2 Development Description

2.1 Introduction

2.1.1 This chapter provides a description of the proposed development for the purposes of identifying and assessing likely significant effects. Information is provided on:

- the location of the proposed development;
- the physical characteristics of the operational proposed development;
- typical activities associated with the construction and commissioning of the proposed development;
- typical activities associated with the operation of the proposed development; and
- typical activities associated with the decommissioning of the proposed development.

2.1.2 This chapter is supported by:

- Technical Appendix 2.1: Outline Construction Environmental Management Plan (CEMP);
- Technical Appendix 2.2: Watercourse Crossing Details;
- Technical Appendix 2.3: Outline Temporary Mineral Workings Assessment;
- Technical Appendix 2.4: Private Water Supply Assessment;
- Technical Appendix 2.5: Peat Management Plan;
- Technical Appendix 2.6: Peat Slide Risk Assessment;
- Technical Appendix 2.7: Carbon Balance Assessment;
- Technical Appendix 2.8: Peat Depth Survey and Information to Inform an Assessment of Blanket Mire Condition;
- Technical Appendix 2.9: Phase 2 Peat Depth and Coring Survey; and
- Technical Appendix 2.10: Access Management Plan.

2.1.3 Figures 2.1-2.15 are referred to in the text where relevant and include the following:

- Figure 2.1a-b: Infrastructure Layout;
- Figure 2.2: Wind Turbine Elevation;
- Figure 2.3: Wind Turbine Foundations;
- Figure 2.4: Crane Hardstanding;
- Figure 2.5: Typical Access Track Details;
- Figure 2.6: Typical Control Building and Compound Plan;
- Figure 2.7: Typical Control Building and Compound Elevation;
- Figure 2.8: Underground Cable Trench;
- Figure 2.9a-b: Typical Watercourse Crossing Details;
- Figure 2.10: Indicative Mineral Workings General Arrangement;
- Figure 2.11: Construction Compound;
- Figure 2.12: Typical Batching Plant Layout;
- Figure 2.13: Site Entrance;
- Figure 2.14: Typical Gatehouse Layout; and
- Figure 2.15: Indicative Grid Connection.

2.2 Site Location

2.2.1 The proposed development site ('the site') covers an area of approximately 37.4 km² and is located approximately 5 km north of the A86 and approximately 8 km west of the village of Laggan (EIAR Volume 3: Figure 1.1). Two main watercourses, Allt Coire Iain Oig and Allt Gilbe, run southwards off the highest ground on the site and join the River Spey on the site's southern boundary.

2.2.2 There are sections of coniferous plantation woodland located within the central southern part of the site, between the Allt Coire Iain Oig and the Allt Gilbe and on the southern boundary. The Beauly-Denny 400 kV overhead line (OHL) intersects the site on its southern boundary and lies immediately north of an undesignated length of General Wade's Military Road. The majority of the site comprises open moorland used for grazing livestock and for rearing grouse.

2.2.3 The nearest residential properties are located to the south of the site, alongside the minor road which leads from Strathmashie to Glenshero Lodge and Garva Bridge. No properties are located within the boundary of the application site.

2.2.4 The consented Stronelairg Wind Farm, which is currently under construction, is located immediately to the north of the site.

2.3 Project Description

2.3.1 The proposed development comprises 39 horizontal axis turbines, each up to a maximum of 135 m to tip height with a total installed capacity of over 50 MW. The proposed development has an indicative capacity of 168 MW[1]. Key elements of the proposed development include associated access tracks, crane hard standings, control building and substation compound and underground cabling. During construction and commissioning there would be a number of temporary works including mineral extraction areas, concrete batching plant, construction compounds and welfare facilities. A detailed plan of the proposed development is shown in EIAR Volume 3: Figure 2.1. EIAR Volume 3: Figure 2.2 presents the maximum wind turbine elevations.

2.3.2 Permission is sought for the proposed development comprising:

- 39 three-bladed horizontal axis wind turbines, of a maximum ground to tip height of up to 135 m (EIAR Volume 3: Figure 2.2);
- Turbine foundations (EIAR Volume 3: Figure 2.3);
- A wind farm control building/substation compound (EIAR Volume 3: Figure 2.6 and Figure 2.7);
- Crane hardstanding area at each turbine base with a maximum permanent area of 1,200 m² (EIAR Volume 3: Figure 2.4);
- A total of approximately 28 km of new on-site access track and turning points with associated watercourse crossings (the proposed development would also make use of 18.5 km of existing tracks within Stronelairg Wind Farm). (Typical excavated and floating access track - EIAR Volume 3: Figure 2.5);
- 2 temporary site entrance offices and layby areas with a maximum total area of 900 m² each (EIAR Volume 3: Figure 2.14);

[1] 39 turbines with an indicative capacity of 4.3 MW each.

- Up to 3 temporary site construction compounds and laydown areas with a maximum total area of 4,000 m² each (EIAR Volume 3: Figure 2.11);
- Underground cabling linking the turbines with the substation (EIAR Volume 3: Figure 2.8);
- Search areas for up to 7 temporary mineral workings, with a total maximum search area of 118,424 m² and a predicted extraction volume of 195,000 m^3 identified (EIAR Volume 3: Figure 2.10);
- A concrete batching plant (EIAR Volume 3: Figure 2.12);
- Associated ancillary works; and
- Engineering operations.

Site Layout and Flexibility

2.3.3 A plan of the proposed development showing the positions of the turbines, access tracks, hard standing areas, control building/substation compound and indicative mineral extraction areas are shown in EIAR Volume 3: Figure 2.1a and b. The turbine coordinates of the proposed turbines are set out in Table 2.1.

Table 2.1: Turbine Coordinates

Turbine ID	Easting	Northing
T1	248013	800118
T2	248493	800028
T3	248342	799607
T5	248760	798869
T6	248494	799139
T7	249008	799343
T8	248901	799815
T9	249362	799666
T10	249617	799994
T11	250027	799747
T12	249968	800345
T13	250623	800053
T14	250179	800806
T15	250567	800502
T16	253542	799869
T17	253074	799659
T18	253198	798901
T19	253527	799465
T20	253481	798676
T21	253617	798336
T22	253973	799327
T23	254042	799767
T24	254526	799690
T25	253740	800472
T26	254469	800164

Table 2.1: Turbine Coordinates		
Turbine ID	**Easting**	**Northing**
T27	254195	800487
T28	255106	800465
T29	254461	801148
T30	254869	800893
T31	255186	801365
T32	255463	800933
T33	255576	800262
T34	255810	800702
T35	256098	800357
T36	255052	800017
T37	253160	800367
T38	253818	798956
T39	249702	799389
T40	248034	799186
Note: T4 has been removed from the scheme in an earlier design iteration.		

2.3.4 Although the design process seeks to combine environmental and economic requirements with the best data available at the time, the Applicant would nevertheless wish some flexibility, where necessary, in micrositing the exact positions of the turbines and routes of on-site access tracks and associated infrastructure (50 m deviation in plan from the indicative design). This would allow the accommodation of possible variations in ground conditions across the development site, which would only be confirmed once trial pits and boreholes for detailed site investigations are dug during the detailed infrastructure design prior to the commencement of construction. Any repositioning should not further encroach into environmentally constrained areas. Therefore, 50 m flexibility in turbine and infrastructure positioning would help mitigate any potential environmental effects e.g. avoidance of archaeological features not apparent from current records.

Permanent Land Take

2.3.5 The site area is approximately 3,740 Ha (EIAR Volume 3: Figure 1.1). Within this area the permanent[2]land take would be limited to the wind turbine plinths and paths, access tracks, permanent crane hardstandings, control building and substation hardstandings which account collectively for about 0.54% of the total area within the site boundary.

2.3.6 The turbine foundation (EIAR Volume 3: Figure 2.3) is made up of a central excavation of approximately 20 m diameter and an approximate depth of 2 m – 3 m subject to prevailing ground conditions. Sloping batters would increase the excavated area to approximately 35 m diameter at ground level; possibly greater where poor ground conditions are encountered.

2.3.7 Each turbine requires a crane hardstanding to facilitate construction and maintenance. At each turbine there would be a 1,200 m^2 permanent hardstanding (EIAR Volume 3: Figure 2.4).

[2] In the context of the proposed development, permanent land take means for the life of the wind farm.

2.3.8 Following completion of the turbine installation, the permanent hardstanding remaining would be approximately 1,282 m^2 at each turbine site (includes the concrete plinth to which the steel tower is attached and a 2 m wide maintenance track/path around the base of the turbine (EIAR Volume 3: Figure 2.3)). The completed foundation would be covered with soil approximately 1.5 m – 3.0 m deep, leaving only the concrete plinth exposed at ground level to which the steel tower would be attached.

2.3.9 The proposed development would result in the construction of approximately 28 km of new track. The running width of the track would be 4.5 m on straight sections, with 0.5 m wide shoulders on each side. Tracks would be wider on bends. Typical access track details are presented in EIAR Volume 3: Figure 2.5. The total permanent hardstanding area for the new track would be approximately 152,697 m^2, which includes the hardstanding area for turning heads. The proposed development would utilise approx. 18.5 km of existing track within the Stronelairg Wind Farm. It is anticipated that no additional widening would be required along this section of existing access track.

2.3.10 The substation compound would take up an area of approximately 66.5 x 66.5 m (4,422.25 m^2) (EIAR Volume 3: Figure 2.6). Typical elevations are presented in EIAR Volume 3: Figure 2.7. The wind farm control building would require an approximate area of 450 m^2 within the substation compound. It is anticipated that there would be transmission network operator's equipment located here. The exact size and requirements would be dependent upon the network operator, but the area identified would be sufficient to contain this equipment.

Temporary Land Take

2.3.11 The excavation area around each turbine could be up to 1,800 m^2 and is temporary. In addition to the permanent crane pads and laydown areas, an additional 10,710 m^2 of temporary hardstanding for crane pads and laydown during the construction phase would be required.

2.3.12 The temporary construction compounds would require a hardstanding area of approximately 12,000 m^2 (50 m x 80 m), which allows area for staff parking. This area would be re-vegetated after construction is complete (EIAR Volume 3: Figure 2.11).

2.3.13 The temporary concrete batching plant would require a hardstanding area of approximately 3,900 m^2 (50 m x 80 m) and has been situated within an existing borrow pit (EIAR Volume 3: Figure 2.12).

2.3.14 Ancillary excavation works and material storage around other parts of the proposed development, such as those for cable trenching, would have a negligible impact on environmental receptors due to the very minor scale of the excavation or duration of the works and are not considered further in this EIAR.

2.3.15 The area of temporary and permanent hardstanding associated with the proposed development is presented in Table 2.2.

Table 2.2: Summary of Temporary and Permanent Hardstanding

Wind Farm Element	Temporary	Permanent
Turbines, Crane Pads and Laydown Areas	24,570m^2	46,800m^2
33/132kV Substation	N/A	4,422m^2
On-site Access Tracks (New)	N/A	152,697m^2
Construction Compounds	12,000m^2	N/A
Batching Plant compound	4,000m^2	N/A

Table 2.2: Summary of Temporary and Permanent Hardstanding		
Wind Farm Element	**Temporary**	**Permanent**
Gate House compounds	1,800m^2	N/A
Total Hardstanding	42,370m^2	203,919m^2

Wind Turbines

2.3.16 The wind turbine industry is constantly evolving, designs continue to improve both technically and economically. The most suitable turbine model for a particular location can change with time and therefore a final choice of machine for the proposed development has not yet been made. The most suitable machine would be chosen before construction, with an overall height limit of up to 135 m to blade tip as assessed in this EIAR.

2.3.17 For acoustic assessment purposes, the most suitable candidate turbine available in the market place (4.2 MW[3] nominal capacity and with an overall height to blade tip of 135 m) has been assumed. Most of the dominant wind turbine manufacturers are now producing turbines that are classed as suitable for the wind regimes typical of Scotland and many are also producing turbines that match the 135 m tip height being suggested for the proposed development. Exact tower and blade dimensions vary marginally between manufacturers, but suitable turbines are produced by Senvion, Nordex, GE and Vestas amongst others. A diagram of a typical 135 m tip height turbine is given in EIAR Volume 3: Figure 2.2.

2.3.18 The colour and finish of the wind turbine, blades, nacelles and towers would be agreed with the Highland Council (THC).

2.3.19 A significant amount of research has been undertaken in relation to turbine colour and finish. Siting and Designing wind farm in the Landscape (Version 3a) SNH, August 2017 states that as a rule for most rural areas of Scotland:

- A single colour of turbine is generally preferable;
- The use of graded colours at the turbine base should be avoided as public perception studies have demonstrated that aesthetic unity is viewed more favourable. Graduated schemes, or turbines with colour variation, should be used with caution;
- Light coloured turbines seen against a land backdrop may have greater prominence than light or dark turbines seen against the sky;
- The use of coloured turbines (such as greens, browns or ochres) in an attempt to disguise wind turbines against a landscape backcloth is usually unsuccessful although variation from the standard light grey colour, using a darker grey, may be successful when the wind farm is backclothed from important viewpoints or receptors. The chosen turbine colour should respond to the character of the site and its setting;
- Paint reflection should be minimised. Texture is an important factor in reducing reflectivity, and matt or light absorbent finishes are preferable; and
- For multiple wind farm groups or wind farm extensions, cumulative colour effects would be a key consideration. A strategic approach to turbine colour is desirable and the colour of turbines should generally be consistent.

2.3.20 Whilst often backclothed in views by topography, the turbines would be seen above the horizon at a number of viewpoints both in close proximity to the site and from more distant

[3] It is expected that should consent be granted the nominal capacity of the turbines would be up to 4.3 MW resulting in an indicative total installed capacity of 168 MW

views. In cognisance of the preceding guidance, a simple pale colour with a semi-matt finish is suggested for the turbines.

2.3.21 Turbines normally rotate clockwise when viewed from the front, although this can vary between models. The computerised control system within each turbine continuously monitors the wind direction and instructs the turbine to turn (yaw) to face into the wind to maximise the amount of energy that is captured. Turbines begin generating automatically at a wind speed of around 3 to 4 metres per second (m/s) and have a shutdown wind speed of about 25 m/s.

2.3.22 It is proposed to install infrared lighting on the turbines in a pattern that is acceptable to the Ministry of Defence (MoD) for aviation visibility purposes. Infrared lighting allows military aircraft with night vision capabilities to detect and avoid the proposed wind farm. Infrared lighting cannot be detected with the naked eye, thereby reducing visual effects.

2.3.23 Each turbine would have a transformer and switchgear. The transformers would be internally contained within the nacelle or tower base. The transformer's function is to raise the generation voltage from approximately 690 volts to the higher transmission level of 33 kV that is required to transport the electricity around the proposed development.

Turbine Foundations and Hardstanding

2.3.24 The wind turbines would be erected on steel reinforced concrete foundations. It is anticipated that the foundations would be of gravity base design however there may be a requirement to use piled foundations where ground conditions dictate. Final base designs would be determined after a full geotechnical evaluation of each turbine location. EIAR Volume 3: Figure 2.3 provides an illustration of the construction of a typical wind turbine foundation.

2.3.25 During the erection of the turbines, crane hardstanding areas would be required at each turbine base. Typically, these consist of one main permanent area of 1,200 m² (EIAR Volume 3: Figure 2.4) adjacent to the turbine position where the main turbine erection crane would be located. The other areas, totalling 630 m², would be temporary and used to assist turbine erection. The hardstanding would be constructed using the same method as the excavated access tracks. This involves the topsoil being replaced with hardcore to around the original ground level.

2.3.26 After construction operations are complete, the temporary crane pad areas shown on EIAR Volume 3: Figure 2.4 would be reinstated. There would be a requirement to use cranes on occasion during the operational phase of the proposed development and so the main crane hardstanding (1,200 m²) would be retained to ease maintenance activities. This approach complies with best practice guidance[4] which recommends crane hardstandings are left uncovered for the lifetime of the proposed wind farm.

Substation and Control Building

2.3.27 The proposed development would be connected to the grid at Melgarve substation at 132kv (EIAR Volume 3: Figure 2.15). In order to transform the 33kv power supplied by the wind farm array cables, an indoor 33/132kv substation would be constructed along with a wind farm control building and ancillary electrical equipment. These elements would be contained in a single compound area as detailed in EIAR Volume 3: Figures 2.6 and 2.7.

[4] SNH, Scottish Renewables, SEPA and the Forestry Commission Scotland Version 3 (September 2015) "Good Practice during Wind Farm Construction"

2.3.28 The indoor substation would consist of two conjoined buildings, the transformer hall measuring 40 m x 20 m x 17.5m high and a protection and control building measuring 15 m x 15 m x 5m high.

2.3.29 The separate control building would accommodate metering equipment, switchgear, the central computer system and electrical control panels. A spare parts store room, toilet and wash basin along with a kitchenette would also be located in the control building. The buildings would be staffed by maintenance personnel on a regular basis. This building would measure approximately 32.4 m x 13.9 m x 5.5 m high.

2.3.30 The compound area containing the above described elements would measure 66.5 m x 65 m. The compound area would provide staff parking and would be illuminated by downwards pointing passive infra-red (PIR) activated lighting. Electrical equipment would be guarded by palisade fencing to protect the general public and workforce.

2.3.31 There is a preference to source water supply for the building locally where possible. This could be through ground water supply or alternatively it could be sourced from a rain water harvesting system. This would collect rain water from the roof of the control building via a modified drain pipe system and feed into a storage tank either within the roof space of the building or an external buried tank. An overflow from the tank would drain to the outside of the building into a rainwater soakaway.

2.3.32 The storage tank would supply raw / untreated water to the toilet and water via a UV filter to the hand basin. If an extended period of low rainfall occurs, water would be transported to the site in small tanks, as required.

2.3.33 Following an assessment of foul treatment options through a review of Pollution Prevention Guidelines, it was determined that both the toilet, wash hand basin and sink should drain to a small package treatment plant or septic tank located adjacent to the control building, which would follow the Controlled Activities Regulations (CAR) and be constructed and located in accordance with the relevant Building Standards and agreed with the THC.

2.3.34 A permanent external waste and recycling storage area is required within the Control Building compound. The area would consist of a concrete plinth typically 4 m x 2 m surrounded with a palisade fence and double gate.

On-site Electrical Cabling

2.3.35 Assuming the use of the currently available models, each wind turbine would generate electricity at 690 V and would have an ancillary transformer located within the nacelle or the base of the tower to step up the voltage to the on-site distribution voltage of 33 kV. Each turbine would be connected to the substation by underground cable (EIAR Volume 3: Figure 2.8). Within the development site the cables would be likely to follow the onsite tracks.

2.3.36 The substation and compound locations are shown in EIAR Volume 3: Figure 2.1. The substation is described in greater detail below.

Connection to Electricity Grid

2.3.37 A plan showing an indicative route of the projects connection to the national grid network is provided in EIAR Volume 3: Figure 2.15. The grid connection route to the Melgarve Substation would be by underground cable and would generally follow the route of the existing Stronelairg Wind Farm cable; however, the final location would be subject to a separate application by the relevant network operator (Scottish and Southern Hydro Electric Transmission thereafter referred to as SHET) under the Electricity Act 1989 after further detailed surveys and assessments.

Access Tracks

2.3.38 Typical access track designs are shown in EIAR Volume 3: Figure 2.5. This figure shows the use of floating and excavated tracks.

2.3.39 The on-site access track layout has been designed to minimise environmental disturbance and land take by wherever possible following a route through shallower areas of peat, areas of slope below 11% and avoiding or minimising areas of identified environmental constraints, as set out in EIAR Volume 4: Technical Appendices 2.6: Peat Slide Risk Assessment, 2.8: Peat Depth Survey and Information to Inform an Assessment of Blanket Mire Condition, and 2.9: Phase 2 Peat Depth and Coring Survey. New tracks are proposed to access the various turbine locations totalling approximately 28 km in length. Also, 18.5 km of existing tracks constructed as part of the existing Stronelairg Wind Farm would be utilised to reduce the need for new construction.

2.3.40 Where the track is required to cross an area of peat and topsoil greater than 1 m thick over an appreciable distance, a 'floating road' construction would be used where practicable. A layer of geotextile reinforcement would be placed directly onto the route of the track. The track would then be built up on the geotextile by laying and compacting stone up to a thickness of approximately 500 mm - 1000 mm, the exact depth being dependent on ground conditions (see EIAR Volume 3: Figure 2.5).

2.3.41 The use of 'floating roads' in areas of deep peat eliminates the need for excavation and minimises effects on ecology and disruption to existing water paths and allows for some filtration. Approximately 16% of the on-site tracks may be constructed as floating track.

2.3.42 In areas where the peat and topsoil are consistently less than 1 m thick, the vegetation and soil would typically be stripped to a suitable subsoil layer and the track (approximately 300 mm - 500 mm thick) would be constructed on the subsoil. The upper topsoil layer, together with turf, would be stored separately from the rest of the subsoil in piles adjacent to, or near to the tracks, where appropriate for later reinstatement.

2.3.43 Once the soil has been removed, as described above, to a suitable founding layer, the road and running surface would be constructed by tipping and compacting aggregate to the required shape and thickness. Cross sections of the final road shape following reinstatement of the roadside slopes by replacing the layers of excavated material in the correct order are presented in EIAR Volume 3: Figure 2.5.

2.3.44 The track layout has been carefully designed to avoid water crossings where possible, which are discussed in the section below.

Watercourse Crossings

2.3.45 As noted above, the number of watercourses has been minimised through site design. Nevertheless, there is a requirement for nine crossings of watercourses as identified on 1:50k mapping. Whilst most of these crossings are likely to be achieved by culverting, the crossing identified to the south of Dubh Lochan would most likely require a bridging structure though this would be a clear span. It is expected that several smaller unmapped crossings would be required, and these would be crossed using simple culverts. An example of the typical watercourse crossing design, which could be applied to some of these smaller unmapped watercourses, is shown in EIAR Volume 3: Figure 2.9.

2.3.46 The design would be agreed with SEPA prior to construction and would be dealt with by registration under The Water Environment (Controlled Activities) (Scotland) Regulations 2011(as amended) (CAR) and Water Environment (Miscellaneous) (Scotland) Regulations 2017. The CAR requirements for the watercourse crossings are presented in EIAR Volume 4: Technical Appendix 2.2.

2.3.47 Guidance on the size, scale, design and construction of the crossings would be taken from the Construction Industry Research and Information Association (CIRIA) Culvert design and operation guide (C689). The crossings would be designed to ensure that they do not disconnect the watercourses at times of low flow and that they have appropriate flood capacity.

2.3.48 The crossings would be designed to ensure that fish and mammal movement is not restricted (specific mitigation for the safe passage of fish and mammals through culverts is considered within Chapter 6: Ecology).

2.3.49 The hydraulic requirements of all watercourse crossings would be considered and using the following guidance the watercourse crossings would be appropriately sized:

- Flood Estimation Handbook (Statistical Analysis) and Flood Studies Report (FSR) where appropriate used to determine the design flow;
- CIRIA Culvert design and operation guide (C689); and
- Scottish Executive (2002) River Crossings and Migratory Fish: Design Guidance (where appropriate).

2.3.50 Additional factors considered in the design and orientation of watercourse crossings includes:

- use of clear span crossings in order to avoid disruption to the stream bed where stream bed width is >2 m;
- embedment of closed culverts to allow a natural bed substrate to form;
- crossing direction to generally be perpendicular with access road direction, therefore minimising the length of stream affected;
- consideration of the passage of out-of-bank flood flows;
- provision of mammal (e.g. otter/water vole) passage through the crossing structure in all flow conditions; and
- consideration of any factors or recommendations arising out of a pre-construction habitat survey of the watercourse channel at the crossing location.

Temporary Construction Compounds and Gatehouses

2.3.51 Three construction compounds measuring 80 m x 50 m would be constructed to provide welfare, offices and laydown facilities across the site. It is envisaged that main site offices and welfare facilities would be established at the most central location with the remaining two acting as satellite facilities. These compounds would be re-instated following completion of construction. Two temporary small gatehouse compounds would be established to control vehicle movements. These compounds would measure 30 m x 30 m (EIAR Volume 3: Figure 2.14).

Temporary Mineral Workings

2.3.52 Temporary Mineral Workings are proposed as a potential source of site won rock for use primarily in the construction of new tracks and hardstandings. The location of seven areas of search for temporary mineral workings are shown in EIAR Volume 3: Figure 2.1. These areas of search are shown larger than the maximum potential area of mineral working extraction and it is not anticipated that these areas would be fully exploited. The larger areas include space to store overburden, manage stockpiles and for the provide suitable drainage and water management.

2.3.53 Areas of search are shown as the nature and quality of the underlying material will not be defined until the results of detailed pre-construction ground investigations are known. At this point, the exact extent of mineral extraction area cannot be defined. Indicative temporary mineral working general arrangements are shown in EIAR Volume 3: Figure 2.10. These show indicative extraction areas to illustrate the potential works if the search areas prove suitable for stone excavation. It is not expected that all of the search areas would be utilised and, in the event that all are found suitable for stone extraction, the preference would be to utilise a central location to minimise the haulage of stone across the site.

2.3.54 An Outline Temporary Mineral Workings Management Plan is provided in EIAR Volume 4: Technical Appendix 2.3. A working method would be put in place to manage topsoil or peaty topsoil removal and reuse for restoration and overburden removal and storage. Provisions for the control of surface runoff both during and post construction and the re-vegetating of working faces post-construction would also be included.

2.3.55 Blasting may occur up to 2-3 times a week for the first six months, before tapering off and becoming less frequent. Chapter 9: Noise assesses the potential effects of vibration and blasting activity.

2.3.56 Once operations are sufficiently underway, restoration would take place progressively behind the working area to encourage re-vegetation. This would minimise any impact to the surrounding environment by minimising the working area at any point.

Concrete Batching

2.3.57 The concrete batching plant would be located at the position shown on EIAR Volume 3: Figure 2.1. The batching equipment, shown in EIAR Volume 3: Figure 2.12, would be located on a hardstanding that would be constructed in the same way as the temporary construction compound.

2.3.58 The construction batching equipment would include:

- concrete and aggregate storage bins;
- concrete batching equipment;
- wash out facilities;
- testing facilities;
- water supply; and
- waste storage area.

2.3.59 It is anticipated that a borehole would be sunk to provide a reliable water supply for the concrete batching plant. Any borehole would be subject to suitable yields being available, which would be determined through future geotechnical site investigation. Any borehole would require suitable authorisation under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) and Water Environment (Miscellaneous) (Scotland) Regulations 2017.

2.3.60 Alternatively, water may be extracted from suitable sources of surface water such as a river or lochan. The final location of such abstraction would need to be identified and would be subject to licence under Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) and Water Environment (Miscellaneous) (Scotland) Regulations 2017.

2.4 Construction Activities

Construction Programme

2.4.1 It is anticipated that the construction of the proposed development would take 24 months.

Hours of Work

2.4.2 It is envisaged that the construction hours of work would be Monday to Saturday 07.00 to 19.00. There would be no deliveries made to the site after 13:00 on Saturdays. There would be no working on a Sunday.

Construction Traffic and Plant

2.4.3 In addition to staff transport movements, construction traffic would consist of heavy goods vehicles (HGVs) and abnormal load deliveries.

2.4.4 Chapter 8: Traffic and Transport sets out the expected number of vehicle movements to and from the site each month, taking into account forecast vehicle numbers from construction activities with the highest volume of traffic occurring during months 9 to 15 of the 24-month construction period. A detailed Traffic Management Plan (TMP) would be written in consultation with THC prior to construction commencing should consent for the proposed development be granted. This is discussed further in Chapter 8: Traffic and Transport.

2.4.5 Turbine components would be supervised during their transportation using appropriate steerable hydraulic and modular trailer equipment where this is required. Axle loads would be appropriate to the roads and access tracks to be used. The transportation of turbine components would be conducted in agreement with the relevant roads authorities and local police. RES would notify the police of the movement of abnormal length (e.g. turbine blade delivery) and abnormal weight (e.g. crane) vehicles and obtain authorisation from the Scottish Government prior to any abnormal vehicle movements.

2.4.6 Police escorts would be used where necessary and the appropriate permits obtained for the transportation of abnormal loads to ensure that other traffic is aware of the presence of large, slow moving vehicles. Where long vehicles would have to use the wrong side of the carriageway or need to swing into the path of oncoming vehicles, a lead warning vehicle would be used, and escort vehicles would drive ahead and stop oncoming traffic. Vehicles would also be marked as long/abnormal loads. For return journeys, the extendible low loaders used for wind turbine delivery would be retracted.

Standard Mitigation and Working Methods during Construction

Construction Environmental Management Plan

2.4.7 The assessment in this EIAR has been carried out on the basis that standard mitigation measures would be implemented during the construction work, including compliance with both project wide and site specific environmental management procedures, which would be included in a Construction Environmental Management Plan (CEMP). An Outline Construction Environmental Management Plan (CEMP) is provided in EIAR Volume 4: Technical Appendix 2.1. A detailed CEMP would be agreed with THC and relevant statutory consultees prior to construction commencing. The CEMP would, as a minimum, include details of:

- construction methodologies;
- pollution prevention measures;
- public liaison provision;

- peat slide, erosion and compaction management;
- control of contamination/pollution prevention;
- drainage management and SuDS;
- water quality monitoring;
- management of construction traffic;
- control of noise and vibration; and
- control of dust and other emissions to air.

2.4.8 EIAR Volume 4: Technical Appendix 2.1 provides a list of generic mitigation measures that would be included in the CEMP and implemented during the construction and decommissioning of the proposed development. It would be a contractual requirement that the appointed contractor complies with the CEMP.

Watercourse Crossings

2.4.9 EIAR Volume 4: Technical Appendix 2.2: Water Crossings Design contains details of the watercourse crossings required as part of the proposed development and the proposed crossing type together with the relevant licensing requirements.

2.4.10 Typical watercourse crossings are presented on EIAR Volume 3: Figure 2.9 and the final crossing type would be identified as part of the detailed design of the proposed development prior to construction and in line with current best practice guidance[5].

Private Water Supplies

2.4.11 A review of Private Water Supplies has been undertaken for the site and 5 km buffer around the site boundary (EIAR Volume 4: Technical Appendix 2.4). The assessment identified five PWS within the buffer and confirmed that based on their distance from the site and their hydrological setting the proposed development would not have an adverse effect on them. In addition, water quality control measures would be implemented on site through the CEMP (EIAR Volume 4: Technical Appendix 2.1).

Peat Management

2.4.12 EIAR Volume 4: Technical Appendix 2.5: Peat Management Plan provides a 'stage 1' peat management plan, which outlines the proposed working methods where the excavation of peat would be required and provides further details on potential volumes of peat excavated and the likely requirements for reinstatement. This provides details of the predicted volumes of peat that would be excavated for the proposed development, the characteristics of the peat that would be excavated, and how the excavated peat would be reused and managed. This document would be updated during the detailed design stage and agreed with SEPA prior to construction and would be included in the final version of the CEMP.

Peat Slide Risk

2.4.13 EIAR Volume 4: Technical Appendix 2.6: Peat Landslide Hazard and Risk Assessment (PLHRA) provides further technical information on the likely risk and hazards associated with peat instability, and the proposed standard mitigation and working methods that would be implemented during construction to seek to avoid adverse effects associated with peat instability. The PLHRA has reviewed the survey data gathered from across the development site and has concluded that there is a negligible to low risk of peat instability over most of the

[5] Engineering in the water environment: good practice guide, River Crossings, 2nd Edition, November 2010, SEPA

site. In the remaining limited areas where a medium risk has been identified a hazard impact assessment was completed and concluded that, subject to the implementation of appropriate mitigation measures all these areas could be considered as an insignificant risk.

Access Management

2.4.14 EIAR Volume 4: Technical Appendix 2.10: Access Management Plan sets out the proposals for managing public access to the site during the construction phase of the proposed development.

2.5 Operation Management and Maintenance

2.5.1 Wind turbines and wind farms are designed to operate largely unattended. Each turbine at the proposed development would be fitted with an automatic system designed to supervise and control a number of parameters to ensure proper performance (e.g. start-up, shut-down, rotor direction, blade angles etc.) and to monitor condition (e.g. generator temperature). The control system would automatically shut the turbine down should the need arise. Sometimes the turbines would re-start automatically (if the shut-down had been for high winds, or if the grid voltage had fluctuated out of range), but other shut-downs (e.g. generator over temperature) would require investigation and manual restart.

2.5.2 The proposed development itself would have a sophisticated overall Supervisory Control and Data Acquisition system (SCADA) that would continually interrogate each of the turbines and the high voltage (HV) connection. If a fault were to develop, which required an operator to intervene then the SCADA system would make contact with duty staff via a mobile messaging system. The supervisory control system can be interrogated remotely. The SCADA system would have a feature to allow a remote operator to shut down one or all of the wind turbines.

2.5.3 An operator would be employed to monitor the turbines, largely through remote routine interrogation of the SCADA system. The operator would also look after the day-to-day logistical supervision of the proposed wind farm and would be on-site intermittently.

2.5.4 Routine maintenance of the turbines would be undertaken approximately twice yearly. This would not involve any large vehicles or machinery.

2.5.5 If a fault should occur, the operator would diagnose the cause. If the repair warranted the proposed wind farm being disconnected from the grid then the operator would make contact with SHET. However, this is a highly unlikely occurrence as most fault repairs can be rectified without reference to the network utility. If the fault was in the electrical system, then the faulty part or the entire proposed wind farm would be automatically disconnected.

2.5.6 A sign would be placed on the proposed wind farm giving details of emergency contacts. This information would also be made available to the local police station and SHET.

2.6 Residues and Emissions

2.6.1 The EIA Regulations require that the EIAR provides an estimate, by type and quantity, of expected residues and emissions (such as water, air and soil and subsoil pollution, noise, vibration, light, heat, radiation and quantities and types of waste produced) resulting from the construction and operation of the proposed development.

2.6.2 Table 2.3 provides a summary of the anticipated residues and emissions.

Table 2.3: Residues and Emissions	
Topic	**Potential Residue/Emission**
Water	Construction: Surface water runoff and discharges from construction working areas are likely during construction, although overall the quantity of surface runoff would not change overall as a result of the construction work. In addition, occasional and low quantity discharges could arise from pumping, or over-pumping in order to dewater foundation excavations. Pollution sources could arise as a result of soil erosion or from oil/ fuel or chemical storage and use. All discharges would be managed in accordance with the Water Environment (Controlled Activities) (Scotland) Regulations 2011, as amended by The Water Environment (Miscellaneous) (Scotland) Regulations 2017. The proposals for water the control and management of water quality and quantity from the proposed development are presented in EIAR Volume 4: Technical Appendix 2.1: Outline CEMP. Operation: No water emissions or pollution sources have been identified for the operational phase.
Air	Construction: The construction phase would require the transport of people and materials by road, with associated emissions to the atmosphere. There are no air quality management areas within the vicinity of the proposed development. Overall the quantity of air emissions is expected to be low relative to the general background air emissions from road traffic. No significant air emissions are anticipated. Operation: Due to the nature of the proposed development no significant point source or diffuse air emissions would be produced during its operation. The proposed development would contribute to providing renewable electricity, in turn displacing emissions associated with fossil fuel-based electricity generation elsewhere. The construction of the proposed infrastructure, and subsequent operation and decommissioning of the proposed development would include activities that either directly or indirectly result in CO_2 emissions. EIAR Volume 4: Technical Appendix 2.7: Carbon Balance Assessment calculates the greenhouse gas emissions and carbon payback times for wind farm developments in Scottish peatlands and concludes that the proposed development would ‘pay back’ the carbon emissions associated with its construction, operation and decommissioning in a 1-2-year period.
Soil and Subsoil	Construction: Soil and subsoil excavation, handling and storage would be required during construction. All soil and subsoil would be stored temporarily for use in reinstatement, such that there would be no residue (surplus) remaining following the construction work. Further details on peat management are provided in EIAR Volume 4: Technical Appendix 2.5. Operation: No requirement for soil or subsoil excavation or handling during the operation phase has been identified. No pollution sources have been identified for the operational phase.
Noise and Vibration	Construction: Noise sources during the construction phase would include increased traffic flows and noise from construction plant. Further details are provided in EIAR Volume 2: Chapter 9: Noise. Operation: The wind turbines would generate noise during operation, and the noise levels would vary according to the wind speed. The location of residential receptors in relation to the proposed development was a consideration in the design development process and the predicted noise levels are within acceptable limits. Full details of the noise impact assessment are present in Chapter 9: Noise.

Table 2.3: Residues and Emissions	
Topic	**Potential Residue/Emission**
Light	Construction: EIAR Volume 4: Technical Appendix 2.1: Outline CEMP notes that temporary lighting would be required at the temporary construction compounds for security purposes and to ensure that a safe working environment is provided to construction staff. In addition, temporary lighting could be required to ensure safe working conditions at infrastructure locations during construction. All temporary lighting installations would be downward facing and all lights would be switched off during daylight hours and out with working hours. Operation: It is proposed to install infrared lighting on the turbines in a pattern that would be acceptable to the Ministry of Defence (MoD) for aviation visibility purposes. The lighting proposed would not be visible to the naked eye. The substation buildings are likely to be equipped with passive infra-red controlled security lighting. These would illuminate the sub-station compound area when activated. Any effect would be temporary and not expected to be significant during normal operation of the proposed development.
Heat and Radiation	No significant sources of heat and radiation have been identified during either the construction or operation phase of the proposed development.
Waste	Construction: EIAR Volume 4: Technical Appendix 2.1: Outline CEMP provides details on pollution prevention control and site waste management that would be implemented during construction. A Site Waste Management Plan would be designed to follow the principles of: Avoidance; Minimisation; Separable; Recyclable. Operation: The power generation aspect of the proposed development would not produce any waste emissions or pollutants. The general operation and maintenance of the proposed development has the potential to produce a small amount of waste. This is likely to be restricted to waste associated with the control building from employees and visiting contractors and the storage of oils and lubricants.

2.7 Decommissioning

2.7.1 The expected operational life of the proposed wind farm would be 30 years from the date of final commissioning. Towards the end of this period a decision would be made as to whether to refurbish, remove or replace the turbines. If refurbishment or replacement were to be chosen, then relevant applications would be made. If a decision was taken to decommission the proposed wind farm this would require the removal of all the turbine components, transformers, the substation and associated buildings. Cables would be cut away below ground level and sealed. Some of the access tracks could be left on site to ensure the continued benefit of improved site access for the landowner or they could be reinstated. It is not currently usual to remove concrete foundations from the site as this would cause more damage to the environment. The exposed concrete plinth would be removed to a depth of 1 m below the surface and the entire foundation would be graded over with soil and would be replanted if appropriate.

2.7.2 This approach follows SNH Report No. 591 Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms and advice given in former Planning Advice Note: PAN 45 (Revised 2002) (which advised in paragraph 33 that *"Concrete foundations may be best left in place and covered over")* and is retained in the Scottish Government's web-based renewable advice which replaced PAN 45. This approach also follows advice given in the SNH Commissioned Report No. 591, which states that *"noise, ground disturbance, and cost* *(excavation / breaking / processing / transporting) along with associated carbon emissions, may create a larger environmental impact than leaving such concrete in situ."*

2.7.3 In alkaline or neutral pH ground water conditions, no chemical degradation of the concrete foundation would take place. The concrete mass would remain intact and have no effect on the local soil or groundwater. In soft, acidic groundwater conditions (low dissolved calcium content and high dissolved carbon dioxide content), where the water table is in contact with the concrete mass e.g. peat or marshland, sulphate attack of the concrete would tend to take place. This may cause alkali to leach into the groundwater in contact with the concrete. If this effect occurs it would be highly localised around the foundations.

2.7.4 However, as discussed in the foundation construction section above, the concrete mix for the turbine foundations would be designed to withstand sulphate attack and it is therefore likely that the rate of alkali leaching would be low and would not be expected to have a significant effect on the local soil or groundwater conditions.

2.7.5 A draft Decommissioning and Restoration Plan is provided in EIAR Volume 4: Technical Appendix 2.1: Outline CEMP. If the proposed wind farm obtains planning permission it is expected that an agreement would be put in place to allow for the establishment of a decommissioning bond or fund to be set aside for when the proposed wind farm is decommissioned after its operational life. Prior to decommissioning of the proposed wind farm, a method statement would be prepared and agreed with THC.

2.7.6 Unlike most other forms of electricity production, wind farms are able to be decommissioned with comparative ease. Plant can readily be dismantled and removed from the site. Site restoration is relatively straight forward and after restoration there would be no significant visible trace of prior existence and no legacy of pollution.