4. DESCRIPTION OF THE PROPOSED DEVELOPMENT

4. Description of the Proposed Development

4.1. Introduction

4.1.1. This chapter provides a description of the proposed Shepherds' Rig Wind Farm ('the Proposed Development'). The application for Electricity Act consent and deemed planning permission is for a wind energy development comprising the construction, 25 year operation and subsequent decommissioning of up to 19 turbines; together with on-site access tracks, hardstanding areas, temporary borrow workings, a substation, battery energy storage and control building compound, operational anemometry mast and on-site underground cabling. During construction, a temporary construction compound will be required which will house a site office and welfare facilities.

4.1.2. The purpose of the Proposed Development would be to generate electricity from the 19 proposed wind turbines. Based on current turbine specifications, it is expected that each wind turbine would have an output of 4.2 megawatts (MW), except turbines 1 and 3, which would each have a maximum output of 3.6 MW, giving a total maximum installed capacity from all of the wind turbines of 78.6 MW. Turbines with a greater installed capacity could be used if they are available at the time of procurement for the Proposed Development and providing that they would also fit within the environmental and planning parameters considered in this EIA report[1].

4.1.3. The maximum output from the battery energy storage facility would be 6MW based on current technology, and consequently the overall maximum output from the Proposed Development would be 84.6MW.

4.1.4. This chapter of the EIA report describes the Proposed Development, which with the inclusion of mitigation measures outlined in each of the technical chapters that follow, serves as the basis for the consent application. The Construction Method Statement (CMS) section in this chapter (see paragraph 4.4.9 et seq.) details how the mitigation measures would be secured and implemented.

4.2. Proposed Development Layout

4.2.1. The layout of the Proposed Development is shown in **Figure 4.1**. Table 4.1 specifies the indicative national grid references and maximum tip height for each of the proposed turbines; the turbines will be subject to a micro-siting allowance as detailed within this section to ensure their final position on the ground optimised.

4.2.2. **Figure 4.1** also shows the location of the ancillary infrastructure necessary for the Proposed Development. In summary, the associated elements of the

[1] The actual turbine capacity may differ from 4.2MW, and would be the result of a turbine procurement process which would aim to maximise the renewable energy generation at the site. However the final procured turbine would not exceed the physical specifications described in this EIA report, nor would it exceed the level of residual effects predicted by the EIA process in all topics.

Proposed Development, separate to the turbines, hardstandings and access tracks, are to be located at the following approximate locations:

- the temporary construction compound at (eastings) 262476 (northings) 591260;
- the substation, battery energy storage and control building compound at (eastings) 261909 and (northings) 593645; and
- two borrow workings at (eastings) 261871 and (northings) 592555 and (eastings) 262109 and (northings) 595388.

Table 4.1: Wind Turbine Approximate Grid References and Maximum Tip Heights

Turbine No.	Easting	Northing	Maximum Turbine Tip Height (m)
1	261952	595637	125
2	262221	595349	149.9
3	262915	595224	125
4	261650	595201	149.9
5	262475	594930	149.9
6	261899	594817	149.9
7	262775	594588	149.9
8	262058	594415	149.9
9	262520	594105	149.9
10	262007	593901	149.9
11	262921	593780	149.9
12	262325	593596	149.9
13	261752	593497	149.9
14	262667	593305	149.9
15	262123	593084	149.9
16	261406	593046	149.9
17	262482	592799	149.9
18	261690	592707	149.9
19	262045	592402	149.9

Micro-siting

4.2.3. Current knowledge of the ground conditions at the Site is based on desk top studies and preliminary site investigations. These would be verified by more detailed pre-construction ground investigations which may result in minor adjustments to turbine and ancillary infrastructure locations due to environmental or technical constraints.

4.2.4. For this reason, a **75 m** micro-siting allowance has been included around the following proposed turbine and ancillary infrastructure locations: Turbine 4 (T4), T6, T8, T9, T10, T13 and T16. A smaller **50 m** micro-siting allowance is sought for the remaining turbines. Turbine 7 and its associated infrastructure, near Craigengillan Cairn, would not be micro-sited further to the south west.

4.2.5. The micro-siting area allowances are considered and assessed throughout the technical and environmental chapters (Chapters 8 to 21) completed as part of the EIA for the Proposed Development.

4.3. Description of the Wind Farm Elements

Wind Turbines

4.3.1. A diagram of a typical wind turbine with a tip height of 149.9 m is shown in **Figure 4.2**, and a diagram of a typical wind turbine with a tip height of 125 m is shown in **Figure 4.3**. These figures show a typical horizontal axis wind turbine comprising four main components: a rotor (consisting of a hub and three blades), a nacelle (containing the generator and gearbox), to which the rotor is mounted, a tower, and a foundation. The specific turbine is dependent on the final choice of turbine models available at the time of procurement and will be chosen with the aim of optimising renewable energy generation at the Site. However, the chosen turbines will have a maximum blade tip height of no more than 149.9 m (with turbines one and three having a maximum blade tip height of 125 m) as these are the upper limit environmental and planning parameters considered in the EIA.

4.3.2. The wind turbines would convert the kinetic energy of the wind into electrical energy, the air passing over the blades causing them to rotate. This low speed rotational motion of the blades is converted into electrical energy using a generator located inside the nacelle.

4.3.3. A transformer then steps up the voltage to 33 kilovolts (kV) which is then fed into the control building via underground electrical cabling linking all of the turbine unit transformers. The turbine transformers are expected to be located within the nacelle or tower of the turbine; however if required due to the turbine model selected for installation on site, they may be located immediately adjacent to each turbine in a small kiosk, typically 3 m x 2 m x 3 m, such that they are generally indistinct from the tower base unless viewed close up or in silhouette against the skyline at greater distance.

4.3.4. The electricity generated by the wind farm would be metered in the on-site control building and fed into the electricity network to which it is connected.

4.3.5. The turbine dimensions would vary depending on the turbine selected but for the purposes of the EIA, the Vestas V117 (4.2 MW) and Vestas V105 (3.6 MW) (for turbines 1 and 3) have been used as the reference wind turbines.

4.3.6. The turbine blades would rotate at approximately 6.7-14 revolutions per minute (rpm), generating power for wind speeds between 3-25 metres per second (m/s). At speeds greater than 25 m/s, the turbine reduces power output by pitching the blades out of the wind to protect the turbine from damage caused by high wind speeds. These very high wind conditions usually prevail for less than 1% of the year.

4.3.7. Turbines have a proven track record for safety, although a very small number have been known to fail through accidental damage due to lightning or mechanical problems. However, turbine control and monitoring systems operate with several levels of redundancy to protect the turbines from damage.

4.3.8. All turbines are controlled by a sophisticated Supervisory Control and Data Acquisition (SCADA) system, which would gather data from all the turbines in order to control them from a central remote location. Communications cables connecting to each turbine would be buried in the electrical cable trenches to facilitate this.

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

4.3.10. Wind turbines are designed to withstand very high wind speeds, and the Vestas V117 4.2 MW (the reference turbine) is normally certified against structural failure for wind speeds up to 70 m/s.

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

4.3.12. In cold weather, ice can build up on blade surfaces when operating. The turbines can continue to operate with a thin accumulation of snow or ice, but would shut down automatically when there is a sufficient build up to cause aerodynamic or physical imbalance of the rotor assembly.

4.3.13. During the construction phase, heavy lifting cranes will be used to install the wind turbines. The crane type would be confirmed when the specific turbine type has been selected. However, it is anticipated that two teams would carry out turbine erection, each using two road-going cranes (one of approximately 160 tonne capacity and one of 800 to 1,200 tonne capacity). The construction contractors would determine the actual cranes used, together with the exact programme and number of teams on site.

4.3.14. The methodology for turbine erection would depend on the crane supplier. Two common methods of blade installation exist: single blade lifts or full rotor assembly on the ground prior to lifting. Turbine manufacturers prefer the latter as it is quicker and does not require re-alignment of turbine components. As described below, lay down areas would accommodate components ready for assembly, and crane hard-standings would provide a firm base for cranes used to erect the turbines. If a full rotor assembly is required to be carried out prior to lifting, then additional temporary supports would be required to be positioned under the hub and blades. Because of the uncertainty of support requirements (it varies by turbine manufacturer) exact details cannot be defined but may include the creation of small additional support areas built off the sides of the crane hardstanding area.

Wind Turbine Foundations

4.3.15. The wind turbines would be installed on foundations of stone and concrete. A diagram of a typical wind turbine foundation is shown in **Figure 4.4**.

4.3.16. Construction of turbine foundations would involve the excavation to expose the underlying load bearing strata or bedrock. Topsoil and other vegetation removed will be laid on the surrounding undisturbed ground until required for reinstatement.

4.3.17. The load bearing strata or bedrock would be levelled off and blinded prior to the in-situ casting of the steel-reinforced concrete slab that would be approximately 20.8 m in diameter. The depth of the excavation would be approximately 3 - 4 m, and depending on the depth of the load bearing strata or bedrock, the sides would be battered back to ensure that they remain stable during construction. Each foundation is expected to be made up from approximately 500 m^3 of concrete.

4.3.18. On top of the slab, a concrete up-stand would then be cast, to which the turbine tower would later be bolted. The excavated area would be backfilled with compacted layers of graded material from the original excavation and capped with topsoil. The exact details of each foundation would vary across the Site in response to the actual ground conditions encountered. A detailed ground investigation would be undertaken prior to construction to establish the requirement at each foundation.

4.3.19. Whilst the foundation excavation is open (typically for 1 to 2 months) it would need to be kept free of water to allow construction of the reinforced concrete base. Water ingress would potentially be from ground (from exposed faces), surface, and rain water. The foundation excavation would be designed to be gravity draining where local topographical conditions allow. If this is not possible, the excavation would be dewatered by pumping. The discharges from dewatering operations would be subject to a method statement agreed with the on-site ecologist and SEPA. Where necessary, settling ponds, filter treatment facilities, and buffer strips would be installed to remove sediment from pumped water. No water from foundation dewatering operations would be discharged directly into a watercourse.

Crane Hardstandings

4.3.20. Each wind turbine requires an area of hardstanding to be built adjacent to the turbine foundation. A soft, levelled area is also required adjacent to the hardstanding for the assembly of turbine components. The hardstanding will provide a stable base on which to lay down turbine components for assembly, erection, and to lift the tower sections, nacelle and rotor into place.

4.3.21. Topsoil and peat would be removed from the area of the crane pad and either laid at the margin but within the disturbed area or preferably, transferred directly to the areas to be restored. The area would then be covered by geo-grid overlain with compacted stone to approximately 1,500 mm depth, dependent on ground conditions and load capacity.

4.3.22. The crane hardstanding would be left in place following construction in order to allow for the use of similar plant should major components need replacing during the operation of the wind farm. These could also be utilised during decommissioning at the end of the wind farm's life.

4.3.23. The total area of hardstanding at each turbine location, including the turbine foundations would be approximately 1,780 m^2. Based on a fill depth of 1,500 mm, an approximate total of 2,345 m^3 of stone would be required per hardstanding. A typical crane hardstanding is shown in **Figure 4.5.**

On-Site Access Tracks

4.3.24. A total of approximately 11 km of on-site access tracks would be required for the Proposed Development. It is anticipated that approximately 8.0 km of new access track including turning heads, and approximately 3.0 km of existing upgraded forest track is required.

4.3.25. 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;
- minimise the number of dead ends within the layout;
- avoid or minimise incursion into identified constraints, such as watercourses, areas of deeper and potentially unstable peat, priority habitats, and steep slopes.

4.3.26. The location of the on-site access tracks is shown in **Figure 4.1**.

4.3.27. Owing to the size of some of the turbine components, all on-site access tracks would be a minimum of 5.0 m wide with some additional localised bend widening to approximately 7 m. Temporary passing places (approx. 50 m x 5 m) would also be provided as required along with turning heads (approx. 30 m length, 50 m radius) to facilitate traffic movements. The new and upgraded tracks will be unpaved and formed of crushed rock sourced onsite, where possible.

4.3.28. The design of a particular length of site track would depend on local geological, topographical and drainage conditions. To achieve a track structure that meets the conditions encountered on the Site, whilst meeting the primary track design objectives, four different designs have been developed (each with associated construction techniques), as summarised in Table 4.2 and shown in **Figure 4.6a and Figure 4.6b.**

Table 4.2: Track Construction Techniques

Design	Typical site conditions
Excavated Track	Shallow areas of peat of <1 m depth (estimated road thickness 600 mm)
Rock Filled Track	Shallow areas of peat of <1 m depth (estimated road thickness 600 mm)
Floating Track	Deep, flat, stable areas of peat ≥1 m with (estimated road thickness 1000 mm)
Widened Existing Track	Shallow areas of peat of <1m depth (estimated road thickness 600 mm)

Track Drainage

4.3.29. The need for drainage on the access track network would be considered for all parts of the track network separately, since slope and wetness vary considerably across the Site. In flat areas, drainage of floating tracks is not required, as it can be assumed that rainfall on to the road would infiltrate to the ground beneath the tracks or along the verges. Track-side drainage would be avoided, where possible, in order to prevent any local reductions in the water table or influences on the tracks structure and compression (the latter can occur where a lower water table reduces the ability of the peat to bear weight, increasing compression).

4.3.30. Where tracks are to be placed on slopes, lateral drainage would be installed on the upslope side of the track. The length of drains would be minimised, to prevent either pooling on the upslope side or, at the other extreme, creating long flow paths along which rapid and concentrated runoff could occur. Regular cross-drains would be required to allow flow to pass across the track (as recommended in SEPA's guidance[2]), with a preference for subsequent re-infiltration on the downslope side, rather than direct discharge to the drainage network.

[2] Version 3 of the Good Practice During Wind Farm Construction, 2015, Scottish Renewables, SNH, SEPA, FCS

Drainage Ditches along Excavated Tracks

4.3.31. Excavated tracks could cut off natural drainage across it; therefore, drainage ditches would be required. It is anticipated that at times the water in the ditches may contain high concentrations of sediment from excavations and track construction as well as possible accidental pollutants from construction activities; therefore, no water from a drainage ditch would be discharged directly to a watercourse. Instead it would pass through a sand filter, filter strip, silt trap or other best practice pollution control feature. Drains would not be ended directly into natural channels, ephemeral streams or old ditches.

4.3.32. The ditch design would be considered in line with the recommendations of the Forestry Civil Engineering (FCE) and SNH guidance[3], including the use of flat-bottomed ditches to reduce the depth of disturbance.

4.3.33. In instances of drainage close to surface watercourses, discharge from the drainage may be to surface water rather than re-infiltration. In these situations, best practice control measures including sediment settlement would be undertaken before the water is discharged into surface water systems. The discharges would be small and collected from only a limited area, rather than draining a large area to the same location.

4.3.34. Although drainage would be provided in areas of disturbance as required, areas of hardstanding would be minimised so that this need is reduced. This includes careful design of construction compounds and minimising the size of crane pads at each turbine location.

Cross Drainage

4.3.35. Where tracks are to be placed on slopes, lateral drainage would be required on the upslope side of the road. The length of drains would be minimised to prevent either pooling on the upslope side or at the other extreme, creating long flow paths along which rapid runoff could occur. Regular cross-drains would be required to allow flow to pass across the road (as recommended in SEPA's guidance), with a preference for subsequent re-infiltration on the downslope side rather than direct discharge to the drainage network.

4.3.36. Cross-drainage may be achieved using culverts or pipes beneath the track, in line with the FCE and SNH guidance. Drainage would be installed before or during track construction, rather than afterwards, to ensure that the track design is not compromised. The cross drainage would flow out in to shallow drainage, which would allow diffuse re-infiltration to the peat on the downslope side. The cross drains would flow out at ground level and not be hanging culverts. The avoidance of steep gradients for the tracks would also reduce the risk of erosion occurring at cross-drain outflows.

[3] Floating Roads on Peat, August 2010, Forestry Civil Engineering and SNH

Check Dams

4.3.37. Check dams (small dams built across channels or ditches) may be required at regular intervals in the drainage ditches alongside an excavated track. They are required for two principal reasons: firstly, they act as a silt/pollution trap slowing the flow of water so allowing sediment to settle out, and secondly, they help to direct water into the cross drains and allow natural drainage paths to be maintained as much as possible. The spacing of the check dams would depend on the following factors:

- the gradient of the track;
- the spacing of cross-drains; and
- the depth of excavation.

Interface between Different Types of Road Drainage

4.3.38. Where the track construction method changes, the drainage methods would also change. If this results in an end point for a drainage ditch, the ditch would be piped across the road and allowed to discharge to land on the down side of the slope taking into account the precautions against peat instability, pollution and erosion discussed later in this chapter.

4.3.39. As discussed above, the alignment of the on-site tracks has already been subject to initial review and rerouting to respond to readily identifiable constraints. The final decision on alignment and on the appropriate type of access track design to adopt for a particular length of track would be made by a team of engineers, geologists, and the Environmental Clerk of Works (ECoW), in advance of construction and giving enough time to produce method statements and define working areas for discussion with SEPA prior to construction.

4.3.40. Construction timing and design of access tracks can strongly influence the potential for effects on the freshwater environment. Construction during wetter periods of the year poses a significantly greater risk of causing erosion and siltation, which can be particularly severe following major rainfall or snowmelt events. Whilst there is no proposal to restrict construction during such periods, the awareness of the increased potential for effects to arise following precipitation would be captured within the Construction Method Statement described at paragraph 4.4.9 below.

Watercourse and Service Crossings

4.3.41. Whilst every attempt has been made to avoid watercourse crossings, it has been necessary for the on-site access tracks to cross local watercourses to reach the proposed wind turbine locations. Nine watercourse crossings have been included in the project design, although four of them are upgrades to existing crossings; they are shown on **Figure 13.2**.

4.3.42. Three types of watercourse crossing are proposed for the Development: bridges, box culverts and pipe culverts. However, the use of each of these types of structure would be determined individually to minimise potential effects based on a site-specific assessment, which would account for topographic, hydrological and ecological attributes at each proposed crossing point. All watercourse crossings would be designed in accordance with the SEPA Good Practice Guide for the Construction of River Crossings, and where culverts are required, they would be designed in accordance with the CIRIA Culvert Design and Operation Guide (C689). All river crossings would be designed to convey a 1 in 200 year return period flood event as well as individually sized and designed to suit the specific requirements and constraints of its location. The following paragraphs discuss the currently identified water crossings and the anticipated crossing type. As noted above, it is probable that additional crossings would be identified on site during construction or the proposed crossings may change. All crossing points and methodologies would be agreed prior to construction.

Culverts

4.3.43. Culverts could be used in locations where there are small but distinct channels with no clear topographic variability. The small size and channel capacity limit the hydrological and ecological benefits that a bridge would bring, while the lack of topographic variation would make bridge design unfeasible.

4.3.44. Where culverts are to be used, their design shall meet minimum requirements as set out in CIRIA Culvert Design and Operation Guide (C689).

4.3.45. The size of the culvert would be determined by the design flow of the watercourse and its gradient at the point of crossing. Small circular culverts would be used where a small watercourse needs to be crossed or where the river crossing is deemed to have low environmental sensitivity. Where there is a wider channel, a ‘bottomless arched culvert’ or precast 'box' culvert would be used and typical plans and sections for these are shown in **Figure 4.7.**

4.3.46. The construction techniques would be site specific, either where the watercourse would be temporarily diverted whilst the culvert is constructed or where the watercourse would be diverted to a new alignment through the structure. When installing culverts in streams, they would be laid at the natural bed level and the same gradient, so as not to cause a barrier to fish movement. The riverbed would be reinstated through the length of the culvert to keep the watercourse flowing as naturally as possible. A mammal tunnel, if judged necessary by ecologists following further pre-construction surveys, would be provided so that no restriction is created to established animal movement routes.

Bridges

4.3.47. Bridges are the preferred solution for larger crossings due to their lesser hydrological and ecological effects, and are particularly suited to higher flow watercourses. Bridge construction is unlikely to interfere with the watercourse to the same extent as culvert construction and can be built over the existing alignment of the river without the need for diversion. Foundations would be required on both banks (down to a competent bearing stratum) in order to support the bridge deck. A typical bridge plan and section is shown in **Figure 4.8.**

Service Crossings

4.3.48. There are no service crossings necessary on-site as no underground services have been identified.

Temporary Construction Compound

4.3.49. One main temporary construction compound would be created for the proposed development. The compound would be approx. 100 m x 50 m and its location is shown in **Figure 4.1** while the typical construction compound layout is shown in **Figure 4.9**.

4.3.50. Surface vegetation, top and subsoil 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 1,500 mm depth depending on ground conditions.

4.3.51. Temporary cabins, to be used for site offices and welfare facilities (including toilets and drying rooms) with provision for sealed waste and storage) are proposed. Welfare facilities would be installed as required by the Construction (Design and Management) Regulations 2015. If possible, the site welfare facilities would utilise services already in existence, for instance, low voltage power. If connection to local power is not possible, a diesel generator (bunded to 110 % diesel capacity) would be used to service the site facilities.

4.3.52. Where possible, water for welfare facilities would be provided via mains water supply. Where a mains supply is not available, water would be provided by ground water extraction.

4.3.53. The temporary site construction compound area would be fully reinstated with following the construction period.

Substation Compound, Battery Energy Storage Facility, and Control Buildings

4.3.54. The electricity substation compound would comprise a fenced hardstanding with maximum dimensions of approximately 145 m x 24 m, which would contain electrical equipment, the battery energy storage facility and two single storey control buildings, one Scottish Power control building measuring approximately 18 m x 12 m x 4.7 m and the other a wind farm operator's control building measuring approximately 16 m x 11 m x 6.3 m. The control buildings would house switchgear, metering, protection and control equipment as well as welfare facilities. **Figure 4.10** shows the substation compound, battery storage facility and control buildings. The proposed location of the compound control building and main site compound is shown in **Figure 4.1**. **Figures 4.11 – 4.13** show the control building and battery facility elevations.

4.3.55. 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.

4.3.56. 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.

4.3.57. The battery energy storage facility has been incorporated to maximise the electricity generated from the proposed wind turbines. The facility would have an approximate maximum electricity storage capacity of 6 MWh.

4.3.58. The various options for the use of the battery storage facility are as follows:

- Ramp control: When the local grid network is not able to absorb the additional wind power created by a quick wind speed increase, the battery storage facility would catch this extra generation and then store it in the batteries and release it back onto the grid when possible;
- Predictable power: Provide predictable and consistent power to the local grid network. The battery storage facility would have the ability to smooth out any short-term wind peaks and troughs; and
- Frequency regulation: This allows the wind farm to store energy in the battery storage facility in order to immediately and precisely respond to changes in load, further improving turbine generation flexibility.

Electrical Connections On-Site

4.3.59. The wind turbines typically produce electricity at 690 V, which is normally stepped-up to 33 kV via the turbine transformers.

4.3.60. Underground cables would link the turbines to the on-site control building and substation. Detailed construction and trenching specifications would depend on the ground conditions encountered at the time, but typically cables would be laid in a trench 1100 mm deep and 700 mm to 1300 mm wide. To minimise ground disturbance, cables would be routed alongside the access tracks wherever practicable and, if not, the total footprint of construction activity would be stated within the CMS. Approximately 9.5 km of cable trenches would be required to connect the turbines to the on-site control building. **Figure 4.14** shows a typical cable trench detail. The method of installation would be selected to have minimum disturbance to the peat at the time of installation and afterwards.

4.3.61. The following methods would be used where appropriate:

- burial in ducts across the tracks;
- fitted in ducts along bridges;
- burial in trenches; and
- ploughing.

4.3.62. Any excavations for pits would be cordoned off and marked clearly. Cable hauling operations would be coordinated with traffic movements, especially when hauling is being carried out from the roadway. Cable off-cuts and waste from terminations would be systematically collected, stored, and recycled or disposed of properly.

Borrow Workings

Stone Requirements and Sourcing

4.3.63. Table 4.3 below provides a breakdown of the required rock volumes for each construction element of the Proposed Development. It is anticipated that only the 100 mm thick surface layer of material is to be imported. All of the remaining rock would be sourced from borrow workings within the wind farm site. This has several distinct advantages over importing all of the rock from external sources; it greatly reduces the number of stone lorries on the public highways, reduces haulage distances for stone haulage lorries and hence, reduces fuel consumption.

Table 4.3: Estimated Rock Volumes Required during Construction

Infrastructure	**Total Rock Volume (m^3)**
Hardstandings and foundations	50,750
Tracks	26,700
Temporary construction compound	2,500
Substation compound	800
Total Rock Volume	**80,750**

Borrow Working Areas

4.3.64. Two potential borrow working search areas were identified through iterative design (see **Appendix 12.3**). These locations are informed by professional judgement and based on site survey results, including peat, hydrology, ecology, cultural heritage, and LVIA studies, as described in relevant chapters of this EIA report. The final location, number and estimate of material from each potential site would be determined once full ground investigation works and testing have been completed. Proposed borrow working drawings are shown in **Figures 4.15-4.16**.

4.3.65. The estimated volumes of stone required from each of the borrow workings are indicated in Table 4.4. This volume is in excess of the likely required volume of stone for construction and recognises that detailed investigations may mean a relatively higher proportion is secured from one potential borrow working than the other and that the quality of the rock materials may vary (with varying proportions suitable for re-use). Therefore, the totals indicated below provide flexibility between the choice and size of each borrow working.

Table 4.4: Estimated Volumes of Onsite Rock Available

Working Area	Estimated Area Excavated (ha)	Total Estimated Rock Volume (m3)
1	0.9	42,255
2	1.0	59,057
Total	1.9	101,312

4.3.66. As noted above, detailed intrusive investigations will be undertaken at a later stage of design. Once these are completed, a detailed plan for each borrow working would be developed and agreed with key consultees (e.g. DGC, SEPA and SNH). The plan would address establishment, extraction and restoration phases with the management protocols for the borrow workings included in the Construction Method Statement which is envisaged to be subject to an appropriate planning condition. Any quarrying activities would also follow the Approved Code of Practice, Health and Safety at Quarries Regulations (second edition, 2013).

4.3.67. The typical effects from the use of the borrow workings and the and expected mitigation to address these effects may include:

- Traffic - The majority of traffic moving stone would use on-site access tracks. Any requirement to cross highways would be addressed through a Traffic Management Plan;
- Blasting - Effects from blasting would be controlled through use of relevant protocols, blast mats and through appropriate communication and publicity about blasting occurrence. Blasts at each borrow working can be expected to be infrequent and at substantial distance from residential receptors, and they are not anticipated to be of any substantive concern, nor likely to give rise to nuisance nor significant effects;
- Noise / vibration - Potential effects arise from blasting itself as well as the use of excavation and stone crushing equipment. Use of appropriately silenced equipment, publicity over blasting, adherence to operational hours and the distance to residential receptors provide the main mitigation for such effects which are anticipated to be well within limits of acceptability established by guidance;
- Dust - Residential receptors are at considerable distance (the nearest property is no 1 Muirdrochwood which lies approximately 1.3km away from the southern borrow working area) and thus no dust effects on these are expected. Some potential for dust to be deposited on adjacent vegetation exists, and would be monitored by ecologists with effective mitigation implemented (e.g. with damping down of surfaces or use of mist sprays) should any potential problems be identified;
- Visual intrusion - Construction effects would be discernible through the presence of construction machinery. A long term and appropriate restoration plan for the borrow workings would be developed in agreement with consultees (SEPA, SNH, DGC) which is expected to include some regrading of the final profile and measures to encourage re-vegetation and potentially peat habitat restoration;
- Disturbance of peat - The borrow workings are located in areas where peat is less than 0.5m in depth to minimise the volume of peat disturbed.

However, some quantities of peat would need to be temporarily removed to allow rock extraction. Except for the first borrow working, the removed peat would be translocated directly to the preceding borrow working where excavation has ceased. To ensure progressive restoration and minimisation of peat volume that would be double-handled and in temporary storage, only one borrow working would be operational at a time. Following extraction each of the borrow workings would be progressively restored as described in Outline Peat Management Plan (refer to **Appendix 12.2**);

- Water - The potential for sediment laden water to be released would be controlled through appropriate design and treatment facilities at each borrow working. Design would be specific to each location and where possible would encourage natural infiltration; and
- Wastes - Any waste would be handled as per other construction wastes.

Concrete Batching Plants

4.3.68. Table 4.5 provides estimated volumes of concrete required for the installation of 19 no. wind turbines at the Site. The majority of the concrete used on-site is required for turbine foundations with additional material for the substation and transformer (if required).

Table 4.5: Estimated Volume of Concrete

Infrastructure	Total Volume of Concrete (m^3)
19 Wind Turbine Foundations	9,500
Substation/Control Building Foundations	1,566
Total Concrete Volume	**11,066**

4.3.69. Concrete may be sourced from local concrete suppliers or produced using materials won and processed on site at an on-site concrete batching plant.

4.3.70. Transportation of concrete from off-site locations would require approximately 56 loads per foundation, assuming 9 m^3 wagons are used which could transport approximately 21.7 tonnes (T) of material each. This would result in approximately 2,128 vehicle movements in total, subject to confirmation of design.

4.3.71. On-site concrete batching would result in a significant reduction in the number of vehicle movements on the local road network. The on-site batching plant is likely to be situated within or adjoining the construction compound.

Site Access

4.3.72. Due to the abnormal size and loading of wind turbine delivery vehicles, it is necessary to review the public highways that would provide access to the Site to ensure they are suitable and to identify any modifications required to facilitate access. A preliminary transport access study is included in **Appendix 15.1**.

4.3.73. The following potential abnormal loads delivery route has been identified:

- port of entry Ayr;
- depart port of Ayr via Waggon Road exit;
- southbound on A79 Alison Street;
- eastbound on A719 Whittlets Road;
- at Whittlets Roundabout southbound onto A77;
- at Bankfield Roundabout southbound onto A713;
- douth of Carsphairn eastbound onto B729; and
- into the Site via a new access junction between Muirdrochwood and Smittons on the B729.

4.3.74. A more detailed study would be carried out by the turbine supplier should the Proposed Development be granted consent. As the turbine delivery vehicles are abnormal indivisible loads, a Special Order is required under The Road Vehicles (Authorisation of Special Types) (General) Order 2003.

4.3.75. The detailed off-site access requirements would be confirmed with Transport Scotland and Dumfries and Galloway Council's Highway Department once the exact requirements are established. A Traffic Management Plan would also be put in place to ensure safe operation, and this would also be established in conjunction with the aforementioned authorities.

4.3.76. A detailed drawing of the access junction into the Site is shown in **Figure 4.17**.

Operational Anemometry Mast

4.3.77. An operational phase met mast is required to optimise turbine performance and calibrate turbine wind readings. This mast would be of a lattice design without guy wires and would have a height of up to 100 m.

4.3.78. It would require a concrete foundation with approximate dimensions of approx. 6 m x 6 m x 0.5 m. There would be no requirement for a track leading up to the mast. The mast would be located within the north western part of the site near turbine 4. **Figure 4.18** shows the operational phase meteorological mast.

Development Land Take

4.3.79. The total infrastructure land take (footprint) is 24.5 ha. This area includes for additional areas beyond the components and infrastructure that would be disturbed associated with earthworks. These areas would be reinstated throughout construction and post-construction.

Forestry

4.3.80. Areas of forestry would require to be cleared for the construction and operation of the Proposed Development. The forestry proposals have been developed to identify areas of forest to be removed, including habitat management works;

identify those areas which may or may not be planted as part of the Proposed Development; and describe management practices for the forestry works.

4.3.81. The Forestry Study Area extends to approximately 820.5 hectares (ha) and contains two separate commercial forest blocks under separate ownership. To the north is Craigengillan North Forest covering 297.1 ha, and to the south, Smittons Forest covering 523.4 ha. The combined forestry study area contains a range of woodland types and age classes due to recent restructuring. The forest is comprised largely of commercial conifers with small areas of mixed broadleaves. There is an active felling and restocking programme underway across the study area with areas of ground currently felled awaiting restock.

4.3.82. The wind farm felling plan shows which parts of the forest would be felled as a result of the Proposed Development and when this felling would take place. In this case considering technical and environmental constraints a 2.5 ha (90 m radius) keyhole was adopted around each turbine location within woodland for construction, operation and environmental mitigation, with 10 m buffers for other infrastructure and 30 m corridor for road lines. No additional felling would be required for wind yield or turbine performance purposes.

4.3.83. All felling for the Proposed Development would take place during the construction period, there would be no further development felling during the operational period. In total 55.1 ha would be felled due to the construction of the wind farm. Where possible timber crops would be felled to produce timber for the markets. Forestry waste arising from the felling would be treated in a manner which produces the best environmental outcome taking into account the guidance and conditions prevailing at the time of the crop clearance.

4.3.84. The Proposed Development restocking plan shows which woodlands would be restocked and with which species. No replanting would be carried out on the areas to be felled for the Proposed Development's permanent infrastructure or for habitat management, forest management or forest design purposes. As a result, there would be a net loss of woodland area of 61.1 ha. In order to comply with the criteria of the Scottish Government's Control of Woodland Removal Policy, off-site compensation planting would be required.

Grid Connection

4.3.85. It is likely that the wind farm would be connected into the national transmission system in the vicinity of Holm Hill near the A713, approximately 7 km to the north-west of the Site, via a new pole mounted overhead 132 kV line currently being planned by Scottish Power Energy Networks to connect the Lorg and Longburn wind farms.

4.3.86. This grid connection arrangement is, however, a preliminary estimate at this stage, and the link would be the subject of further appraisal work and a separate application by Scottish Power Energy Networks.

4.4. Construction of the Proposed Development

Timetable of Events and Indicative Programme

4.4.1. The construction period for the Proposed Development would be approximately 21 months in duration and would comprise the following activities:

- construction of access junction;
- construction of borrow workings and sourcing of rock;
- formation of site compound(s) including hardstanding and temporary site office facilities;
- construction of new access tracks and passing places (as required), inter-linking the turbine locations and substation compound;
- construction and upgrade of culverts under roads to facilitate drainage and maintain existing hydrology;
- construction of bridges where required;
- construction of crane hardstanding areas;
- construction of turbine foundations;
- construction of site control building and associated substation;
- construction and installation of battery storage facility;
- excavation of trenches and cable laying adjacent to site roads;
- connection of on-site distribution and signal cables;
- remedial works to the public highway to accommodate turbine deliveries;
- delivery and erection of wind turbines;
- commissioning of site equipment; and
- site restoration.

4.4.2. Where possible, construction activities would be carried out concurrently (thus minimising the overall length of the construction programme), although they would occur predominantly in the order listed. In addition, development would be phased such that, at different parts of the site, the civil engineering works would be continuing whilst wind turbines are being erected. Site restoration would be programmed and carried out concurrently with the construction to allow restoration of disturbed areas as early as possible and in a progressive manner. Stone would be taken from one borrow working at a time with progressive restoration using peat from further construction areas (e.g. next borrow working), once it is necessary to move to the next borrow working.

4.4.3. Floating roads scheduling and construction would take account of predicted settlement rates, with monitoring undertaken to ensure their stability.

4.4.4. The starting date for construction activities will largely be dependent upon the date that consent might be granted and grid availability; subsequently, the programme would be influenced by constraints on the timing and duration of any mitigation measures confirmed in the individual technical chapters or by the consent decision. An indicative construction programme is shown in **Figure 4.19**.

4.4.5. The final length of the programme would be dependent on seasonal working and weather conditions. Summer months are favoured for construction due to longer periods of sunlight allowing longer working days. Summer months are generally also drier which aids the construction progress and reduces the impact of site debris reaching the public highway (e.g. mud, etc.), though wheel wash facilities would be installed at the main site entrance / exit points. Wet weather has the potential to complicate construction activities in peat, although these complications can be minimised through the use of 'stop rules'.

4.4.6. Weather, in particular wind, has a strong influence on the timing of construction activities. Crane activities are generally limited during strong winds (>9 m/s) and turbine erection during these weather conditions would be avoided for safety reasons; the actual conditions would be reviewed as part of the crane lifting plan. During periods of cold weather (<4 °C), concrete pouring of the turbine bases must consider cold weather effects, potentially prohibiting concrete pours.

General Construction Methodology

4.4.7. The following sections describe the outline construction methodologies proposed and serve as a basis for completion of the technical assessments.

4.4.8. The Proposed Development would be constructed in accordance with documented ISO 14001 (2015) environmental management procedures which ensure compliance with applicable environmental legislation and best practice. Effective communication underpins the whole system of environmental management, ensuring appropriate information passes between the Applicant and the consultants / contractors engaged. This ensures that environmental considerations are fully integrated into the management of the wind farm throughout construction, the operation, and maintenance of the completed project and ultimately to decommissioning.

Construction Method Statement

4.4.9. It is anticipated that Dumfries and Galloway Council would wish to secure (within the deemed planning permission) the conditional approval of a Construction Method Statement (CMS) so that construction is completed in accordance with an approved document. This section sets out the basis of the applicant's approach to construction. Should consent be obtained, a CMS would be submitted to the planning authority for approval prior to any construction activity taking place. In turn, the applicant would bind the selected contractor to the terms of the CMS.

4.4.10. Selection of the construction contractor would be based partly upon the contractor's record in dealing with environmental issues and on its provision of evidence that it has incorporated all environmental requirements into its method statements as well as its staffing and budgetary provisions. The Applicant would retain the services of specialist advisers, for example on archaeology, ecology, and peat restoration, to be called on, as required, to advise on specific issues, including micro-siting. More detailed information on the role of such specialist advisors during construction is provided in the relevant technical sections, where appropriate.

4.4.11. The contract between the Applicant and the contractor would specify the measures to be taken to reduce or mitigate the environmental impact of the construction process (as detailed in the technical chapters of this EIA report). A copy of any conditions associated with the deemed planning permission would be incorporated into the contract with the contractor and any subcontractors responsible for constructing the Proposed Development. All contractors will be contractually obliged to adhere to the planning conditions.

4.4.12. All of the general mitigation measures would be set out within a Construction Environmental Management Plan (CEMP) which would be produced prior to the commencement of construction of the development. The CEMP would set out how the development would be constructed and additional mitigation commitments. These additional commitments would include both specific mitigation measures as well as proposals for monitoring and emergency procedures. Such emergency procedures would include a site-specific Pollution Incident Response Plan in order to prevent and mitigate damage to the environment caused by accidents such as spillages and fires.

4.4.13. The CEMP would be fully developed following the grant of consent and be subject to approval by the local authority in conjunction with relevant consultees for the attendant elements, however an Outline Construction Environmental Management Plan (OCEMP) has been prepared for the purposes of the s36 application and this is included in **Appendix 4.1**). The CEMP would incorporate the following:

- Pollution Prevention Plan (PPP);
- Drainage Management Plan (DMP);
- Traffic Management Plan (TMP);
- Site Waste Management Plan (SWMP);
- Stakeholder Management Plan (SMP);
- Habitat Management Plan (HMP);
- Peat Management Plan (PMP, for the outline PMP refer to **Appendix 12.2**);
- Peat Slide Risk Assessment (**Appendix 12.1**); and
- Geotechnical Risk Register (containing, among others, peat stability-specific input from PSRA, refer to **Appendix 12.1**).

4.4.14. The OCEMP (outlined in **Appendix 4.1**) is proposed as the means to capture a diverse range of environmental management controls. Examples of the measures proposed and expected to be incorporated into the CEMP include the adoption of best practice guidance; the appointment of an Environmental Clerk of Works (ECoW) to oversee correct implementation of agreed commitments; completion of a Traffic Management Plan presenting detailed access routes and delivery timings, car parking arrangements, temporary signage etc; demarcation of working area following the micrositing exercise with temporary fencing as required along with location specific method statements if habitat sensitivity is high; completion and implementation of a Habitat Management Plan; development of an infrastructure monitoring programme to identify any requirement for remedial work; and an exclusion of equipment from watercourses and, as far as possible from immediate riparian zones during watercourse crossing construction along with measures to minimise change in in stream substrates.

4.4.15. The developed CMS and CEMP would be submitted for agreement with the appropriate planning authorities and bodies, such as SEPA, prior to construction and development. In order to ensure that the CMS and CEMP are being suitably adhered to by the appointed contractors, an independent and suitably qualified Owner's Engineer would be employed during the construction phase of the project to monitor implementation and provide specialist advice. The Owner's Engineer would liaise with the various environmental, archaeological and other advisers who would have input into the project to ensure compliance is met in relation to any imposed planning conditions as well as the approved CMS and CEMP.

Construction Working Practices

4.4.16. Contractors' working areas would be made available, and the location would be clearly delineated on-site to ensure that no unnecessary disturbance is caused to any sensitive areas.

4.4.17. Particular attention would be given to the storage and use of fuels for the plant on-site. Oil would be stored in accordance with the Water Environment (oil storage) (Scotland) Regulation 2006. Drainage within the temporary site compound, where construction vehicles would park and where any diesel fuel would be stored, would be directed to an oil interceptor to prevent pollution if any spillage occurred. Storage of diesel fuel would be within a bunded area or self-bunded tank in accordance with the SEPA Pollution Prevention Guidelines (PPG). PPGs are considered to constitute 'best practice' within the industry. The PPGs relevant to the Proposed Development are shown in Table 4.6 and are available from: http://www.sepa.org.uk/about_us/publications/guidance/ppgs.aspx.

Table 4.6: Applicable PPG Guidelines

PPG Number		
PPG1	General guide to the prevention of pollution	All activities
PPG2	Above ground oil storage tanks	Plant related activities
PPG3	The use and design of oil interceptors	Plant related activities
PPG4	Treatment and disposal of sewage	On-site facilities
PPG5	Works and maintenance in or near water	Works adjacent to on site watercourses
PPG6	Working at construction and demolition sites	All activities
PPG7	Refuelling facilities	Plant related activities
PPG8	Safe storage and disposal of used oils	Plant related activities
PPG13	Vehicle washing and cleaning	Plant related activities
PPG18	Managing fire water and major spillages	All activities
PPG21	Pollution incident response planning	All activities
PPG22	Incident response – dealing with spills	All activities
PPG26	Storage & handling of drums & intermediate bulk containers	Plant related activities

4.4.18. Standard construction working practices would be implemented during construction and any maintenance works, in order to ensure adherence to relevant guidance and other current best practice, including but not limited to the following:

- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR);
- Water Environment (Controlled Activities) (Scotland) Amendment Regulations 2013 (CAR);
- Water Environment (Oil Storage) (Scotland) Regulations 2006;
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) - A Practical Guide (2015);
- SEPA Engineering in the Water Environment Good Practice Guides available from https://www.sepa.org.uk/regulations/water/engineering/engineering-guidance/. This includes guidance on:
  - Bank Protection; Rivers and Lochs;
  - River Crossings;
  - Riparian Vegetation Management; and
  - Temporary Construction Methods and;
- Good Practice During Windfarm Construction (Scottish Renewables, SNH, SEPA, Forestry Commission Scotland, Historic Environment Scotland, 2015);
- Forests and Water: UK Forestry Standard Guidelines (Forestry Commission, 2011);
- Constructed Tracks in the Scottish Uplands (SNH, 2015);
- Floating Roads on Peat (Forestry Commission Scotland and SNH, 2010); and
- Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (Scottish Government 2017).

Construction Works and Delivery Times

4.4.19. For the purposes of this EIA report, construction activities have been assumed to take place between 07:00 to 19:00 hours on week days and 07:00 to 18:00 on Saturdays. Quiet on-site working activities such as electrical commissioning are assumed to extend outside the core working times, noted above, where required. No work at the site would be undertaken on Sundays or public/bank holidays.

4.4.20. Work outside these hours is not usual, though if it was required to meet specific short term demands (e.g. during foundation pours or to undertake work which is highly weather dependent such as low wind speeds needed for turbine tower erection), the planning authority would be informed, as required.

Air Quality and Dust

4.4.21. In the absence of appropriate mitigation there is the potential for an increase in dust during construction. However, dust control measures form a well-established and effective measure of control during the construction of wind farms. Given the adoption of the mitigation measures that are outlined below, it is not expected that the change in air quality in relation to dust would be significant. The main measures for managing dust that would be used where necessary are:

- Adequate dust suppression facilities would be used on site. This could include the provision of on-site water bowsers with sufficient capacity and range to dampen down all areas that may lead to dust escape.
- Any storage on-site of aggregate or fine materials would be properly enclosed and screened so that dust escape from the Site is avoided. Adequate sheeting would also be provided for the finer materials that are prone to 'wind whipping'.
- Heavy Goods Vehicles (HGVs) entering and exiting the site should be fitted with adequate sheeting to totally cover any load carried that has the potential to be 'wind whipped' from the vehicle.
- Vehicles used on-site should be regularly maintained to minimise vehicle emissions and the risk of leaking of diesel or hydraulic fluids.
- Good housekeeping or 'clean up' arrangements would be employed so that the site is kept as clean as possible. There would be regular inspections of the working areas and immediate surrounding areas to ensure that any dust accumulation, litter or spillages are removed/ cleaned up as soon as possible.
- Wheel wash facilities for vehicles entering and exiting the site would ensure that excavated materials do not leave the Site. Such facilities would automatically clean the lower parts of HGVs by removing mud, clay, etc. from the wheels and chassis in one drive-through operation. A water supply would be provided at the main site entrance/exit points should wheel-washing be necessary for vehicles exiting the Site.
- A site liaison person would investigate and take appropriate action where complaints or queries about construction issues arise.

Construction and Operational Wastes

4.4.22. Any substrate generated by excavation of foundations is expected to be reused on site. Substrate would be reused in restoration of disturbed areas, and other material would be used to backfill excavations where needed. It is not expected that any material would be unsuitable for re-use in these ways, though in the unlikely event that small amounts of such material arise they would be disposed off-site in line with relevant waste disposal regulations. Steps would be taken to minimise the extraction of peat as per the OPMP (refer to **Appendix 12.2**) The OPMP would ensure that peat excavated during construction is safely and suitably re-used within the extent of the Site.

4.4.23. Construction waste is expected to be restricted to normal materials such as offcuts of timber, wire, fibreglass, cleaning cloths, paper and similar materials. These would be sorted and recycled, if possible, or disposed of to an appropriately licensed landfill by the relevant contractor.

4.4.24. Operational waste would typically be restricted to very small volumes of normal materials associated with machinery repair and maintenance. All such materials would be disposed of by the maintenance contractors in line with normal waste disposal practices.

Fuel Storage and Refuelling Activities

4.4.25. Fuel storage and refuelling activities have been identified as having potential effects that can be controlled by the implementation of pollution prevention and control measures and best practice by the site operator.

4.4.26. In order to minimise potential releases into the water environment, fuel would be stored in either a bunded area or self bunded Above Ground Storage Tank (AGST) on site during the course of the construction phase in accordance with PPG2 and other SEPA Pollution prevention guidelines.

4.4.27. Surface water drainage would be directed to a hydrocarbon interceptor prior to discharge, in areas where there is a potential for hydrocarbon residues from runoff / isolated leakages such as in plant storage areas and the location of the fuel storage tanks and refuelling activities in the proposed temporary site compound. The interceptor would filter out hydrocarbon residues from drainage water and retain hydrocarbon product in the event of a spillage to prevent release into surface waters at the discharge point and deterioration of downstream water quality.

Peat Management during Construction

4.4.28. The large majority of the site either does not contain peat or is underlain by relatively shallow peat. There are however some areas of deeper peat, particularly along the western side of the site. The wind farm layout, design, and construction methodology has been refined to minimise peat excavation from tracks and turbine infrastructure, but it has not been possible to avoid it entirely.

4.4.29. Peat would be excavated during the construction of tracks, foundations, hardstandings, substation, and temporary compounds. The majority of peat would come from foundations, hardstandings and track construction and, to a lesser extent, temporary compounds.

4.4.30. The OPMP provided, as **Appendix 12.2**, would be updated prior to construction, following completion of detailed ground investigations and micro-siting, and agreed with SEPA and SNH. This would address methods in respect of peat excavation, haulage, storage, re-use, and disturbed habitat restoration.

4.4.31. **Appendix 12.1** provides the Peat Slide Risk Assessment. The Outline Peat Management Plan together with the mitigation measures in the chapter and the Peat Slide Risk Assessment would ensure that peat excavated during construction is safely and suitably re-used within the extent of the Site.

4.5. Operation of the Proposed Development

General Servicing

4.5.1. Each turbine manufacturer has specific maintenance requirements, but typically, routine maintenance or servicing of turbines is carried out twice a year, with a main service at twelve monthly intervals and a minor service at 6 months. In the first year, there is also an initial three month service after commissioning. The turbine being serviced is switched off for the duration of its service.

4.5.2. Teams of two people with a 4x4 vehicle would carry out the servicing. It takes two people (on average) one day to service each turbine.

4.5.3. At regular periods through the project life, oils and components would require changing, which would increase the service time on-site per machine. Gearbox oil changes are required approximately every 18 months.

4.5.4. Changing the oil and worn components would extend each turbine service by one day. The typical duration of other repair / replacement procedures together with the equipment and personnel that would be required for different tasks is shown in Table 4.7. It should be noted that these figures are only estimates.

4.5.5. Blade inspections would occur as required (somewhere between every two and five years) using a Cherry Picker or similar, but may also be performed with a 50T crane and a man-basket. It could take approximately two weeks to inspect the turbines at the Proposed Development. Repairs to blades would utilise the same equipment.

4.5.6. Blade inspection and repair work is especially weather-dependent. Light winds and warm, dry conditions are required for blade repairs. Hence summer (June, July and August) is the most appropriate period for this work.

4.5.7. The following factors could have significant effects on the duration of repair operations:

- working with cranes is highly weather-dependent;
- the availability of spares; and
- the stage in the component's life cycle.

Table 4.7: List of Potential Operational and Maintenance Activities

Item	Personnel	Equipment	Likely Duration of Job
Generator	2 x fitters	50T (3 axle) or 100T (6 axle) crane. 10T flat bed lorry	1 day
Gearbox	4 x fitters	50T or 100T crane 10T flat bed lorry	6 days
Blade/Rotor	6 x fitters	100T crane and 50T crane Articulated delivery lorry	4 days
Transformer	2 x fitters	50T crane and or 20T flat bed lorry with own crane	1 day
Track Maintenance	Drivers	40T stone delivery lorries, Grader / roller and Excavator	Very limited, likely to be occasional patching

Item	Personnel	Equipment	Likely Duration of Job
Snow Clearance	Driver	Excavator	Conditions specific (unlikely to occur)
Dismantling a turbine	8 x fitters	500T crane and support lorries plus 100T crane. Articulated lorries for components	3 days per turbine
HV/comms. Cable faults	6 x fitters	Vans or tracked vehicles for off-site work	Variable

Track Maintenance

4.5.8. The frequency of track maintenance depends largely on the volume and nature of the traffic using the track, with weathering of the track surface also having a significant effect. Since the volume of traffic using the access tracks during operation would be low (although heavy plant is particularly wearing), the need for track maintenance is anticipated to be low and infrequent. Any maintenance that is required would generally be undertaken in the summer months when the tracks are dry. However, maintenance can be carried out when required.

Land Management

4.5.9. It is anticipated that long term land management practices would continue unaffected by the Proposed Development with normal forestry practices continuing unimpeded.

4.5.10. On-site access tracks could be utilised by transport vehicles, and re-planting can commence soon after turbine construction.

4.6. Decommissioning of the Proposed Development

4.6.1. The Proposed Development has been designed with an operational life of 25 years. At the end of the operational period, it would be decommissioned and the turbines dismantled and removed. Any alternative to this action would require consent from Dumfries and Galloway Council and is not considered in this EIA report.

4.6.2. During decommissioning, the bases would be broken out to below ground level. All cables would be cut off below ground level, de-energised, and left in the ground. Access tracks would be left for use by the landowner. No stone would be removed from the Site. The decommissioning works are estimated to take six months. This approach is considered to be less environmentally damaging than seeking to remove foundations, cables and roads entirely.

4.7. Mitigation and Enhancement Measures Summary

4.7.1. The preceding parts of this chapter capture the inherent Proposed Development design that is the subject of this EIA. In completing the EIA, the subsequent technical chapters have identified a number of environmental measures that provide mitigation for predicted effects or are proposed by the Applicant as enhancement measures. As both enhancement measures and mitigation form an integral part of the Proposed Development, they are summarised in Table 4.8 for completeness.

Table 4.8: Summary of mitigation and enhancement measures

Chapter/Topic	Proposed Mitigation/Enhancement measure
Forestry	In order to comply with the criteria of the Scottish Government's Control of Woodland Removal Policy, 61.1 ha off-site compensation planting would be required. The Applicant is committed to providing appropriate compensation planting. The extent, location and composition of such planting to be agreed with FCS, taking into account any revision to the felling and restocking plans prior to the commencement of construction. A Forestry Waste Management Plan will be prepared during the detailed planning phase following the receipt of consent and will form part of the CEMP.
Landscape and Visual Impact	All mitigation is embedded into the overall design of the Proposed Development.
Ecology:	• An Ecological Clerk of Works (ECoW) will be appointed to provide ecological and environmental advice during pre-construction and construction. • Pre-construction surveys for protected species will be undertaken within the working areas (and appropriate buffers). These surveys will inform the implementation of species protection plans, licencing requirements and appropriate mitigation. • A Construction Biosecurity Plan (CBP) will be written and implemented ahead of the commencement of the construction phase. The CBP will be subject to approval by the local planning authority and will aim to ensure works do not facilitate the spread of signal crayfish. • Measures to maintain hydrological connectivity during construction will put in place, and good practice measures for the management and storage of peat (including appropriate use of vegetated turves) will be undertaken to ensure effective re-use as part of reinstatement works. • An offset distance of 50 m between bat habitats, such as riparian features and forest edges and turbines blade tips will be implemented and maintained throughout the life of the Proposed Development. Any proposed restocking will ensure incorporation of a 50 m separation distance through inclusion in the finalised restocking plan design. •Should the updated guidance confirm a requirement for post-construction monitoring, a programme should be developed to identify and minimise the risk of collision to bats and detailed within a bat monitoring and mitigation plan.

Chapter/Topic	Proposed Mitigation/Enhancement measure
Ornithology: Embedded Mitigation	• Pre-construction surveys for wild birds will be undertaken within the working areas (and appropriate buffers). These surveys will inform the implementation of species protection plans, licencing requirements and appropriate mitigation.
Cultural Heritage	Construction Implementation of an appropriate scheme of archaeological work to be agreed in the form of a Written Scheme of Investigation with Dumfries and Galloway and Historic Environment Scotland. This should cover: • Pre-construction surveys (if any); • Watching Brief during construction (with opportunities for investigation recording); • Control of felling (hand-felling etc.) around the Craigengillan Scheduled Monument; and • Post-fieldwork assessment, analysis and reporting. Post-construction Replanting around Craigengillan Cairn to establish a clearing setting for the cairn. The clearing will be defined by broadleaf and native species, set back sufficiently to better reveal the form of the cairn, and to prevent further damage from root action and tree-fall. It is proposed to: • Provide an agreed level of recording at and around the cairn to assist in the future management of this asset; • Agree the clearing details (size, species mix etc.) with Dumfries and Galloway; • Maintain a watching brief during replanting operations; and • Maintain the agreed clearing (in its mature form) during the lifetime of the Proposed Development.
Geology	Construction The following mitigation during construction is proposed: • Micro-siting of turbine locations (T4, T6, T8, T9, T10, T13 and T16) within areas of deep peat up to a maximum distance of 75m; • Micro-siting of turbine locations (T13 and T16) in line with the approach to minimise disturbance will reduce peat stability risks in parallel; • Adoption of best practice measures for dealing with peat excavations, storage and subsequent backfilling; • Additional ground investigations following forestry felling; and • Slope stability monitoring will occur during pre-construction and construction phases of work. No mitigation is proposed for operational or decommissioning phases.
Hydrology	• All site personnel will be aware they are working in a DWPA and Scottish Water will be notified without delay in the event

Chapter/Topic	Proposed Mitigation/Enhancement measure
	of a pollution incident. • Best practice management will be put in place for chemical storage and use including fuel, oils and concrete. This will include bunding of the construction compound, use of spill kits and absorbent pads and use of impermeable geotextile membranes in chemical storage areas. • Vehicles are to be well maintained and speed limits adhered to. • Best practice measures will be put in place to protect private water supplies including absorbent spill pads / kits and other measures highlighted within the outline CEMP. Best practice construction methods including speed limits and regular vehicle and machine maintenance will be employed. • Measures to protect GWDTEs, including maintaining hydrological connectivity, are to be put in place. • Maximum watercourse buffers have been adopted. • Best practice felling measures will be put in place and any felling in sensitive areas will be approved by the ECoW. • Best practice drainage and sediment management measures will be put in place including the use of check dams, silt fencing / mats. • A programme of water quality monitoring will be carried out during the pre-construction, construction and post-construction periods. • Best practice measures will be employed to manage drainage from access tracks and stored soils. • Best practice measures will be employed to manage dust from haul roads and access tracks. • Best practice measures will be followed during design and installation of watercourse crossings. All crossings agreed with SEPA at detailed design phase. • Details of all mitigation are set out in Technical Appendix 4.1 which will be included in the overall CEMP for the Development.
Noise	Construction/Decommissioning Phases Good practice measures include: • Operations shall be limited to times agreed with Dumfries and Galloway Council. • Deliveries of turbine components, plant and materials by HGV to site shall only take place by designated routes and within times agreed with Dumfries and Galloway Council. • The site contractors shall be required to employ the best practicable means of reducing noise emissions from plant, machinery and construction activities, as advocated in BS 5228. • Where practicable, the work programme will be phased, which would help to reduce the combined effects arising from several noisy operations. • Where necessary and practicable, noise from fixed plant and equipment will be contained within suitable acoustic enclosures or behind acoustic screens. • All sub-contractors appointed by the main contractor will be formally and legally obliged, and required through contract, to comply with all environmental noise conditions. • Where practicable, night-time working will not be carried

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	out. Local residents shall be notified in advance of any night-time construction activities likely to generate significant noise levels, e.g. turbine erection. • Any plant and equipment normally required for operation at night (23:00 - 07:00), e.g., generators or dewatering pumps, shall be silenced or suitably shielded to ensure that the night-time lower threshold of 45 dB, LAeq,night shall not be exceeded at the nearest noise-sensitive receptors.
Traffic	Traffic Management Plan to be prepared prior to construction. This should address the identified potentially significant effect which relates to pedestrian amenity near to schools in Carsphairn, Dalmellington and Patna. Recommended mitigation measures, for adoption in the TMP, are as follows: • As far as reasonably possible deliveries should be scheduled outside of school opening and closing times; • Drivers of all delivery vehicles to be made aware during induction of the presence of schools within these settlements and that formal pedestrian crossing facilities are not present; and • Dalmellington and Carsphairn have part-time 20 mph speed limits which should be in force during school opening and closing times. Drivers to be made aware of this during induction and reminded that strict adherence to these speed limits is expected.
Aviation	The turbines will be illuminated with infra-red lighting which is invisible to the human eye, in order for military aircrew using Night Vision Devices to be able to see and avoid the wind turbines.
Socio-Economics	No mitigation.
Shadow Flicker	In the event of a complaint received by the Developer Site Operator or Local Authority, and an appropriate investigation confirms occurrence, then measures such as those outlined below will be used to prevent re-occurrence and protect residential amenity. Several forms of mitigation for shadow flicker are available, including; • Control at Receptor: The provision of blinds, shutters or curtains to affected properties; • Control on Pathway: for example screening planting close to an affected property; and • Control at Source: for example shutdown of turbines at times when effects occur.
Telecommunications	There are no mitigation measures required for Telecommunications.
Health and Safety	Health and Safety measure are embedded into the design. These include: • The addition of brake mechanisms installed on the turbines to allow them to only operate under specific wind speeds. • The inclusion of vibration sensors on each wind turbine to

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	detect any imbalance which might be caused by ice build-up. • The addition of lightning protection measures in each wind turbine to ensure the lightning is conducted harmlessly. The risk of construction accidents as they relate to human health and safety would be covered in the CEMP and construction method statements, prepared as a condition of the Proposed Development. These would include identifying site specific risks and preparing assessments to minimise and manage the risk such as equipment safe handling, personal protection equipment, amongst others
Climate Change	Mitigation relating to carbon balance is addressed in the Outline Peat Management Plan.