Glenmuckloch to Glenglass Reinforcement Project EIA Report

Chapter 2: The Routeing Process and Design Strategy

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Introduction

2.1 This chapter outlines SP Energy Networks (SPEN)'s approach to routeing, the routeing objective, the routeing methodology and the outcomes of the routeing and consultation process for the Glenmuckloch to Glenglass Reinforcement Project (GGRP). The design strategy for the GGRP is discussed, including consideration of access tracks and other infrastructure, the design of which, in combination with the routeing work undertaken, played a critical role in seeking to avoid and reduce, likely significant environmental effects.

SPEN'S Approach to Routeing

2.2 The UK Government, Ofgem and the electricity industry, including SPEN, have reviewed their positions on the routeing of major electrical infrastructure projects including overhead lines (OHLs). They remain of the view that the need to balance economic, technical and environmental factors, as a result of statutory duties and licence obligations, continues to support an OHL approach in most cases. It is therefore SPEN's view that wherever practical, an OHL approach is taken when planning and designing new or replacement transmission lines. However, SPEN accepts that there are specific circumstances in which an undergrounding approach should be considered.

2.3 In 2020, SPEN published a summary document outlining the approach taken to routeing transmission infrastructure (Approach to Routeing and Environmental Impact Assessment, SPEN 2020)[1]. The routeing of the GGRP has been undertaken in accordance with this document[2].

Overview of the Routeing Consultation Process

2.4 SPEN is committed to consulting with key stakeholders, including statutory and non-statutory consultees and the local community. The consultation and engagement process begins at the early stages of the development of a project and continues into construction once consent has been granted.

2.5 SPEN's approach to stakeholder engagement for major electrical infrastructure projects is outlined in Chapter 5 of the document 'Approach to Routeing and Environmental Impact Assessment'. SPEN aims to ensure effective, inclusive and meaningful engagement with local communities, statutory consultees, stakeholders and interested parties through four key engagement stages:

- pre-project notification and engagement;
- information gathering to inform the routeing stage;
- obtaining feedback on emerging route options; and
- the Environmental Impact Assessment (EIA) stage.

2.6 In addition, as outlined in **Chapter 1: Introduction**, SPEN as holder of a transmission licence, has a duty under section 38 and Schedule 9 of, the Electricity Act 1989, when putting forward proposals for new electric lines and other transmission development, to have regard to the effect of the proposals on communities, in addition to the desirability of preserving amenity, the natural environment, cultural heritage, landscape and visual quality.

2.7 SPEN first undertook a routeing exercises and rounds of public consultation in relation to the GGRP in 2018. These consultations were based on routeing a new double circuit steel tower OHL.

2.8 A Routeing and Consultation Report (2019) was prepared setting out the methodology adopted for the routeing of the new 132 kilovolt (kV) OHL, the routeing objective, the routeing strategy and the outcome of the appraisal of route options culminating in the 'preferred route'. The Routeing and Consultation Document was consulted upon and comments sought from statutory and non-statutory consultees and the public[3].

2.9 Following identification of a preferred route, consultation with the general public, as well as with the local authority and consultees was carried out, culminating in the identification of the 'proposed' route to be progressed to the EIA Scoping stage.

2.10 An Environmental Impact Assessment (EIA) Scoping Report was prepared in December 2019 and in the intervening period since EIA Scoping, extensive field work has been undertaken across the proposed route of the new 132kV OHL and at the location of the new Glenmuckloch substation. The location of the new Glenmuckloch substation and the route of the new 132kV OHL were further refined to allow further consultation to take place at the end of 2021. Further details of the consultation undertaken are provided in **Chapter 3: Approach to the EIA**.

2.11 Details of the routeing process adopted and the findings, as set out in the Routeing and Consultation Report, are summarised below and **Figure 2.1** shows how the route has evolved at key stages of the consultation and EIA process.

The Routeing Objective

2.12 Section 38 and Schedule 9 of the Electricity Act 1989 impose a statutory duty on SPEN to take account of the following factors in formulating proposals for the installation of transmission lines and other works:

"(a) to have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and,

(b) to do what it reasonably can to mitigate any effects which the proposals would have on the natural beauty of the countryside or any such flora, fauna, features, sites, buildings or objects."

2.13 SPEN has a 'Schedule 9 Statement' which sets out how it will meet the duty placed upon it under Section 38 and Schedule 9. As a result of the above, SPEN is required to formulate proposals that meet the technical requirements of the electricity system, which are economically viable, and cause, on balance, the least disturbance to the environment and the people who live, work and enjoy recreation within it.

2.14 In developing and maintaining an efficient and co-ordinated technically and economically viable transmission system, in accordance with its statutory duties and transmission licence obligations, SPEN is committed to limiting disturbance to people and the environment by its operations. It is widely acknowledged that the best way to achieve this is through careful routeing. The exercise of professional judgement is required in weighing a range of issues to ultimately identify routes, which, on balance, best meet the project routeing objective.

2.15 As discussed in the Routeing and Consultation Report, the Routeing Objective for the GGRP was:

"To identify a technically feasible and economically viable replacement route for a continuous 132kV OHL connection supported on lattice steel towers from the Glenmuckloch Pumped Storage Hydro (PSH) substation to Glenglass substation. The route should, on balance, cause the least disturbance to the environment and the people, who live, work and enjoy outdoor recreation within it."[4]

[1] SPEN (2020) Approach to Routeing and Environmental Impact Assessment. Available [online] at: https://www.spenergynetworks.co.uk/userfiles/file/SPEN_Approach_to_Routeing_Document_2nd_version.pdf
[2] This document is reviewed every 3-5 years.
[3] The January 2019 consultation considered both the proposed 132kV OHL and separate 33kV OHL, which was initially proposed to connect the consented Glenmuckloch Wind Farm. The connection for the Glenmuckloch Wind Farm is undergoing a redesign and will be brought forward as part of a separate project at a later date.
[4] The Glenmuckloch 132kV Connection Project: Routeing and Consultation Report (January 2019). https://www.spenergynetworks.co.uk/pages/glenmuckloch_pumped_storage_hydro_and_wind_farm_connections.aspx

The Routeing Methodology

2.16 It is generally accepted across the electricity industry that the guidelines developed by the late Lord Holford in 1959 for routeing overhead transmission lines, 'The Holford Rules', with subsequent updates, should continue to be employed as the methodological basis for routeing high voltage overhead transmission lines[5].

2.17 Key principles of the Holford Rules include avoiding prominent ridges and skylines, following broad wooded valleys, avoiding settlements and residential properties and maximising opportunities for 'backclothing' and the screening of infrastructure[6].

2.18 SPEN's overall approach is based on the premise that the main effect of an OHL is visual, as a result of its scale relative to objects in the vicinity such as buildings and trees, and that as there is no technical way of reducing this other than choice of support (towers and poles), and only limited ways of achieving screening through planting, the most effective way of causing least visual disturbance is by careful routeing. In addition, a well routed OHL takes account of other environmental and technical considerations, even if the length is increased as a consequence.

2.19 The routeing strategy adopted for the GGRP was the following:

"Route options will recognise the grain of the River Nith valley, making use of appropriate crossing points and the containing landform to avoid area of highest amenity value and sensitivity as far as possible. Proximity to settlements and other of developments within the study area will also require consideration to limit, potential visual and cumulative effects."

2.20 Where, due to the requirement to balance a number of technical and environmental factors, the OHL is routed through forestry, the Forestry Commission's Landscape Design Guidelines, which contain guidance in relation to routeing OHLs in areas of forestry, have been followed[7]. The guidelines advise:

"a power line through the forest should:

- *avoid areas of landscape sensitivity;*
- *not follow the line of sight of important views;*
- *be kept in valleys and depressions;*
- *not divide a hill in two similar parts where it crosses over a summit;*
- *cross skylines or ridges where they dip to a low point;*
- *follow alignments diagonal to the contour as far as possible; and*
- *vary in the alignment to reflect the landform by rising in hollows and descending on ridges".*

2.21 The routeing methodology for the GGRP was also informed by the following:

- SPEN and LUC experience of routeing OHLs;
- consultation with stakeholders; and
- relevant national and local planning policy and guidance.

2.22 The methodology for line routeing comprises a number of broadly sequential steps as shown in **Image 2.1** below**.** For simplicity, the methodology is set out in a linear manner, with the findings of each step informing the next step, building up an ever increasing level of understanding to inform the routeing process. However, it is important that the process for identification of routes remains iterative. This means that the outcome of each step is subject to a technical and, where relevant, consultation 'check' to ensure that LUC, SPEN and key stakeholders are confident with the findings prior to commencing the next step.

Image 2.1: Routeing Methodology

2.23 A number of overarching principles which informed the routeing methodology for the GGRP are outlined below.

Technical Considerations

2.24 Technical issues considered in routeing were identified by SPEN. These included physical constraints to routeing such as existing high and low voltage OHLs within the area. Slope, altitude, access, large waterbodies and the location of committed developments, including existing or proposed wind farms and single turbine developments, were also taken into account.

2.25 Additional technical issues, including steel tower design, construction techniques, operational life and maintenance, and government guidelines were considered during the more detailed design stages as discussed further below and in **Chapter 4: Development Description.**

Economic Considerations

2.26 In compliance with the duties within Section 9 of the 1989 Act, the Routeing Objective required the 'proposed route' to be 'economically viable'. This is interpreted by SPEN as meaning that as far as is reasonably possible, and other things being equal, the line should be as direct as possible, and the route should avoid areas where technical difficulty or compensatory requirements would render the scheme unviable on economic grounds.

[5] NGC 1992, SHETL 2003
[6] It is acknowledged that in relation to the provision of woodland screening (with reference to commercial woodland in particular) screening is often only of a temporary nature.
[7] Scottish Forestry (SF), the successor to the Forestry Commission in Scotland in terms of policy, was established as an executive agency of the Scottish Government on 1 April 2019.

Environmental Considerations

2.27 Statutory duties imposed by the Electricity Act 1989 require licence holders to seek to preserve features of natural and cultural heritage interest and mitigate, where possible, any effects which their development may have on such features. The construction and operation of the GGRP will potentially have effects on the environment and the people who live, work and recreate within it, including effects on the following:

- Visual amenity;
- Landscape character;
- Ecology and ornithology;
- Hydrology, geology and water resources;
- Cultural heritage;
- Land uses including agriculture and forestry;
- Residential amenity; and
- Recreation and tourism.

2.28 Some environmental effects can be avoided or reduced through careful routeing whilst other effects are best mitigated through local deviations of the route, the refining of steel tower locations and specific construction practices. **Chapters 6** to **11** indicate, for each specialist topic area, those factors that were taken into consideration in the routeing and design process.

The Routeing Process and Identification of 'Preferred Route' for the new 132kV OHL

2.29 The first step in the routeing process (Step A) involved identification of the study area, predominantly for the purposes of gathering data specific to the GGRP area. In identifying the study area, it was important to ensure that this was large enough to accommodate all likely route options reflecting the Routeing Objective and Routeing Strategy. On this basis, the study area was required to be able to accommodate a continuous new 132kV OHL from the proposed location of the Glenmuckloch PSH (since revised) to the existing Glenglass substation.

2.30 A preliminary check was also carried out to identify the presence of International, European or nationally designated areas within or immediately adjacent to, the study area, to ensure that potential effects on these areas could be considered. Taking account of the above, and also informed by topography, the maximum area (study area) across which the route options were likely to be located, was identified.

2.31 The next step (Step B) was to identify and map the 'areas of highest amenity value' within the study area to further focus the study area, reflecting guidelines included in the Holford Rules. These included the following national level designations and features:

- Sites of Special Scientific Interest (SSSIs): SSSIs are defined in the Wildlife and Countryside Act 1981 (as amended) as areas of land or water which are of special interest by reason of their flora, fauna or geological or physiographical features;
- Unscheduled Archaeology of National Importance; and
- Category B and C Listed Buildings: Listed Buildings are also protected under the Listed Buildings and Conservation Areas (Scotland) Act 1997.

2.32 'Regional or local high amenity value' designations were also identified to be avoided where possible. These included:

- Areas of Ancient Woodland (AW) as defined by the Ancient Woodland Inventory (AWI); and
- Local Nature Conservation Sites (LNCS): a 'catch-all' term used to define various local nature conservation sites designated by local authorities. In most cases, these are designated as they represent a viable example of a habitat or species of conservation interest at a local level.

2.33 A 150m 'trigger for consideration' was mapped around each residential property to allow this proximity to be balanced with other considerations, while also helping identify possible 'pinch points'.

2.34 In total seven route options were identified and appraised. The appraisal objective was to identify a 'preferred route' for the project, in a comparable, documented and transparent way. The route options were appraised using the following criteria[8], which continued to reflect the key considerations of the routeing methodology:

- length of route;
- biodiversity and geological conservation;
- landscape and visual amenity (including recreation and tourism);
- cultural heritage;
- land use;
- forestry; and
- flood risk.

2.35 An emerging 'preferred' route was identified which was considered on balance to cause the least disturbance to the environment and the people, who live, work and enjoy outdoor recreation within it, and best reflects the Routeing Strategy. The emerging 'preferred' route was reviewed by SPEN in relation to the system/network design requirements. This review was undertaken to ensure that, based on the level of detail available, the 'preferred' route was within the technical parameters required to construct OHLs. Following this technical confirmation of the 'preferred' route, an environmental review was undertaken of the 'preferred' route option. The objective of this was to ensure that the emerging 'preferred' route continued to meet the Routeing Objective and SPEN's statutory duties.

Identification of the 'Proposed Route'

2.36 Following the feedback received during consultation on the preferred route, SPEN published a response to the key issues raised by stakeholders on its consultation website[9]. The document confirmed that feedback had been taken into consideration in identifying the 'proposed route' for progressing to EIA Scoping in December 2019.

2.37 Further to the consultation in 2019 and the EIA Scoping exercise, a full suite of environmental surveys took place which informed the final proposed route of the new 132kV OHL. In addition, a proposed new location and design of the new Glenmuckloch substation was developed, informed by environmental surveys and technical requirements. The final route of the GRRP has also been informed further by another consultation that took place at the end of 2021 as detailed further in **Chapter 3**.

The Design Strategy Policy Context

2.38 In line with The Town and Country Planning (Development Management Procedure) (Scotland) Regulations 2013 (as amended)[10], Part 3, Regulation 13, an application for planning permission for developments belonging to the categories of national developments or major developments require to be accompanied by a design statement explaining the principles and concepts which have been applied to the design. Although the GGRP is not a development to which the regulations apply, SPEN recognises the value in explaining the design principles and concepts which have been applied to the proposals. Scottish Planning Policy (SPP) (2014) also highlights the importance of design as a material consideration in the determination of planning applications with design statements considered a valuable tool in guiding the quality of developments and the promotion of positive change. Development design and well-designed places is highlighted as a key consideration in the vision for the planning system in Scotland as set out in the SPP.

2.39 Planning Advice Note (PAN) 68 Design Statements (2003) aims to see design statements used more effectively in the planning process to create places of lasting quality. Importantly, whilst PAN 68 is concerned mainly with urban design and the architectural quality of buildings as opposed to utility infrastructure, it does state that even where a formal design statement is not necessary, applicants should still have a clear and logical design philosophy which could be explained if required.

2.40 PAN68 highlights the need for the programme for delivery of a project to be considered in its design. The programme for construction of the GGRP is 16 months. Further details of the construction and decommissioning phases are provided in **Chapter 4.**

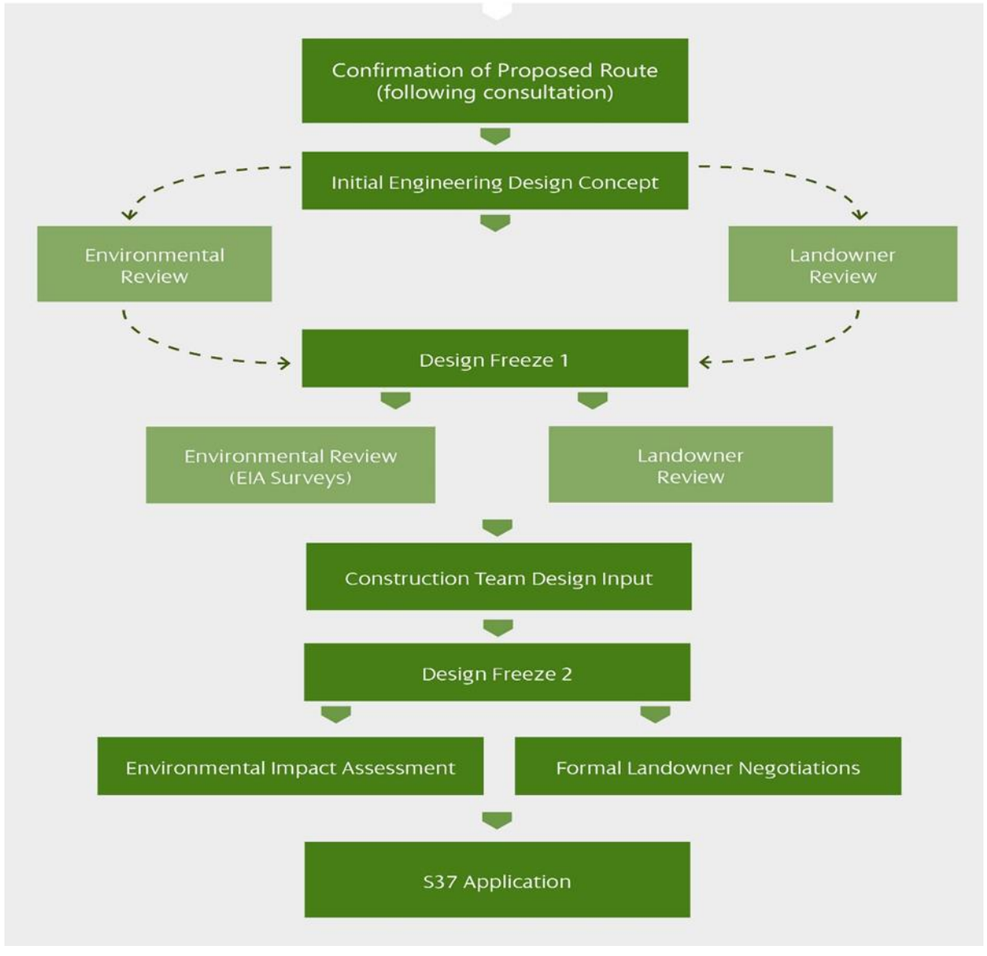
[8] See Appendix 2 of the Glenmuckloch to Glenglass Connection Project: Routeing and Consultation Report (January 2019).
[9] The Glenmuckloch 132kV and 33kV Connections Project: Summary of Feedback from First Round of Consultation (November 2019). Available [online] at: www.spenergynetworks.co.uk/userfiles/file/Glenmuckloch_Consultation_Summary_Report.pdf

Detailed Design Alignment

2.41 Following the identification of a 'proposed route', work was progressed to identify the most appropriate alignment for the GGRP. This design process was led by the SPEN OHL design team informed by the emerging findings of the environmental surveys, comments from consultees via the scoping process, subsequent consultation in 2021, and landowner feedback.

2.42 The process adopted for designing and assessing the final route alignment is outlined in **Image 2.2** below.

Image 2.2: Detailed Design and Assessment Process



Project Design Parameters

2.43 It is important to highlight the following project parameters which influenced the design of the GGRP from the outset:

- The purpose of the GGRP is to reinforce the network via a new 132kV OHL from a new substation on the site of the Glenmuckloch PSH to the existing 132kV substation at Glenglass to accommodate new renewable energy developments and to avoid multiple OHLs converging into Glenglass.
- The required voltage and capacity was an important design parameter in influencing the selection of the support type.
- Under Section 38 and Schedule 9 of the 1989 Act, SPEN is required to consider technical, economic and environmental issues in undertaking its duties, for which design plays an important role. As a consequence of the above, design and routeing objectives for the GGRP required technical, economic and environmental issues to be balanced.
- The design strategy reflects well established procedures and guidance (the Holford Rules[11]) and incorporates towers and associated infrastructure used widely across the UK electricity transmission network.

2.44 In line with established practice, the design of the tower locations, type, and span length and the location and design of access tracks, working areas and other infrastructure, including forestry felling was considered in sequence, informed by technical considerations, including the required transmission capacity.

The Design Team

2.45 The design work was led by SPEN's in-house engineering design team, informed by the findings of an environmental constraints mapping exercise undertaken by the project environmental specialist teams. In consultation with SPEN and LUC, the implications for forestry were reviewed by RTS Ltd, who are experienced forest management specialists. Consultation has also been undertaken with landowners to inform the siting of steel towers and other infrastructure.

Steel Tower Design

2.46 The key design objective for selection of the steel towers has been to meet technical requirements, including capacity, network security requirements, and OHL design parameters, whilst taking account of economic and environmental considerations. On this basis, SPEN selected a 132kV L7 lattice steel tower design due to the altitude of the terrain and the ratings required. There are three types of tower proposed:

- *Line* or *suspension* towers where the tower is part of a straight section of line and no change in direction is required
- *Angle* or *tension* towers where there is a horizontal or vertical deviation in the line direction of a specified number of degrees. There are three main types of angle tower 30 degrees, 60 degrees and 90 degrees
- *Terminal* towers where the OHL terminates into a substation or on to an underground cable section via a separate cable sealing end compound or platform.

2.47 Proposed span lengths between steel towers across the route range between approximately 285m and 176m with an average span of 238m. The maximum tower height is 39m and minimum tower height is 26m, with the standard design and (average for the new 132kV OHL) of an L7 above ground being 27m.

2.48 Further details of the towers, including construction details, diagrammatic illustrations and photographs are provided in **Chapter 4**.

2.49 It is not possible to colour towers to camouflage them for all times of day, all seasons or from all viewpoints. In addition, as steel lattice towers are to a large degree 'transparent', their colour can only be recognised from a short distance, beyond which the colour is not distinguishable and appears as shades of light and dark. New galvanised lattice towers turn a dull grey colour after about 18 months and are normally painted at intervals of approximately 15 to 20 years, subject to atmospheric conditions, for continued protection against corrosion.

Access Track Design

2.50 Access to the steel tower locations and working areas is proposed during the construction of the GGRP. The overall design objective for the access tracks has been to avoid and/or reduce effects upon natural and cultural heritage interests and to cause least disturbance to current land use and land management practices. The principal method employed to achieve this has been to maximise the use of existing tracks where possible. Further details of the proposed tracks are provided in **Chapter 4**, including the temporary track options available for different ground conditions, and the proposals for reinstatement once the tracks are removed.

Forest Felling and Re-Planting Design

2.51 The overall design objective has been to minimise the extent of felling required and woodland areas and individual trees were avoided where possible during the routeing phase. Where routeing through woodland has been unavoidable, a 'wayleave' corridor is required for safety reasons to ensure that trees do not fall onto the line and for health and safety of forestry operatives. SPEN has

[11] The Holford Rules for the Routeing of New High Voltage Overhead Transmission Lines (1959). Reviewed circa 1992 by the National Grid Company (NGC) plc (now National Grid Transmission (NGT)) as owner and operator of the electricity transmission network in England and Wales, with notes of clarification added to update the Rules. Both the Holford Rules (and NGC clarification notes) were reviewed subsequently by Scottish Hydro Electric Transmission Limited (SHETL) in 2003 to reflect Scottish circumstances.

statutory powers to control tree clearance within the wayleave corridor. For the new 132kV OHL, a corridor of 80m (i.e. 40m either side of the centre line) is required. Where possible the design of the new 132kV OHL and associated infrastructure has sought to avoid/minimise felling where possible, when balancing with other technical and environmental objectives.

The Design Stages

2.52 An initial engineering concept design comprising angle towers only was designed by SPEN's OHL design team to reflect technical parameters which aimed to:

- minimise the number of towers required;
- maximise the span lengths between towers; and
- minimise the number of angle towers.

2.53 The initial engineering design of the GGRP was subsequently subjected to a review by the environmental specialist teams, informed by environmental information gathered during the desk and field surveys as well as feedback from consultees. This further environmental information and its application to the alignment stage included:

- **Landscape and Visual:** informed by consultation responses and landowner feedback, field work was undertaken to establish the existing baseline conditions, from publicly accessible and private land (where access was granted) to identify potential landscape receptors, and key views and visual receptors (people). The alignment of the GGRP was reviewed in relation to landscape and visual sensitivities, and potential landscape and visual effects, to determine the most appropriate alignment, as well as the location and height of individual towers (subject to technical limitations of the OHL design e.g. topography). The landscape and visual review considered key views from nearby residential properties, recreational routes (e.g. users of the Southern Upland Way), key transitory routes (e.g. the A76) and how the alignment of the GGRP is integrated alongside existing landscape features (e.g. forestry and wind farms) and in relation to underlying landform and topography.
- **Forestry:** desk based and field surveys were undertaken to assess existing woodland conditions and review proposals for long term management of woodland blocks. This information was used to inform the alignment of the GGRP, to seek to minimise felling of broadleaf woodland, mature conifers (where not scheduled for felling imminently to avoid/minimise windthrow) and utilise existing forest edges where possible.
- **Geology, Hydrology, Hydrogeology and Peat**: a walkover hydrological survey was carried out to identify and document watercourses, identify other water features such as wetlands and springs, ground-truth private water supply (PWS) data within 250m of the route, undertake an overview assessment of areas identified as floodplain within the SEPA Flood Maps and provide a general overview of landscape and land cover of importance to hydrology. These findings resulted in a number of design modifications to the alignment of the GGRP , with a 50m 'buffer' being placed around all watercourses, and all towers being located outwith this buffer wherever possible. Peat probing was undertaken where peat was anticipated (based on the review of British Geological Survey Superficial Geology maps, Soils Scotland Mapping and SHN Carbon and Peatland Mapping), to identify the spatial coverage and depth of peat along the 'proposed route'. Tower locations were selected to avoid areas of relatively deep peat where possible.
- **Ecology:** the ecology field surveys comprised an extended Phase 1 Habitat Survey, National Vegetation Classification of habitats of conservation concern and protected species walkover to identify suitable habitat for, and direct evidence of, protected species (including bats, badger, otter, water vole, red squirrel and pine marten).
- **Ornithology:** the ornithological survey work was agreed in consultation with NatureScot and included surveys for black grouse, moorland birds (for waders), scarce breeding birds (for raptors and owls, including targeted surveys for goshawk).
- **Cultural Heritage:** a desk-based assessment and walkover field survey was conducted to identify all known cultural heritage assets within 200m of the 'proposed route' which resulted in changes to the proposed infrastructure to avoid Deil's Dyke (see **Chapter 10: Cultural Heritage** for further details). Visits to key cultural heritage assets which have potential intervisibility with the GGRP within the wider study area were also undertaken, to assess whether the presence of the GGRP would affect their settings.

2.54 SPEN's wayleaves team also held discussions landowners to discuss the design and gather their feedback as the GGRP evolved. Where tower positions were considered to have a potentially adverse effect on the environment, or an adverse effect on land holdings, a new position was suggested by the SPEN wayleaves team and passed to the environmental specialists for comment. This feedback was then provided to the SPEN OHL design team for further consideration and accommodation where possible, (without compromising the technical design requirements).

Detailed Alignment Outcome and EIA

2.55 SPEN is of the opinion that the final design of the GGRP best meets the strategic Routeing Objective and SPEN's wider statutory duties, and this is shown in **Figure 4.1**.

Consideration of Alternatives

2.56 Regulation 5(2d) of the EIA Regulations states that an EIA Report should include:

> *"a description of the reasonable alternatives studied by the developer, which are relevant to the development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment".*

2.57 In the context of the requirements of the EIA Regulations and guidance, SPEN has considered the following reasonable alternatives to the final design of the GGRP, and these are discussed in further detail below:

- Alternative Routes;
- Use of Wood Poles; and
- Undergrounding.

Alternative Routes

2.58 Alternative routes within the overarching study area were identified and appraised in the Routeing and Consultation Report (2019) against a number of environmental and technical considerations. The route that was identified as the 'preferred route', on the whole best satisfied the routeing objective and routeing strategy derived at the start of the routeing exercise, and was selected as the option to progress to consultation and subsequently, EIA scoping. This was then updated based on the findings of the environmental surveys, consultation, and landowner discussions to reach the final route presented in the EIA Report. SPEN considers that the final route results in a minimal effect on the environment when compared to alternative routes considered.

Use of Wood Poles

2.59 It is proposed to build the L7 steel lattice towers with twin bundle phase conductors (wires)[12] to provide the capacity required for the connections in the area. The option to use wood poles to carry the OHL was suggested during the consultation undertaken in November 2021, however wood pole circuits cannot carry the twin conductor system or accommodate a double circuit. If the same capacity as being carried on the steel towers was to be accommodated on wood poles, then this would require four separate circuits. This would not be an economic and efficient solution given the infrastructure needs and the width of land-take that would be required to accommodate four circuits. The wood pole circuits could be arranged in parallel, following separate routes, or a combination of these options. In any of these scenarios, the wood pole circuits would result in greater land sterilisation due to there being significantly more structures required on the route and associated with the stays which would be required around some of the wood pole structures.

2.60 Wood poles do not allow for sufficient span length to cross the Kello Water and hence a longer route or a hybrid solution (utilising steel towers to cross the Kello Water) would be required. Furthermore, due to the terrain and altitude, the span lengths for wood poles would be significantly reduced from their average span length, potentially to as low as 50m on single pole design and 70m on H-pole design. This would result in additional infrastructure being required (i.e. a greater number of wood poles in the landscape). The use of four separate wood pole circuits would also have long-term implications on costs of the infrastructure.

2.61 Whilst the environmental effects associated with use of four separate wood pole circuits cannot be fully assessed without detailed routeing and/or wood pole siting, it is likely that there would be some increased effects when compared with the L7 tower design proposed for GGRP (e.g. effects on forestry and other land uses including additional land take). While the wood pole structures would be lower in height than the L7 towers proposed for GGRP, this does not automatically mean that landscape and visual effects would be reduced in every case (taking account of the increased amount of infrastructure, and potential effects if

[12] "Twin bundle phase conductors" refers to two conductors being installed per phase (i.e. six per circuit). This is due to the capacity requirements of the circuit exceeding the capability of a single conductor and so two conductors are required.

multiple circuits were to be routed in parallel). The L7 design is the most economic and efficient solution for the route and SPEN considers that on balance, likely fewer environmental effects than a wood pole solution.

Undergrounding

2.62 SPEN is obliged to comply with the requirements of the 1989 Act to develop and maintain an efficient, co-ordinated and economical system of electricity transmission. SPEN's approach seeks to find an OHL solution for all connections and only where there are exceptional constraints would underground cables be considered as a design alternative. Such constraints can be found in urban areas and in rural areas of the highest scenic and amenity value. Where an OHL solution is not achievable for technical reasons, SPEN looks to an underground cable solution as an alternative. However, sections of underground cable identified for inclusion within a scheme, must balance the economic, technical and environmental considerations. With underground cable, the cost is the dominant consideration.

2.63 The main environmental advantage of underground cable when compared to OHL is often the reduction in effects on visual amenity and landscape character. Such environmental benefits must also be balanced against the substantial additional costs when compared to the equivalent OHL solution, environmental disadvantages and technical considerations.

2.64 The main environmental disadvantages of underground cable when compared to OHL often relate to greater effects on habitats and natural heritage interests; unknown archaeology; drainage and land use for construction/development. The disadvantages often arise from the invasive nature of excavation of trenches to lay the cable, the extent of the area disturbed, the equipment required, and the volume of materials involved.

2.65 In consideration of the above factors, including consideration of the EIA and the potential environmental effects of installing a new steel tower 132kV OHL between the new substation at Glenmuckloch and the existing Glenglass substation, SPEN remains of the opinion that the proposed OHL solution and alignment meet with our project routeing objective.

2.66 This approach and its conclusion also reflect SPEN's overarching approach to routeing of major electrical infrastructure[13].

[13] SPEN Approach to Routeing Major Electrical Infrastructure Projects
https://www.spenergynetworks.co.uk/userfiles/file/SPEN_Approach_to_Routeing_FINAL_20150527.pdf