5. DESCRIPTION OF DEVELOPMENT

5.1 Introduction

5.1.1 This chapter describes the proposed development, including installed components and site layout. Information regarding the construction, operation and decommissioning phases is also provided.

5.1.2 The indicative layout of the proposed development is shown on Figure 5.1. The operational wind farm will include the following key components, which are described in further detail in this chapter:

- 16 turbines of up to, but not exceeding, 149.9 m tip height with external transformers;
- hardstanding area at each turbine base with an approximate area of 1,800m^2;
- three permanent meteorological masts and associated hardstand areas;
- up to two site substations (one new substation and possible retention of the existing Tangy I and Tangy II Wind Farm substation);
- one operations control building with parking and welfare facilities;
- a total 11 km of onsite access tracks with associated watercourse crossings (of which approximately 7.4 km are new access tracks and 3.6 km are upgrades to existing tracks); and
- onsite underground cabling.

5.1.3 In addition to the above components of the operational wind farm, the construction phase will involve the following:

- temporary construction compound and laydown areas (option for on-site concrete batching);
- temporary meteorological masts;
- temporary telecoms infrastructure;
- forest removal and subsequent replanting;
- dismantling of existing turbines and associated reinstatement (turbine bases to ground level and approximately 2.1km of redundant access tracks); and
- up to 4 borrow pits.

5.1.4 These key components of the proposals for the construction and operational phases of the wind farm are described further in Section 5.3 (Operational Phase Components and Maintenance) and Section 5.4 (Construction Phase Components).

5.1.5 It is estimated that the maximum permanent development footprint of the wind farm will be approximately 13.74 ha. During the construction period, it is estimated that a further 15.98 ha will be temporarily required which will be reinstated following completion of the works. These land-use requirements are set out in Table 5.1.

Table 5.1: Land Use* estimation based on current site information

Wind Farm Component	Temporary Land Use (m^2)*	Permanent Land Use (m^2)*
Turbines	26390	5027
Hardstands	9504	28800
New Cut Track	16648	47723
New Float Track	15388	14811
Existing Tangy I/II Track (to be upgraded and retained)	10698	30659
Existing Tangy I/II Track (for construction only, then reinstated)	6407	0

Table 5.1: Land Use* estimation based on current site information		
Wind Farm Component	**Temporary Land Use (m^2)***	**Permanent Land Use (m^2)***
Existing Forest Track (to be upgraded)	1479	4239
Passing Places (4x4 vehicles)	0	3480
Passing Places (turbine transports)	0	660
Borrow Pits	710662	0
Temporary Construction Compound	10000	0
Construction Laydown Area	10000	0
Ops Building and Compound	0	2500
Substations	0	4200
Met Masts	0	2100
Total (m2)	**817176**	**144198**
Total (ha)	**82**	**14**

5.2 Site Access

5.2.1 A summary of vehicular access to the site is provided below, with full details of the assessment of effects on the local road network provided in Chapter 15 (Access, Traffic and Transport).

5.2.2 The construction and operations access to the site would be from the A83 to the south of the site and connects to Campbeltown and the B842 and B843 roads. It is envisaged that the turbine components would be delivered to the port facilities at Campbeltown and transported to the site via the A83. The B843 provides access to Machrihanish and to CS Wind UK, where turbine towers could be transported to the site.

5.2.3 Timber haulage from site will use the route from the A83 at Kilchenzie, temporarily upgraded as required, detailed in Chapter 15, (Access Traffic and Transport). Traffic accessing the site from the north via the A83, will continue southbound past Westport and Low Ballevain and turn left at Kilchenzie to access the site via the upgraded route. Most onward timber transport will be by sea utilising the timber handling facilities at Campbeltown harbour.

5.3 Operational Phase Components

Wind Turbines

Turbine Specification

5.3.1 The wind farm proposal comprises 16 three-bladed horizontal axis wind turbines. The turbines are computer controlled to ensure that at all times each turbine faces directly into the wind. As a result of this, the appearance of the wind farm will change with changes in wind direction. Table 5.2 provides a list of the proposed turbine locations.

Table 5.2: Proposed Turbine Locations		
Turbine ID	**Easting**	**Northing**
1	167315	628150
2	167860	628240
3	167392	628558
4	168349	628427
5	168850	628597
6	167456	628996

Table 5.2: Proposed Turbine Locations		
Turbine ID	**Easting**	**Northing**
7	167517	629424
8	167555	629887
9	168130	629820
10	168650	629740
11	169185	629495
12	169000	628979
13	168475	628908
14	167951	628835
15	168040	629307
16	168573	629327

5.3.2 A range of turbines are currently available within the proposed maximum tip height parameter of up to 149.9 m. The final choice of turbine will be dependent on commercial agreements and available technology at the time of construction, but will be within the maximum dimensional envelope of up to 149.9 m blade tip height. For the purposes of assessment, an indicative rotor diameter of up to 130 m rotor diameter and 91.5 m hub height were used. Where it has been necessary to select a specific representative turbine model or component size for the purposes of undertaking the environmental assessment, this has been highlighted in the individual assessment chapter. Figure 5.2 shows indicative turbine dimensions and elevations. Based on currently available technology, the generating capacity could be up to 80 MW for the site.

5.3.3 The turbines will generate electricity in wind speeds between approximately 4 and 25 m/s (9 to 56 mph). At wind speeds greater than this the turbines will shut down for self-protection.

5.3.4 The turbine towers will be of tapering tubular steel construction. The blades will be made from fibre-reinforced epoxy. The finish of the turbines is expected to be semi-matt pale grey colour, to be agreed in consultation with Argyll and Bute Council (ABC), within the required technical parameters.

5.3.5 A transformer will be required for each turbine, and depending on the turbine specification selected these may be contained within the turbine towers, or located adjacent to each turbine. These are typically 4m x 3m area and 2m in height (if located adjacent to the turbine, and would be sited within the standard hardstanding area as shown on Figure 5.3).

Turbine Installation

5.3.6 Turbine towers, blades and nacelles are likely to be transported via trailers with self-steering rear axles (refer to Plate 5.1). The tower sections and other turbine components will be stored either at a designated laydown area or at each turbine hardstanding until turbine erection commences.

Plate 5.1: Typical Haulage Vehicle for Turbine Delivery

Turbine Bases

Foundations

5.3.7 A typical foundation arrangement for the candidate turbine is shown on Figure 5.3, although these will vary depending on the turbine selection and ground conditions at each turbine site. Site-specific designs will therefore be developed once the turbine is selected and detailed intrusive ground investigations are undertaken at the construction phase.

5.3.8 Construction of the turbine foundations will generally require the excavation of subsoil and rock to a specified formation level, usually around 4m below existing ground level. The formation will be levelled off prior to the in-situ casting of a steel-reinforced concrete foundation. Foundations are likely to be circular with a diameter of approximately 20m. The depth of the excavation will depend on the depth to bedrock, with the sides 'battered' back to ensure that they remain stable during construction. Each foundation will require approximately 550m^3 of concrete and 70 tonnes of steel reinforcement.

5.3.9 The foundation inserts will then be cast into a central concrete up-stand section, to which the turbine tower will later be bolted. The excavated area will be back-filled with compacted layers of graded material from the original excavation, and capped with peat or soil. Locally around the turbines the finished surface will be capped with crushed aggregate to allow for safe personnel access around the base of the turbine.

5.3.10 Plate 5.2 illustrates the typical construction of turbine foundations.

Plate 5.2: Construction of Turbine Foundations

5.3.11 Temporary drainage will be incorporated into the design to divert surface water from the foundation, and various cable ducts and other ancillaries will also be installed.

Hardstandings

5.3.12 As shown on Figure 5.3, the turbine foundations will be located within a hardstanding area, dimensions for which vary considerably, and will depend on the turbine manufacture specification. The hardstanding areas accommodate the cranes required for construction, and provide a laydown area adjacent to each turbine location. The hardstanding areas will therefore be sufficiently level to ensure safe operation of the cranes required to erect the turbines. The final detail of the hardstanding will depend on the exact specification of the cranes chosen by the contractor. It is anticipated that a large crawler or wheeled/mobile crane (estimated 1000 tonne capacity) will be required for turbine erection, with one smaller 160 tonne pilot crane assisting with the lift procedure. It is anticipated that the temporary hardstanding area required at each turbine during construction would be approximately 2394m^2(permanent area plus a third).

5.3.13 It is anticipated that an area approximately 1,800m^2 will be required permanently for the hardstanding area at each turbine. The optimal layout (to minimise land take) for the current candidate turbine is shown on Figure 5.3.

5.3.14 Turning areas will be constructed at a number of turbines to allow unloaded delivery vehicles to turn safely and exit the site.

Plate 5.3: Existing Tangy Turbine Hardstanding and Turning Area

Access Tracks

Access Track Specification

5.3.15 The access track layout is shown on Figure 5.1 with indicative plans and cross-sections shown on Figure 5.4. The proposed access tracks are a total of approximately 11 km in length with a 6 m wide running surface. Of this 11 km, approximately 3.6 km are existing tracks from the Tangy I and II Wind Farm that are currently 3 m wide and would be widened by 3 m and have their surface upgraded to provide a 6m wide running surface. Approximately 493 m of existing forest track may be temporarily used to gain access to the site of Borrow Pit C.

5.3.16 Of the 7.4 km of new tracks to be constructed, it is currently expected that approximately 5.5 km would be a 'cut' design and 1.9km of a 'floating' design (see Paragraph 5.3.18 to 5.3.22 below). All tracks will be designed to incorporate passing places; both for 4x4 traffic and turbines. It is

anticipated that for 4x4 traffic, five passing places will be required every kilometre i.e. approximately every 200 m, and they would be approximately 15m long and 3m wide with 5m splays. There would be three turbine passing places on the whole site and they would be approximately 50 m long and 4 m wide with 5 m splays).

Table 5.3: Access Tracks* **estimation based on current site information**

Track Type	**Total Length (m)**		
New (Cut)	5,549	Total New Tracks: 7,473	Total Tangy IV Tracks: 11,039
New (Float)	1,924		
Existing Tangy I/II (Retained for Tangy IV)	3,566		
Existing Tangy I/II (Reinstated)	2,136		
Existing Forest (For Borrow Pit Access Only)	493		

5.3.17 As described in Chapter 4: Site Selection and Alternatives, the access track layout has been designed taking into account a range of environmental and technical constraints. This included a requirement to maintain appropriate gradients (<11%) for construction and turbine delivery vehicles and avoid watercourses and deeper peat where possible.

Access Track Construction

5.3.18 Figure 5.4 provides the indicative access track specifications. Site access tracks will be constructed with locally (on site) won graded stone and imported geotextiles (where necessary) with the surface course comprising durable graded crushed rock, also sourced from on-site borrow pits. This will match the existing site access roads/tracks in form and appearance. Plate 5.4 shows an existing access track within Tangy Wind Farm.

Plate 5.4: Existing Site Access Tracks

5.3.19 Depending on local ground conditions, access tracks will be constructed using either a 'floating track' or a 'cut track' design. Figure 5.1 shows the indicative locations of cut and floated track which will be refined post consent during the detailed design phase.

- Generally, a 'floating track' design will be utilised on the site in areas of deep peat and where technically feasible. This will incorporate geotextile material laid onto the surface at a width to

suit the road width, which will greatly increase the resistance to prevent the tracks settling into the ground. A layer of approximately 800 mm of crushed stone will then be laid on the geotextile to form the track, which produces a steep stone batter with the edges of the site track raised above the surface. This style of track is typically used in peaty areas across Scotland including other wind farm developments as well as public roads.

- In areas of shallow or no peat (0-1m), a 'cut track' design will be utilised for which the topsoil and peat will be stripped to expose a suitable foundation horizon on which to build the track. The track will then be constructed by laying and compacting crushed rock (obtained from suitable on-site borrow pits) to the required level. Given the variable and undulating topography across the site, it is likely that earthworks (cuttings and embankments) will be required to achieve the required gradients for tracks and crane hardstandings. Cutting slopes will be designed to reflect the existing landscape and topography and will likely range from gradients of 1:1 to 1:2. The upper soil/peat horizon, together with any vegetation, will be placed to one side for later reinstatement, if appropriate.

5.3.20 The average peat depth across the site, confirmed through peat probing, is generally shallow (<1m) with some areas of deeper peat up to 3m and small areas of >3m deep peat, refer to Figure 11.6 and Table 3.3 in Appendix 11.1. It is therefore anticipated that of the 8km of new access tracks to be constructed, the majority (approximately 5km) will be of cut track design. A peat depth summary plan and details of peat depth probing are provided in Appendix 11.1. Where appropriate, peat and other similar material from excavations on site will be placed along both sides of the site track and allowed to regenerate naturally, reducing the visual effect of these tracks. As described in Sections 5.4 (Construction Phase Components) and Section 5.7 (Site Management) of this chapter, excavated peat will also be used to restore other parts of the site, including borrow pits, reinstated access tracks, cable trenches and turbine foundations.

5.3.21 In the isolated areas of deeper peat, it is anticipated that a floating track design would be used, where deemed technically feasible. The typical cross-sectional detail of a floating track design is provided on Figure 5.4. The benefits of a floating track design are that it provides a firm surface over very soft terrain without the need to excavate large volumes of peat. In addition, there is minimal disruption of the sub-surface flow of water within the peat body, and no new channels are formed by which water can drain from the peat mass which can result in damage to the peat. Approximately 2km of access tracks will be of floating design to reduce volume of peat excavated and to mitigate against potential peat instability, as described further in Appendix 11.1 (Peat Stability Risk Assessment (PSRA)).

5.3.22 The typical cross-sectional detail of a cut track design is provided on Figure 5.4. As explained in EIA report Chapter 4 (Site Selection and Alternatives), the layout of the proposed development was refined during the design process to avoid, where possible, areas of elevated peat slide risk. The majority of the access tracks will be of cut design due to the relatively shallow peat depth (<1m) encountered on the site.

Access Track Drainage

5.3.23 Construction of site tracks requires robust drainage. Run-off will be diverted away by ditches into swales and settlement lagoon/ponds to attenuate flows and remove sediments before discharging to land. Further details are provided in Appendix 5.1 outline Construction Environmental Management Plan (CEMP). Existing drainage infrastructure will be utilised where possible, as described in Chapter 12 (Surface Water).

5.3.24 The tracks will have an engineered crossfall to shed surface water into adjacent ditches. Where practical, interceptor (cut-off) ditches will be formed on the upslope side of the track to collect and divert clean water away from the tracks. Refer to Figure 5.4: Indicative Access Track Detail.

5.3.25 Cross drains will be installed at regular intervals to prevent flooding / surcharging of trackside drainage and maintain hydraulic pathways. As far as possible, these will coincide with naturally occurring drainage channels.

5.3.26 The proposed routes for the site tracks have been designed to minimise watercourse crossings by a combination of avoidance and by using existing crossings wherever possible. Due to the re-use of existing tracks in the proposed design only one new watercourse crossing is required for the proposed development. An appropriate crossing will be designed to suit each location, dependent on the width of the crossing, the nature of the substrate, other local conditions and the amount of traffic that will use it. These crossings will be designed based on best practice, including:

- SEPA (2015)WAT-PS-06-02 Culverting of Watercourses, V2, June 2015;
- WAT-SG-25:SEPA (2010), Engineering in the Water Environment, Good Practice Guide, Construction of River Crossings, Version 2;
- Scottish Executive (2000): River Crossings and Migratory Fish: Design Guidance;
- The Water Environment (Controlled Activities) Regulations (Scotland) 2011, as amended (referred to hereafter as 'CAR');
- Construction Industry Research and Information Association (CIRIA) (2005): C650: Environmental Good Practice on Site; and
- CIRIA C689 Culvert Design and Operation Guide

5.3.27 Further details of the proposed watercourse crossings and the environmental controls afforded by the above legislation and guidance are included in EIA report Chapter 12 (Surface Water).

Substation

5.3.28 The proposed development includes a new substation building and DVAR (Dynamic Volt-Amp Reactive) building containing the isolators, circuit breakers and transformers and the Supervisory Control and Data Acquisition (SCADA) system. Workshop and welfare facilities for maintenance staff will also be provided. These facilities will be surrounded by a steel palisade security fence or similar. An indicative design for the substation is shown on Figure 5.5. The existing substation that is currently in use for the Tangy I and II Wind Farm is also expected to be retained as part of the proposed development.

Meteorological Masts

5.3.29 Three permanent meteorological masts will be erected to collect meteorological data for the operational life of the wind farm. Table 5.4 indicates the proposed locations for the permanent meteorological masts and a typical elevation is shown on Figure 5.7 and the proposed locations are included on Figure 5.1. It is assumed that each mast will have a concrete base of 10m x 10m, in addition to a 600m^2 crane pad for mast erection.

Table 5.4: Permanent Meteorological Mast locations

Mast	Proposed Location (Easting, Northing)
1	167086, 628020
2	167283, 628797
3	168636, 628414

5.3.30 Up to four temporary meteorological masts for the purposes of Power Performance Testing are proposed. The exact locations of these masts are determined in agreement with the turbine supplier so the exact locations cannot be identified at this stage. In general terms, the masts will be erected in pairs as follows. Two will be located on turbine locations, the 'turbine masts'. These turbine masts will be on the extremities of the wind farm, and are most likely to be on the south or west of the site. The remaining two masts, the 'reference masts' will be located approximately 2.5

rotor diameters upwind of their respective turbine masts. The temporary masts will be erected early in the construction programme and will record data for several months before turbine erection. Prior to the turbines being constructed, the turbine masts will be decommissioned and removed, with the reference masts being removed after a period of one to two years following turbine commissioning.

Electrical Infrastructure

On-site Cabling

5.3.31 Turbines are likely to be connected by a single electrical circuit 'array', with the output connecting to the substation. The cabling for this will be laid in trenches of varying width (depending on the number of cables) and approximately 1m in depth alongside the site tracks. These trenches will also carry earthing and communications cables. Details of the trenches are shown on Figure 5.9. It is unlikely that the existing cabling in place for the Tangy I and II turbines will be suitable for re-use due to its size and electrical capacity, and therefore it has been assumed that new cabling will need to be laid to all Tangy IV turbines.

5.3.32 Cables will be laid in trenches with sand or in-situ peat, and the trenches will then be backfilled with excavated sub-soil and peat topsoil. Earthing cables and communications cables will be included in the same trench.

Grid Connection

5.3.33 The proposed site substation will step up the voltage for transmission to the grid network. An application has been made to National Grid to provide a grid connection route to the site. At the time of application, a grid connection offer for 39.1MW has been received from Scottish and Southern Energy Power Distribution (SSEPD), with the connection route north-west to Carradale substation. This is in addition to the existing Tangy I and II connection capacity of 18.7MW.

5.4 Construction Phase Components

Principal Site Operations

5.4.1 Construction onsite will consist of the following principal operations:

- phased forest felling to facilitate construction;
- construction of additional access tracks required for the proposed development;
- excavation of aggregates from on-site borrow pits for track, turbine base and hardstanding construction;
- construction of temporary hard standing and temporary office and welfare facilities;
- dismantling of the existing 22 turbines (Tangy I and II);
- reinstatement of redundant turbine bases and access tracks;
- construction of new turbine foundations;
- construction of permanent crane hardstandings;
- excavation of trenches and cable laying, adjacent to the access tracks;
- connection of distribution and telecommunications cables;
- erection and commissioning of turbines; and
- reinstatement of borrow pits and the temporary construction compound areas.

Forest Clearance

5.4.2 The northern part of the site includes an area of commercial plantation forest. The proposed development includes clear felling of approximately 270.5 ha of forest within the site boundary. Replanting will be carried out on site, to a keyhole design, with growth up to 10 m in height.

5.4.3 Forest felling will be undertaken in a number of ways, including conventional harvesting and whole tree chipping or mulching for un-merchantable crops. Activities will be carried out with the use of standard forestry equipment, with merchantable timber being removed from site. Lop and top (branch wood and small dimension timber) and tree stumps would remain on site as is standard forestry practice, unless otherwise specified.

5.4.4 Further information regarding changes to forest use is provided in Chapter 16 (Land Use, Socio-economics and Recreation).

Construction Compounds and Laydown Areas

5.4.5 One temporary construction compound and one laydown area will be required, providing site accommodation, materials and small component storage, car parking and welfare facilities as shown on Figure 5.8 (at the locations shown on Figure 5.1). The configuration of the compound and laydown area will depend on the contractor specification; therefore, for the purposes of this assessment a search area has been identified. The proposed compound and laydown area are each likely to be no more than approximately 100m x 100m, and would be located in the identified search areas shown on Figure 5.1 which have been selected taking into account environmental considerations such as watercourse buffers, ground conditions and landscape effects.

5.4.6 It will be necessary to provide a temporary borehole water supply and foul drainage and this is considered further in Chapter 12 (Surface Water).

5.4.7 Approximately 550 m^3 of concrete and 70 tonnes of steel reinforcement will be required for each turbine foundation. At this stage, it has been assumed that concrete batching will be undertaken off site. The vehicle movements associated with importing concrete have been taken into account in the traffic assessment in Chapter 15 (Access, Traffic and Transport) and the traffic noise assessment in Chapter 14 (Noise) in order to reflect a potential worst case scenario. However, it is possible that concrete batching could be undertaken on site, which would require a temporary concrete batching plant to be established. Should this approach be adopted, the temporary concrete batching plant would be located on the temporary construction laydown area and would require a water abstraction point from one or more of the watercourses on site. Water abstraction would be subject to either registration or a licencing application to SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2011, as amended.

5.4.8 Traffic movements as a result of construction activities are considered in the assessment, for further details refer to Chapter 15 (Access, Traffic and Transport).

Decommissioning and Reinstatement of Tangy I and II Wind Farm

5.4.9 Decommissioning and reinstatement of Tangy I and II will comprise:

- Removal of the 22 existing wind turbines and towers to ground level.
- Reinstatement of turbine bases/foundations.
- Removal of approximately 2.2km of access tracks and reinstatement of former track routes.

5.4.10 The decommissioning of the existing turbines will need to be managed in order to ensure that no significant impact on the environment occurs. The following sections provide information on how the applicant intends to manage potential and actual environmental risks. Environmental management for the decommissioning of Tangy I and II, and the construction of Tangy IV is described in detail in Appendix 5.1 (CEMP) and in the topic assessment chapters of this EIA report.

5.4.11 The proposed methodology for reinstatement is described in Appendix 5.1 (CEMP), however is summarised here for each of the key components. It is possible that the existing substation would be retained and used as part of Tangy IV, so decommissioning of the substation and associated buildings is not described.

Turbines and Foundations

5.4.12 The existing 22 turbines will be decommissioned, dismantled and removed from the site in their largest component parts and transported, by public road, either to Campbeltown harbour where they will be loaded onto a suitable sea vessel, or by public road to another destination. These components may be sold on, re-used or recycled.

5.4.13 The existing reinforced concrete foundation of each tower cannot be re-used as part of the new turbine foundations and will largely be left in-situ with the top 1m of the foundation being broken down to just below ground level. Where the existing turbine foundations fall within the infrastructure for Tangy IV, the foundations will be capped using stone and where the foundation falls outside the new infrastructure, a topsoil cap will be used to reinstate the area to ground level and left to re-vegetate naturally from the indigenous vegetation.

Access Tracks and Cabling

5.4.14 As described in more detail in the CEMP (see Appendix 5.1), redundant tracks will be broken out and stone excavated for reuse on site as part of the construction works for Tangy IV. Tracks will be reinstated with suitable sub-soil/topsoil. Seeding may be required if suitable vegetation turfs are not available. Seed mix will be approved by the ECoW prior to reinstatement works commencing.

5.4.15 It is not proposed to re-use the existing electrical cables that are in place as part of the Tangy I and II infrastructure, however, to minimise ground and habitat disturbance it is not proposed to remove them, and they will be left in situ.

Materials

5.4.16 Reinstatement will be undertaken by use of either:

- soil material generated on site during the repowering construction works; or
- imported soil and topsoil (it is not currently anticipated that this would be required due to the likely availability of soil material on site).

Transport

5.4.17 Any areas of the public road that require protection during any abnormal load movements, as part of the removal of the decommissioned turbines, will be identified and protection measures will be agreed with the roads authority. It should be noted that the new turbines to be installed for Tangy IV are larger than those that would be removed from Tangy I and II, and therefore the swept path analysis that has been conducted for the transport of the new turbines will take into account the removal of the existing turbines and no specific assessment needs to be conducted. The results of the swept path analysis are discussed in Chapter 15: (Access, Traffic and Transport).

Waste Management

5.4.18 The applicant will prepare a draft Site Waste Management Plan (SWMP) to be agreed prior to commencement of the decommissioning works. The plan will detail waste types and disposal routes/final destinations in accordance with current regulations and guidance.

5.4.19 The decommissioning of turbine components with regard to disposal and/or end-use will be undertaken in line with best practice and the waste hierarchy. In order to minimise the impact on the surrounding habitats and species, and to reduce the volume of potential waste materials generated as part of the decommissioning works, the applicant proposes to remove those components and materials which will be replaced as part of the repowering works.

5.4.20 Where possible, turbine components will be re-used (sold on) or recycled off-site and concrete broken out from existing turbine foundations and hardstanding areas will be re-used on site (e.g. in the construction of Tangy IV). Where this is not possible, materials will be assessed for potential reuse off-site or recycling.

Borrow Pits

Predicted Extraction Requirements

5.4.21 It is estimated that approximately 130,850m^3 of stone (excluding aggregate for concrete) will be required to be excavated from the borrow pits for construction of the proposed development (including access tracks and surface course, structural fill beneath turbine foundations, and hardstandings at turbine bases and compounds). An additional 9,900m^3 is expected to be recovered from reinstatement of existing infrastructure (e.g. Tangy I and II access tracks that will be removed and reinstated). It is anticipated that all new stone material will be sourced from on-site borrow pits.

Borrow Pit Locations

5.4.22 Proposed locations of the borrow pits are shown on Figure 5.1. Information on the borrow pits is presented in Table 5.5. The volumes provided in Table 5.5 are considered to be indicative of the maximum volume of stone each borrow pit would provide but this is subject to detailed ground investigation and design during the pre-construction design phase. The total available volume of stone is significantly greater than the anticipated volume of stone required to be extracted to construct the development (estimated at 130,850m^3). The purpose of this is to allow for identification of preferential borrow pits (quality of stone / slope stability / overburden removal etc.) during detailed design. As such, it is unlikely that all borrow pits would be used during construction, and not all of the available stone from each borrow pit would need to be extracted. Therefore, the borrow pit indicative working areas shown on Figure 5.1 can be considered a worst case scenario. Further details are provided in Appendix 11.2 (Borrow Pit Search Report) and Figures 11.8 to 11.11.

Table 5.5: Borrow Pits

Borrow Pit Reference[1]	Easting	Northing	Required rock Yield[2] (m^3)
BPA	168376	628342	37,750
BPB	167824	628102	37,750
BPC	167066	629148	37,750
BPE	168876	628658	37,750

Note 1: Borrow Pit D was removed from the layout design during layout design optimisation

Note 2: Assumes a total maximum required rock yield of 151,000m3 equally divided between the four potential borrow pit locations

5.4.23 Environmental considerations have influenced the position, size and shape of the new borrow pit to minimise the effect on ecology, hydrology and landscape, and to allow successful reinstatement measures to be put in place as appropriate. Noise issues associated with stone extraction are addressed in Chapter 14 (Noise). Temporary land-use required for the borrow pits is assessed in Chapter 16 (Land Use, Socio-economics and Recreation).

5.4.24 Using on site borrow pits will reduce the haulage distances required. The borrow pits will require the use of plant to both win and crush the resulting rock to the required grading. It is anticipated that rock will be extracted by breakers and some blasting may be required.

Borrow Pit Reinstatement

5.4.25 Following construction, the borrow pits will be reinstated (part filled and contoured, as indicated on the borrow pit drawings (refer to Appendix 11.2).

5.4.26 The reinstatement of the borrow pits will take place along the following principles:

- Borrow pits will be landscaped, reducing sheer rock faces and generally graded to more gentle profiles appropriate to the landscape character and existing natural surrounding landform.

- Suitable site-won material (e.g. original borrow pit overburden, peat or suitable materials excavated in other areas of the site) will be used to backfill and contour areas of the borrow pits.
- Reinstated borrow pits will be covered with peat turves / vegetated top layers. Where insufficient turves are available to provide a complete cover, the area will either be allowed to regenerate naturally (or seeded with a native grass seed mix. The seed mix will either be collected from the site or commercially sourced and approved by an Ecological Clerk of Works (refer to Chapter 10: Ecology and Nature Conservation).
- Borrow pit reinstatement plans will be prepared by the Principal Contractor prior to reinstatement, detailing origin, type and volumes of material to be used in the borrow pit reinstatements, together with topographical levels prior to and following reinstatement.

Construction Programme

5.4.27 It is expected that many of the above operations will be carried out concurrently, although predominantly in the order identified. This will minimise the overall length of the construction programme such that it is limited to approximately 22 months. The indicative Construction Programme, as illustrated in Table 5.6, is subject to change, dependant on forestry and decommissioning activity phasing. This period is however dependent on weather and ground conditions experienced at the site. It is proposed that construction activities be limited to the working hours of 07:00 to 19:00 Monday to Friday and 07:00 to 13:00 on Saturdays.

Table 5.6: Indicative Construction Programme

Activities	Month																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Forestry Mobilisation																						
Forest Keyhole																						
Forest Clear Fell																						
Principal Contractor Mobilisation																						
Borrow Pits																						
Upgrade Existing Track																						
Construct New Track																						
Turbine Base/Hardstanding Construction (x16)																						
Wind Turbine Generator Decommissioning (x22)																						
Wind Turbine Generator Base Breakout																						
Reinstatement Track																						
Substation Construction																						
Operations Building Construction																						
Wind Turbine Generator Installation (x16)																						
Borrow Pit Restoration																						
Site Restoration																						

5.4.28 Site reinstatement will be programmed and carried out to allow rehabilitation of disturbed areas as early as possible in order to minimise storage of excavated material on vegetation.

Construction Working Practices

5.4.29 An outline Construction Environmental Management Plan (CEMP) has been provided in Appendix 5.1 of this EIA report. The principal objective of this document is to provide environmental management information for the construction stage and to detail measures to aid in preventing, minimising and controlling the associated adverse environmental effects. Furthermore, the CEMP will provide information on all environmental commitments (e.g. as made as part of the EIA/ES) and planning conditions, together with industry best practice measures. The CEMP will form part of the contract documents between the applicant and the appointed construction contractor.

5.4.30 An updated CEMP and will be agreed with the relevant statutory bodies prior to commencement of construction works. The CEMP will then be implemented and adhered to by the appointed Principal Contractor, unless otherwise agreed in writing with the Planning Authority / relevant Consultees.

Environmental Management

5.4.31 The Principal Contractor will have overall responsibility for environmental management on the site. As noted previously, the CEMP provided in Appendix 5.1 will be updated by the applicant to accommodate any specific measures required by the planning conditions or other pre-construction surveys to be undertaken during the post-consent / detailed design phase of the development. The services of specialist advisors e.g. Ecological Clerk of Works will be retained as appropriate to be called on as required to advise on specific issues. The Principal Contractor and applicant will ensure construction activities are carried out in accordance with the mitigation measures outlined in this EIA report.

5.4.32 In order to ensure all mitigation measures outlined within this EIA report (refer to Chapter 18: Schedule of Mitigation) are carried out on site, contractors will be required to implement and adhere to, and if necessary update (and obtain written approval from the planning authority), the following documents for adherence to throughout the construction process:

- CEMP; and
- Traffic Management Plan.

5.4.33 It should be noted that the applicant will provide the Contractor with an updated version of the CEMP as part of the main civil works contract.

5.4.34 A copy of any conditions of consent will be incorporated into all relevant tender documents and CEMP as appropriate. The selection criteria for the main civil works construction contractor will include their record in dealing with environmental issues, and provision of evidence that they have incorporated all environmental requirements into their method statements.

Waste Management

5.4.35 Waste management is addressed in detail in the CEMP (refer to Appendix 5.1), and proposals for managing excavated stone and material are described in Paragraph 5.4.27 above. All wastes to be removed from site will be segregated on site and removed to suitable recycling facilities or disposed of to a suitably licensed waste management facility, in accordance with current waste management regulations and best practice applicable at the time.

Site Reinstatement

5.4.36 Reinstatement in this section is referring to reinstatement of temporary works areas used during the construction of Tangy IV. Decommissioning and reinstatement of Tangy I and II is described separately above.

5.4.37 Reinstatement works are generally undertaken during construction (and immediate post-construction phase) and aim to address any areas of ground disturbance and changes to the landscape as part of the construction works. Reinstatement is undertaken as soon as possible following the construction works in each area, such as the re-dressing of road and track verges and turbine bases (and other areas that may be disturbed as a result of the construction process). Re-seeding and hydro-seeding may be part of reinstatement measures where redressing proves unsuccessful. The proposed methods for reinstatement are summarised below.

5.4.38 Reinstatement will be undertaken to provide a natural ground profile to tie-in with existing undisturbed ground levels to prevent the collection of surface water. It will be undertaken wherever practical at the earliest opportunity, to minimise storage of turf and other materials and to provide completed reinstatement in a timely manner. Typically, reinstatement will include the following operations:

- soil and vegetation temporarily stored during construction will be replaced as intact as possible once construction is complete. Movement of material will be kept to a minimum, i.e. where possible materials excavated will be utilised for reinstatement in the same area. Reinstatement with original materials temporarily stored will be undertaken in reverse order of excavation.
- Utilising vegetated turf is the most suitable finish for reinstated areas as it uses only plant material found on the site, thus conserving genetic biodiversity, and retaining the structure and composition of the original plant communities. In addition, this forms a stable mat over reformed ground, thus reducing erosion.
- Bare peat areas will be allowed to re-vegetate naturally as experience elsewhere has shown that un-seeded peat is likely to develop a vegetation community close to that on adjacent undisturbed ground (derived from the existing seed bank) more quickly than peat re-seeded with a predominantly grass mix.
- On 'floating' site tracks, site-won vegetation turves and suitable top / sub-soil or peat from other excavations on site (i.e. from the cut sections of the site track and from the turbine and hard standing areas) will be placed over the batters or edges of the tracks. It is anticipated that these areas will easily re-root and that vegetation cover will develop over time.

5.4.39 Site tracks and hardstanding areas at each turbine location will be retained for use in ongoing maintenance operations (including component replacement as necessary) and decommissioning of the wind farm. The edges will as far as possible be blended to the adjacent contours, natural vegetation being allowed to re-establish.

5.4.40 Any other temporary hardstanding areas will be re-graded with suitable peat or soil to a natural profile and reinstated as appropriate.

5.4.41 All construction equipment and other temporary infrastructure will be removed from site and the temporary storage areas will be reinstated as necessary. All waste will be removed from site in accordance with the site Waste Management Plan (as part of the CEMP) and in line current waste management regulations.

5.5 Site Operation and Maintenance

Site Operations

5.5.1 One operation building is proposed, as shown on Figure 5.10 (at the locations shown on Figure 5.1). This will provide site accommodation for materials, welfare facilities, office space, electrical controls and car parking. The building will be located within the construction compound search area near the site entrance and within the substation search area (refer to Figure 5.1). The configuration of the building will depend on the turbine specification and any operational requirements for the site. These specifications will follow best practice and the latest health and safety procedures for the operation of wind farms. For the purposes of this assessment search

areas have been identified rather than defining specific locations, as the required standards may change between now and any potential consent.

Employment

5.5.2 It is anticipated that full-time staff will be employed to manage and operate the wind farm.

5.5.3 Routine maintenance and servicing will be carried out on each turbine approximately twice a year, in addition to the initial service three months after commissioning. On average two people will take five days to service each turbine.

5.5.4 At regular periods oil and components will require changing, increasing the service time per machine. Gearbox oil changes are required approximately every 20 months. Blade inspections are carried out as required (normally somewhere between every two and five years). Appropriate maintenance works will be carried out immediately following any unexpected events on site, such as failure of a generator or gearbox.

5.5.5 There will be no public vehicular access to the site.

Track Maintenance

5.5.6 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 an appreciable effect. Heavy plant is particularly wearing and ongoing track maintenance will be undertaken as necessary throughout the year. Safe access will be maintained all year round. Stone would be won from the borrow pits during the construction phase and stored for use during regular track maintenance.

Tangy IV Wind Farm Decommissioning

5.5.7 The decommissioning period for a wind farm of this size is estimated to be six months.

5.5.8 Following the period of wind farm operation, decommissioning of the wind farm will be undertaken or the site would be repowered. When decommissioning is required, this is anticipated to involve the activities listed below:

- Dismantling and removal of the turbines, met masts and site substations and operations buildings.
- Removal to 1m below ground level of the turbine and met mast foundations.

5.5.9 Detailed decommissioning proposals will be established and agreed with relevant authorities prior to commencement of decommissioning activities. This will take cognisance of guidance available at the time.

5.5.10 The decommissioning effects have been taken into account in each of the specialist assessments contained in this EIA report.

5.6 Health and Safety and Related Issues

5.6.1 Health and safety will be initially addressed as part of the Pre-Construction Information Pack prepared by the CDM Co-ordinator for the project under the Construction (Design and Management) Regulations 2015. The contractor will be required to prepare a Construction Phase Health and Safety Plan and forward information to the CDM Co-ordinator during the works to enable the Health and Safety File to be completed.

5.6.2 Turbines are designed to be safe and are built to withstand extreme wind conditions. The turbines selected for the proposed development will have a proven record in terms of safety and reliability.

5.6.3 Day to day operational and maintenance activities will be coordinated via the Control Building and in consideration of the Estates operational requirements, where appropriate.

5.6.4 In accordance with section 6(1)(g) of the Land Reform Act 2003, general public access rights are removed throughout the construction period for health and safety reasons.

5.6.5 An Operations and Maintenance Manual for the design life of the wind farm will be prepared, which will cover all operational and decommissioning procedures.

5.7 Residues and Emissions

5.7.1 Table 5.7 details the anticipated residues and emissions associated with the proposed development, as required by Schedule 4 of the EIA Regulations.

Table 5.7: Residues and Emissions

Topic	Potential Residue/ Emission
Water	All surface water runoff from the proposed development would be captured by a SuDS to control the rate, volume and quality of discharge in to the water environment. All discharges would be subject to regulations in accordance with a pollution prevention plan to be approved under the CAR, and subject to a Construction Site License to be issued by SEPA. No significant residues or emissions have been identified.
Air	Due to the nature of the proposed development no significant point source or diffuse air emissions would be produced during its construction or operation. The proposed development would generate renewable electricity and would therefore displace CO_2 emissions associated with electricity generation from non renewable sources. The Scottish Government Carbon Calculator for Wind Farm on Peatlands was used to calculate a payback period for the proposed development based on the full development lifecycle. The results of this assessment are contained in Appendix 5.2: Carbon Balance Assessment and indicate that the proposed development would have an expected payback period of 1.8 years (maximum of 4.2 years) compared to grid mix of electricity generation. The proposed development would save approximately 94,611 tonnes of carbon dioxide per year (compared to a typical grid mix of electricity supply). Appendix 5.2 also provides an assessment of the carbon balance for the existing Tangy I and II Wind Farm. The assessment for the existing wind farm indicates that the development would have an expected payback of 3 years (maximum of 3.5 years) relative to a current (2018) grid mix of electricity generation. This therefore indicates that the existing wind farm has had a net beneficial effect in reducing carbon dioxide emissions for at least 11 years (so far). The existing Tangy I and Tangy II Wind Farm is estimated to have saved approximately 15,258 tonnes of carbon dioxide per year (compared to a typical grid mix of electricity supply).
Noise and Vibration	The wind turbines would generate noise during operation, and the noise levels would vary according to the wind speed, within an agreed noise limit designed to protect residential amenity at nearby dwellings. Further details are presented in Chapter 14: Noise. There would be no vibration emissions associated with the proposed development.
Light	Construction compounds and working areas (during construction) may require lighting. The substation and control buildings are likely to be equipped with passive infra-red sensor 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, especially given the presence of existing lighting on the Tangy I and Tangy II Wind Farm operational site. The applicant would seek to agree suitable lighting scheme with Highlands and Islands Airports Limited. For the purposes of this EIA Report, it has been assumed that the lighting strategy would use low intensity (35 candela), omni-directional lights, mounted on the nacelle of cardinal turbines. Further detail on the assessment of light emissions is provided in Chapter 8: Landscape and Visual. It was agreed that lighting effects would not lead to significant visual effects on the

Table 5.7: Residues and Emissions	
Topic	**Potential Residue/ Emission**
	basis that the lighting would be similar to that present within the existing operational site. Further details on the aviation impacts are provided in Chapter 17: Aviation.
Soil pollution/ Waste	The power generation aspect of the proposed development would not produce any significant waste emissions or pollutants. However, the general operation and maintenance 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 waste gearbox oils and lubricants. No soil pollution is anticipated. Peat excavated during construction would be managed in accordance with a Peat Management Plan (PMP). The Stage 1: PMP is provided in Appendix 11.2.

5.8 References

CIRIA (2005). Construction Industry Research and Information Association (CIRIA) (2005): C650: Environmental Good Practice on Site.

CIRIA (2010). Construction Industry Research and Information Association (CIRIA) (2010): C689: Culvert design and operation guide.

Construction (Design and Management) Regulations (CDM) (2015). www.legislation.gov.uk.

Land Reform (Scotland) Act 2003.

Scottish Executive (2000). River Crossings and Migratory Fish: Design Guidance.

SEPA (2015). Culverting of Watercourses: WAT-PS-06-02.

SEPA (2010). Engineering in the Water Environment, Good Practice Guide, Construction of River Crossings, Version 1: WAT-SG-25.

The Water Environment (Controlled Activities) Regulations (Scotland) 2011. URL: http://www.legislation.gov.uk/ssi/2011/209/contents/made