black Law Wind Farm Extension Phase 2	*Operational*	*11*	*117*	*North*
Tormywheel Wind Farm	*Operational*	*15*	*111*	*North*

Climpy Road	*Operational*	*1*	*102*	*North*
Greendykeside	*Operational*	*2*	*100*	*North West*
Easter Glentore Wind Turbine, The Shetland Centre	*Operational*	*1*	*102*	*North West*
Gardrum Farm	*Operational*	*1*	*86*	*North*
Gardrum Farm 2	*Operational*	*1*	*86*	*North*
Whiterigg Wind Turbine	*Operational*	*1*	*77*	*North*
Polmont Golf Club	*Operational*	*1*	*77*	*North*
Pates Hill Wind Farm	*Operational*	*7*	*107*	*South East*
Upper Haywood Forth	*Operational*	*1*	*67*	*North*
Black Law Wind Farm	*Operational*	*54*	*110*	*North*
Damhead Farm	*Operational*	*1*	*100*	*West*
Pearie Law Wind Farm	*Operational*	*6*	*125*	*South East*
Harburnhead Wind Farm	*Operational*	*22*	*125*	*South East*
Muirhall Wind Farm (Stallashaw Moss)	*Operational*	*6*	*125*	*South East*
Muirhall Wind Farm Extension	*Operational*	*2*	*145*	*South East*
Muirhall Wind Farm South	*Operational*	*3*	*146*	*South East*
Braidenhill Farm	*Operational*	*1*	*77*	*North West*
Bellstane Farm	*Operational*	*1*	*86*	*North West*
AG Barr Factory wind turbine	*Operational*	*1*	*70*	*North West*
Rosti Turbine, Strutherhill	*Operational*	*1*	*110*	*South West*
Lochhead Farm	*Operational*	*3*	*100*	*South West*
Lochhead Farm Extension	*Operational*	*2*	*100*	*South West*
Marshill Farm 1	*Operational*	*1*	*119*	*South West*
Marshill Farm 2 (aka Netherburn West)	*Operational*	*1*	*100*	*South West*
Whitehill Farm, Stonehouse	*Operational*	*1*	*77*	*South West*
Tanhill Farm 1	*Operational*	*1*	*77*	*South West*
Westtown Farm, Stonehouse	*Operational*	*1*	*77*	*South West*
Southfield Farm	*Operational*	*1*	*67*	*South West*
Auchnotroch Farm	*Operational*	*1*	*84*	*South West*
Lampits Farm	*Operational*	*2*	*64*	*South East*
Shotlinn Farm, Nr Chapelton	*Operational*	*1*	*77*	*South West*
Burnbrae Farm	*Operational*	*1*	*66*	*South West*
Haspielaw Farm	*Operational*	*1*	*78*	*South West*
Blantyre Muir Wind Farm	*Operational*	*3*	*111*	*South West*
Blantyre Muir Wind Farm Extension	*Operational*	*3*	*115*	*South West*
Kirkton Farm, Dunfermline	*Operational*	*1*	*100*	*North East*
Tulliallan Concrete Works	*Operational*	*1*	*74*	*North East*

Southrigg 2 (aka Rigg Wind Turbine)	*Consented*	*1*	*149*	*East*
Forrestfield Wind Farm	*Consented*	*4*	*125*	*West*
Drumelzie	*Consented*	*1*	*126*	*North*
Brownhill Farm	*Consented*	*2*	*149*	*South*
Easter Drumclair Wind Farm	*Consented*	*2*	*150*	*North*
Hartwood Wind Farm Resubmission	*Consented*	*7*	*132*	*South West*
Greengairs East Wind Farm	*Consented*	*8*	*150*	*North West*
Tormywheel Wind Farm Extension	*Consented*	*3*	*126*	*South East*
Heathland Wind Farm	*Consented*	*14*	*180*	*South East*
Longhill Burn Wind Farm	*Consented*	*8*	*200*	*South East*
Greengairs Wind Farm	*Consented*	*9*	*125*	*North West*
Albert Bartlett	*Consented*	*1*	*126*	*North West*
Watsonhead Farm	*Consented*	*2*	*150*	*South West*
Greenwall Farm	*Consented*	*1*	*55*	*South*
South Lanarkshire Council Roads Depot	*Consented*	*1*	*50*	*South West*
Kittymuir Farm	*Consented*	*2*	*77*	*South West*
Lampits Farm 2	*Consented*	*1*	*64*	*South East*
Low Blackwoodyards Farm	*Consented*	*1*	*67*	*South West*
Dewshill Wind Farm	*Application*	*3*	*150*	*West*
Marshill North Wind Turbine	*Application*	*1*	*180*	*South West*
Bughtknowes Farm	*Scoping*	*1*	*127*	*South East*

2.3 Site Policy Context

2.3.1 In 2017, the Scottish Government published the Onshore Wind Policy Statement (OWPS) (2017)[2] and Scottish Energy Strategy (SES) (2017)[3] which recognise that increased efficiency and power output in wind turbine technology, has resulted in increases in the size and scale of wind turbines (e.g., increased turbine blade length and resultant increases in overall tip heights). For example, Paragraph 23 of the OWPS states that *"we 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".*

2.3.2 Whilst the Ministerial Foreword of the OWPS (Page 3) and the SES (Page 43) also state that *"increasingly – the extension and replacement of existing sites, where acceptable, with new and larger turbines, based on an appropriate, case by case assessment of their effects and impacts"* as onshore wind continues to play an important role in meeting Scotland's energy generation and climate change goals.

2.3.3 In March 2021, the Scottish Government published Scotland's Energy Strategy Position Statement (2021 SES)[4] which builds on the support for onshore wind outlined in the 2017 SES. The 2021 SES notes that:

2.3.4 "The Scottish Government is committed to supporting the increase of onshore wind in the right places to help meet the target of Net Zero. In 2019, onshore wind investment in Scotland generated over £2 billion in turnover and directly supported approximately 2,900 full-time equivalent jobs across the country."

2.3.5 The 2021 SES also identifies the Scottish Government's key priorities for energy, which amongst others includes a refresh of the OWPS.

2.4 Environmental Designations in the Wider Locality

2.4.1 The Site is not covered by any environmental designations however, the following are considered within the EIA Report:

National Landscape Designations:

- The site is not subject to any statutory landscape designations and does not lie within or close to any nationally or regionally designated areas of landscape interest such as a National Park or National Scenic Areas.
- There are four country parks and three Garden and Designed Landscapes (GDL) within 15 km of the Site.

Heritage:

- Three Garden and Designed Landscape (GDL) areas within 15 km of the Site including Allanton, Harburn House, and Callendar Park;
- Between 5 and 15 km of the Site, there are[5]:
  - Two World Heritage Sites;
  - Two Registered Battlefields;

[2] Scottish Government (2017) Onshore Wind Policy Statement [Online] Available at: https://www.gov.scot/publications/onshore-wind-policy-statement-9781788515283/ (Accessed 24/01/2023)
[3] Scottish Government (2017) Scottish Energy Strategy [Online] Available at: https://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/ (Accessed 24/01/2023)
[4] Scottish Government (2021) Scotland's Energy Strategy Position Statement [Online] Available at: https://www.gov.scot/publications/scotlands-energy-strategy-position-statement/documents/ (Accessed 24/01/2023)
[5] As detailed in Technical Appendix 12.2 - Sieving Exercise, please note that some heritage assets have been scoped out of assessment in the EIA Report.

- 10 regionally designated Conservation Areas;
- 77 Scheduled Monuments; and
- 561 Listed Buildings (28 Category A, 282 Category B, and 251 Category C).

Ecology:

- Four ecological statutory designated sites within 5 km of the Site, including:
- Blawhorn Moss Special Area of Conservation (SAC), XX (NNR) and Site of Special Scientific Interest (SSSI) designated for active raised bog and degraded raised bog;
- Hassockrigg and North Shotts Mosses SSSI designated for raised bog;
- Taynish and Knapdale Woods SAC designated for clear-water lochs, march fritillary, otter and other;
- North Shotts Moss SAC designated for active raised bog and degraded raised bog; and
- Black Loch Moss SAC and SSSI designated for active raised bog.
- There are approximately 13 non-statutory sites within 1 km of the Site. These are made up of One Local Biodiversity Site (LBS) and eight Sites of Importance for Nature Conservation (SINCs) and four Ancient Woodland Inventory (AWI) sites.

Ornithology:

- Two ornithology statutory designated sites, two of international importance, within 20 km of the Site, including:
- Slamannan Plateau Special Protection Area (SPA) and SSSI designated for Non-breeding taiga bean goose; and
- Firth of Forth SPA, SSSI and Ramsar Site designated for non-breeding assemblage.

Hydrology:

- The Site lies within the sub catchment of How Burn which lies within the River Almond catchment. The watercourses within the Site primarily comprise artificial drainage ditches.
- Both How Burn and the River Almond are shown to be classified by SEPA as having an overall water quality of "Poor";
- A small area to the north of the Site is located in the sub catchment of Barbauchlaw Burn within the River Avon catchment. Barbauchlaw Burn is classified by SEPA as having an overall water quality classification of "Poor".
- No statutory hydrology designations that are hydrologically connected to the Proposed Development were found within 10 km of the Site.

2.4.2 There are no Public Rights of Way (PRoW) within the Site, although there are 16 Core paths and The National Cycle Route 75 located within 2 km of the Site.

2.5 Site Selection

2.5.1 The selection of an appropriate site which has the potential to support a commercial wind farm development is a complex and lengthy process. It involves examining and balancing a number of environmental, technical, planning and economic issues. Only when it has been determined that a site is not subject to major known environmental, technical, planning or economic constraints is the decision made to invest further resources in developing the proposal and conducting an EIA.

2.5.2 In accordance with the EIA Regulations, the design alternatives need to be studied with key reasoning, taking into account the potential environmental effects. The Site was selected as a suitable location for wind farm development by the Applicant as it met the following criteria:

- Suitable and proven high annual mean wind speed across the Site;
- Viable grid connection;
- Suitable and proven port of delivery and road access for the delivery of large components;
- Suitable road access;
- Sufficient distance from nearest residential properties to ensure compliance with appropriate noise limits;
- Limited peat on site;
- The Site does not support any international or national ecological or landscape designations; and
- Located adjacent to existing operational wind farms, where the Site would be often seen as an extension to the existing wind farms.

2.6 Site Design

Overview

2.6.1 The purpose of a wind farm development is to harness the power in the wind to generate electricity. The optimum design is therefore to locate wind farms in areas exposed to the highest windspeeds, with turbines located in the optimum position. However, this does not take into account the potential environmental effects of a wind farm. The design of a wind farm must therefore be a balance between achieving an acceptable level of environment effects and maximising energy yield. In addition to these factors, the technical limitations of constructing a wind farm must also be considered in the design stage.

2.6.2 The optimum layout of a wind farm is based on a range of technical criteria. A minimum distance must be maintained between wind turbines to reduce the effects of turbulence and associated increased turbine fatigue and reduction in energy yield. This separation distance is usually a function of rotor diameter and prevailing wind direction, with turbine manufacturers requiring turbines to be located typically between three and five times the rotor diameter apart. This distance determines the minimum achievable distance between turbines when designing a site. The following additional criteria must also be considered in the design of a wind farm:

- Wind speed;
- Prevailing wind direction;
- Existing infrastructure;
- Topography;
- Ground conditions;
- Local environmental issues; and
- Landscape and visual considerations.

2.6.3 One of the further key factors which is taken into account when designing adjacent to an operational wind farm is consideration of how the design ties in with the existing scheme. This includes elements such as the scale of the extension turbines, the increase in the visual extent of the wind farm as a result of the extension, and how the extension turbines interact with the existing turbines from a wind turbulence and energy yield perspective.

2.6.4 In addition to the turbines, the other elements of the Proposed Development which have been designed to minimise environmental effects include: the access tracks; crane hardstanding areas; Temporary Construction Compound (TCC);and the Substation Compound. The effects of these have been minimised through use of existing infrastructure where possible, careful design, siting, routing and construction methods.

The Design Strategy

2.6.5 The approach to the design of the Proposed Development has considered, wherever possible, to enhance the existing composition of the Proposed Development through an approach to design that includes:

- Minimising the number of watercourse crossings;
- Maintaining separation distances from the M8, surrounding B-roads, telecoms (where possible), and landowner boundaries.
- Optimising the layout with respect to wind resource and environmental constraints;
- Limiting the physical extent of the wind farm; and
- Avoiding areas of deep peat.

2.6.6 Constraints were identified through desk study, site survey and analysis including consideration of the responses received from consultees during the early stages of the EIA process, predominantly during Scoping. The key constraints which have been taken into account during the design process include:

- Presence of sensitive habitats and protected species;
- Presence of sensitive ornithological species;
- Presence of watercourses,
- Presence of cultural heritage features and the perceived interaction between these (e.g., sightlines);
- Proximity to noise sensitive receptors;
- Presence of peat;
- Ground conditions and topography; and
- Key recreational and tourist routes.

2.6.7 The principles of the design strategy were to maximise the number of turbines and wind energy capture, whilst minimising significant adverse environmental effects.

2.6.8 Embedded mitigation was used to minimise any predicted environmental effects, and where applicable to a specific technical assessment, such mitigation is detailed in the relevant chapter within this EIA Report.

2.6.9 The design strategy has been informed by a number of general and site-specific design objectives relating to the siting and design of the turbines in the first instance, whilst acknowledging that the feasibility and appropriateness of other ancillary infrastructure locations (including access tracks) should also be considered throughout the design process.

Site Specific Environmental Constraints and Design

Landscape and Visual Impact

2.6.10 NatureScot guidance Siting and Designing Wind Farms in the Landscape - Version 3a (2017)[6] notes that "design is a material consideration in the planning process and good siting and design helps to produce development which is appropriate for a landscape whilst delivering renewable energy".

2.6.11 In accordance with this guidance, the landscape and visual impact of the Proposed Development has been a key consideration from an early stage in the feasibility studies and design process.

2.6.12 The Landscape Character Area (LCA) in which the Site is located, is described as Plateau Moorlands which extends to the west and south, although it falls on the boundary with the West Lothian Plateau which is a modified landscape which gradually merges with the farmland of the River Almond valley.

2.6.13 As the land rises to the north to form the smooth plateau landform, the land becomes less agricultural, wilder, and more exposed in character. Predominant land cover changes from improved and semi-improved grassland used for grazing, to heather and grass moorland. The landscape also becomes very sparsely populated, with a handful of single dwellings.

2.6.14 This landscape is notable for its transitional character of contrasting remote, exposed upland and more settled farmland of the lowlands. The local landscape has been significantly modified over time through coal mining, railroads, a motorway, industrial units, and forestry plantation.

2.6.15 This LCA also contains the operational wind farms of Torrance Farm Wind Park and its Extension, Black Law and Black Law extension, and consented wind farms including West Benhar, Brownhill Farm and Greengairs wind farm. The existing wind farms are an influencing and defining characteristic within the landscape.

2.6.16 The landscape and visual effects are fully assessed within **Chapter 6 – LVIA**.

Ecology

2.6.17 Both desk-based studies and site visits were undertaken as part of the ecology baseline studies which were key to informing the final design of the Site. Desk-based studies determined the nearby ecological designations and identified historical information relating to the ecological resources within, and surrounding, the Site. Site surveys included the following:

- Phase 1 Habitat Survey;
- National Vegetation Classification (NVC) Survey;
- Great Crested Newt (GCN) Surveys
- Herptofauna Surveys (excluding GCN)
- Protected Mammal Surveys (excluding bats);
- Bat Survey;
- Remote Static Survey; and
- Fish Habitat Survey.

[6] NatureScot (2017) Siting and Designing Wind Farms in the Landscape - Version 3a [Online] Available at: https://www.nature.scot/siting-and-designing-wind-farms-landscape-version-3a (Accessed 24/01/2023)

2.6.18 The purpose of these surveys was to identify sensitive habitats and species within the Site that should be avoided and subsequently ensure the Proposed Development could be designed sensitively to the ecological receptors located within, and nearby, the Site.

2.6.19 The final layout was informed by the aforementioned surveys, which ensured that the Proposed Development avoided the most sensitive habitats.

2.6.20 The effects on ecological receptors are fully assessed within **Chapter 10 – Ecology**.

Ornithology

2.6.21 A series of ornithology surveys have been undertaken to establish the baseline of the Site and have been a key factor in the design process. Site based surveys have included the following:

- Flight Activity Surveys;
- Breeding Bird Surveys; and
- Breeding Raptor Surveys.

2.6.22 In addition to the field surveys, desk-based studies and consultations were undertaken which also informed the assessments.

2.6.23 The effects on ornithological receptors are fully assessed within **Chapter 11 – Ornithology**.

Cultural Heritage

2.6.24 There are two scheduled monuments within 5 km of the Site. Due to their proximity to the Proposed Development, these heritage assets are considered might be susceptible to receiving changes to their setting resulting in potential significant indirect effects from the Proposed Development. SM1222 Farmstead is located approximately 1.4 km southwest of Woodend Farm; and SM11223 Farmstead, 720 m northwest of Craigmarry.

2.6.25 There are no Gardens or Designed Landscapes (GDLs) within 10 km of the Site, but three within 15 km. The nearest is Allanton (Inventory number 12) which lies approximately 10.2 km to the southwest of the Site with negligible intervisibility with the Proposed Development.

2.6.26 There are several listed buildings within 5 km of the Site. The nearest is a category B Listed Building, 14553 Westcraigs Inn in Blackridge, located approximately 1 km north of the Site.

2.6.27 There are no world heritage sites, Inventoried battlefields, or Conservation Areas within 5 km of the Site.

2.6.28 The effects on heritage receptors are fully assessed within **Chapter 12 - Archaeology and Cultural Heritage.**

Noise Sensitive Receptors

2.6.29 The potential for noise effects to arise at residential properties located in the surrounding area of the Site was an important consideration in the design.

2.6.30 An assessment including noise modelling was undertaken in accordance with ETSU-R-97 and relevant Good Practice Guidance, with the methodology agreed with the Environmental Health Officer (EHO) of the Council.

2.6.31 The noise assessment concluded that the turbines were sited in locations that would ensure the Proposed Development would not generate noise emissions that would exceed ETSU-R-97 limits.

2.6.32 The effects on the noise environment are fully assessed within **Chapter 7 - Noise.**

Water Environment

2.6.33 The Proposed Development lies within the main river catchments of the How Burn and River Almond. The watercourses on Site largely consist of artificial drainage ditches which are present across the Site.

2.6.34 To the west of the Site, a natural, potentially modified watercourse flows south east through a grassland field. This watercourse is shown to be a small section of How Burn which flows under a bridge culvert before continuing south under the M8 and converging with How Burn. While the watercourse presents as natural, this stream appears to be fed by artificial drainage ditches.

2.6.35 The effects on the hydrology environment are fully assessed within **Chapter 14 – Hydrology and Hydrogeology**.

Geology and Peat

2.6.36 Published geological mapping of superficial soils indicates the majority of the Site to be underlain by Devensian Till with small areas consisting of Peat or being unrecorded. Peat is a partially decomposed mass of semi-carbonized vegetation which has grown under waterlogged, anaerobic conditions, usually in bogs or swamps.

2.6.37 Published bedrock geology mapping indicates the Site to be underlain by various rock types. The majority of the Site is comprised of Scottish Lower Coal Measures Foundation. Coal seams are common, and many exceed xxx m in thickness.

2.6.38 National Soils Map of Scotland mapping indicates the majority of the Site, can be characterised by the soils group 'Brown Soils' and 'Mineral Gleys'.

2.6.39 Further information on peat and other ground conditions of the Site is contained within **Chapter 13 - Geology and Peat.**

Socio-Economics, Land Use, Recreation and Tourism

2.6.40 A desk-based study of socio-economics, land use, recreation and tourism receptors was undertaken at an early stage to establish the socio-economic make-up of the local area and gain a full understanding of the recreation and tourism receptors within the wider area.

2.6.41 The desk-based study established that the wider area is host to a range of tourism and recreation receptors, based around the natural and built environment. These receptors were considered fully within the design process. Furthermore, core paths and local recreational routes were also considered.

2.6.42 The effects on the socio-economic, land use, recreation and tourism resources are fully assessed within **Chapter 15 - Socio-Economics, Land Use, Recreation and Tourism**. Additionally, **Chapter 6 - LVIA** also assesses the visual impact of the Proposed Development on key receptors which relate to tourism and recreational assets.

Site Specific Technical Constraints

Wind Resource

2.6.43 Wind resource can be affected by various site characteristics, such as the prevailing wind direction, and local topography. As a rule, the more elevated areas of Site have the greatest wind resource, and this must be balanced against the landscape and visual effects that may arise at higher elevations.

Turbine Spacing

2.6.44 The spacing of the turbines is a key consideration in wind farm layout design; turbines need to be arranged a minimum distance apart such that turbulence from a specific turbine does not unduly affect the operation of a turbine which is downwind. The spacing for turbines needs to be larger in the prevailing wind direction and will vary from site to site and between different turbine models. The spacing is directly proportional to the size of the wind turbine rotor, whereby the larger the rotor the larger the spacing between turbines, and the fewer turbines that may be accommodated within a specific area.

2.6.45 The spacing chosen for the Proposed Development has been selected based on modelling assumptions and is designed to maximise the energy yield from the Proposed Development and minimise effects upon the Torrance Wind Farm while keeping fatigue loads, caused by turbulence, within the turbine manufacturer's design tolerances.

Topography and Ground Conditions

2.6.46 The suitability of ground conditions was considered during the design of the Proposed Development, which principally considered areas of deep peat.

2.6.47 The presence of peat has been assessed and avoided where possible both from an environmental and technical perspective.

2.7 Site Access

2.7.1 Access to the Site will be taken either from the Harthill Service Station, off the M8, or from the B718 Westcraigs Road to the north of Harthill. The Applicant is currently in dialogue with the operators of the Harthill service station to explore whether the 'Abnormal Load Site Entrance' can also be utilised by general construction traffic (HGVs) during the peak months of the construction phase; this is not a confirmed option at the time of writing but is considered as part of the application should an agreement between the service station and Applicant be reached.

2.7.2 Further details on access to the Site are assessed in Chapter 9: Access, Traffic and Transportation.

2.8 Turbine Layout Design Iterations

Overview

2.8.1 The final layout as presented in the EIA Report has been the subject of a number of iterations and refinements which sought to avoid, or minimise, predicted adverse effects as far as reasonably practicable via design embedded mitigation. The resultant proposal balances the environmental and technical constraints, whilst producing an economically viable project. Design changes made as a consequence of the key constraints are considered to be mitigation which is 'embedded' within the design of the scheme.

2.8.2 Whilst the Proposed Development has undergone numerous design iterations, a selection of the key turbine layout design iterations is described below and are shown in Figure 2.1 (a - d) which demonstrates how the layouts have evolved throughout the EIA process.

Figure 2.1 a – Scoping Layout: Up to 10 Turbines (Tip Height Up to 140 m)

2.8.3 The Scoping Report layout (as illustrated on Figure 2.3 a) consisted of up to 10 turbines with a tip height of up to 140 m, and a generation capacity of up to 46 MW. The Scoping Layout also utilised a larger Site Boundary of 201.4 ha centred on NGR 290152, 665390.

2.8.4 The initial layout maximised potential turbine numbers, reflective of known constraints at the time which were not necessarily subject to detailed site work. The following key known on-site constraints were adhered to:

- Suitable separation distances between turbines based upon anticipated rotor diameters and prevailing wind direction, in order to reduce wake loss and issues associated with wind turbulence; and
- 50 m buffers from watercourses.

2.8.5 The Proposed Development was scoped under the Town and Country Planning (EIA) (Scotland) Regulations 2017 (the EIA Regulations), and a Scoping Opinion was received from North Lanarkshire Council (the Council) in December 2020.

2.8.6 This Scoping Layout can be seen on **Figure 2.1a**.

Figure 2.1 b – Interim Layout: 4 Turbines (Tip Height Up to 200 m)

2.8.7 Following the consultation responses received during the scoping exercise (Technical Appendix A2.2) and through the results of ongoing EIA survey work, a number of iterations took place following the Scoping Layout. This interim Layout utilised a Site Boundary of 105.4 ha centred on NGR 289989, 665068.

2.8.8 As illustrated on **Figure 2.1 b**, the Interim Layout removed six turbines from the scoping layout with the remaining four turbines being increased from 140 m to 200 m. The change in tip height and general dimensions were chosen to reflect current trends in wind turbine technology. The need to produce lower costing renewable electricity has led to wind turbines becoming taller, where substantial improvements in yield are achieved by using longer turbine blades.

2.8.9 The Interim Layout is shown in **Figure 2.1 b**.

Figure 2.1 c – Chilled Layout: 4 Turbines (Tip Height Up to 200 m)

2.8.10 The Chilled Layout (presented on **Figures 2.1 c**) represents the Proposed Development layout proposed in this EIA Report and shared with the local community at the third round of Public Exhibitions (October 2022).

2.8.11 The layout is comprised of up to 4 turbines at a tip height of up to 200 m. The layout incorporates infrastructure elements which were not present on the Scoping Layout and other earlier iterations. This includes internal access tracks, a TCC and Substation Compound, and recreational paths. This Chilled Layout utilised a Site Boundary which extended to the north of the site to include a proposed recreational path which would link the Site to the Core Path NL/213/1. This Site Boundary had an area of 106.4 ha and was centred on NGR 289988, 665073.

2.8.12 The Chilled Layout incorporates necessary rotor spacing requirements, based on a prevailing south-westerly wind, and the turbines positioned to minimise interaction with on-site constraints, including areas of deep peat and watercourses. This included some minor refinements to the positions of turbines one (T1) and four (T4) in the Interim layout, as more detailed site survey results became available and consultation responses identified an Airwave telecommunication link which would be impacted by T4. T1 was moved 34 m south and T4 was moved 45 m northwest.

2.8.13 The chilled turbine layout is shown in **Figure 2.1 c**.

Figure 2.1 d –Frozen Layout – 4 Turbines (Tip Height of 200 m)

2.8.14 The Frozen Layout (presented on **Figures 2.1 d**) represents the Proposed Development layout proposed in this EIA Report and shared with the local community at the third round of Public Exhibitions (October 2022). The layout is comprised of up to 4 turbines at a tip height of up to 200 m, the layout of which remains the same as that seen in the Chilled Layout.

2.8.15 This final iteration featured amendments to the Site Boundary and Proposed Recreational Path. These were found to encroach into the West Lothian Council (WLC) Planning Boundary and so were amended so that both the Site Boundary and Recreational Path were situated entirely within North Lanarkshire. It is anticipated that a separate, future planning application will be submitted to WLC to complete the link between the proposed recreational path and Core Path NL/213/1. This will provide Harthill with a further recreational route which links to the village of Blackridge to the north.

2.8.16 Following the amendments to the Site Boundary, the Site Boundary had an area of 106.2 ha and was centred on NGR 289988, 665071.

2.8.17 The frozen layout is shown in **Figure 2.1 d**.

2.9 Infrastructure Design

Overview

2.9.1 The Turbine Freeze Layout incorporates infrastructure elements not present on the Scoping Layout, including the access tracks, Substation Compound, TCC which are shown on **Figure 1.2**. The design rationale for these elements is outlined below.

2.9.2 A description of associated infrastructure is described in **Chapter 3 - Development Description** of this EIA Report.

Access Tracks

2.9.3 A total of approximately 2.9 km of on-site access tracks would be required for the Proposed Development. It is anticipated that the entirety of the 2.9 km of access track, including turning heads, would be new.

2.9.4 The proposed alignment of access tracks, developed through an iterative process based on the digital terrain model and site surveys, has sought to:

- Minimise the overall track length;
- Minimise the variation of the vertical alignment of the tracks;
- Ensuring a safe and efficient layout to facilitate wind farm construction;
- Minimise the number of dead ends within the layout; and
- Avoid or minimise incursion into identified constraints, such as watercourses, areas of deeper and potentially unstable peat, priority habitats, and steep slopes.

2.9.5 To facilitate construction of the Proposed Development the creation of two new watercourse crossings will be necessary.

2.9.6 Owing to the size of some of the turbine components, all on-site access tracks would be a minimum of 5 m wide with some additional localised bend widening to a maximum of approximately 30 m. Temporary passing places (approx. 3 m x 20 m) would also be provided as required along with turning heads (approx. 54 m length, 25 m radius) to facilitate traffic movements. The new and upgraded tracks will be unpaved and formed of crushed rock sourced onsite, where possible.

Temporary Construction Compound and Substation Compound

2.9.7 One temporary construction compound would be created for the Proposed Development. The compound would be approximately 52.8 m x 16 m and is located in the centre of the Site on relatively flat land which avoids known environmental and technical constraints.

2.9.8 Surface vegetation and mineral substrate would be removed from the area of the construction compound and temporarily stored within the disturbed area at its margins. The area would then be overlain by geogrid materials and covered with compacted stone to approximately 300 mm depth depending on ground conditions.

2.9.9 The electricity substation compound would be located adjacent to the east of the TCC, comprising of a fenced hardstanding area with dimensions of approximately 35 m x 16 m within which would be the substation building of approximately 15 m x 10m as well as a transformer and generator.

2.9.10 The area for the substation compound would be prepared by removing the topsoil and subsoil down to competent bearing strata, and concrete foundations would be required to take the weight of the components. An electrical earth network would be buried around the building.

2.9.11 The underground cables from the wind turbines would be brought into the substation compound in ducts. The ducts would guide the cables to the appropriate switchgear inside the building. Communications cables would enter in a similar manner.

2.10 Summary

2.10.1 The EIA Report is based on the final layout selected for the Proposed Development, as described in detail in **Chapter 3**. The final layout comprises four turbines at heights of up to 200 m, crane hardstandings, substation, temporary construction compound and site tracks.

2.10.2 The final Proposed Development layout has been informed by a robust design iteration process, taking into account potential environmental, landscape and visual impacts and their effects, physical constraints, and health and safety considerations. The information used to inform the design iteration process included baseline data, review of preliminary visualisations, ongoing impact assessments and wind yield optimisation.

2.10.3 The EIA process has been an iterative one, so that potential effects identified throughout the EIA and design process could be avoided and overall impacts of the Proposed Development avoided or reduced.

2.10.4 The assessment of potential effects of the Proposed Development is addressed in Chapters 6 to 17 of the EIA Report. The residual effects after mitigation and good practice have been applied are provided in each relevant technical chapter.