Scottish & Southern Electricity Networks

TRANSMISSION

Connagill Cluster Grid Connections

Consultation Document

December 2023

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Glossary

Term	Definition
Alignment	A centre line of an overhead line (along with location of key angle structures) or underground cable.
Alignment (optimal)	An alignment for the overhead line or underground cable taken forward to stakeholder consultation following a comparative appraisal of alignment options.
Alignment (proposed)	An alignment taken forward to consent application. It comprises a defined centre line for the overhead line (or underground cable) and includes an indicative support structure (tower or pole) schedule, also specifying access arrangements and any associated construction facilities.
Amenity	The natural environment, cultural heritage, landscape and visual quality. Also includes the impact of SSEN Transmission's works on communities, such as the effects of noise and disturbance from construction activities.
Biodiversity Net Gain (BNG)	A process intended to leave nature in a better state than it started using good practice principles established by the Business and Biodiversity Offset Programme (BBOP) and organisations including CIRIA, CIEEM and IEMA.
Conductor	A metallic wire strung from structure to structure, to carry electric current.
Consultation	The dynamic process of dialogue between individuals or groups, based on a genuine exchange of views and, normally, with the objective of influencing decisions, policies or programmes of action.
Corridor	A linear area which allows a continuous connection between the defined connection points. The Corridor may vary in width along its length; in unconstrained areas it may be many kilometres wide.
Design Solution	The design of the transmission infrastructure (e.g. structure type).
Habitat	Term most accurately meaning the place in which a species lives, but also used to describe plant communities or agglomerations of plant communities.
Kilovolt (kV)	A unit of electrical power equal to one thousand watts.
Listed Building	Building included on the list of buildings of special architectural or historic interest and afforded statutory protection under the 'Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997' and other planning legislation. Classified categories A – C(s).
Megawatt (MW)	A unit of electrical power equal to one million watts.
Micrositing	The process of positioning infrastructure to avoid localised environmental or technical constraints.
Mitigation	Term used to indicate avoidance, remediation or alleviation of adverse impacts.
Overhead line (OHL)	An electric line installed above ground, usually supported by steel lattice towers or wood poles.
Plantation Woodland	Woodland of any age that obviously originated from planting.
Route	A linear area of approximately 1 km width (although this may be narrower/wider in specific locations in response to identified pinch points / constraints), which provides a continuous connection between defined connection points.

Route (optimal)	A route for the overhead line or underground cable taken forward to stakeholder consultation following a comparative appraisal of route options.
Route (proposed)	A route taken forward following stakeholder consultation to the alignment selection stage of the overhead line or underground cable routeing process.
Routeing	The work undertaken which leads to the selection of a proposed alignment, capable of being taken forward into the consenting process.
Scheduled Monument	A monument which has been scheduled by the Scottish Ministers as being of national importance under the terms of the 'Ancient Monuments and Archaeological Areas Act 1979'.
Sites of Special Scientific Interest (SSSI)	Areas of national importance. The aim of the SSSI network is to maintain an adequate representation of all natural and semi-natural habitats and native species across Britain.
Span	The section of overhead line between two structures.
Special Area of Conservation (SAC)	An area designated under the EC Habitats Directive to ensure that rare, endangered or vulnerable habitats or species of community interest are either maintained at or restored to a favourable conservation status.
Special Protection Area (SPA)	An area designated under the Wild Birds Directive (Directive74/409/EEC) to protect important bird habitats.
Special Landscape Area (SLA)	Landscapes designated by the Highland Council which are considered to be of regional/local importance for their scenic qualities.
Stakeholders	Organisations and individuals who can affect or are affected by SSEN Transmission works.
Study Area	The area within which the Corridor, route and alignment study takes place.
The National Grid	The electricity transmission network in the Great Britain.
Underground Cable (UGC)	An electric cable installed below ground, protected by insulating layers and marked closer to the surface to prevent accidental damage through later earthworks.
Volts	The international unit of electric potential and electromotive force.
Wayleave	A voluntary agreement entered into between a landowner upon whose land an overhead line is to be constructed and SSEN Transmission.

Executive Summary

This Consultation Document invites comments from all interested parties on the proposals by Scottish and Southern Electricity Networks Transmission (SSEN Transmission) to construct new transmission infrastructure required to connect five consented and/or proposed wind farms, all located in proximity to each other, to the existing transmission network at Connagill 275/132 kV substation. Together the projects are known as the 'Connagill Cluster Grid Connections'.

The five connections under consideration are the consented Strathy South and Strathy Wood wind farms and the proposed Armadale, Melvich and Kirkton wind farms. The connection projects are recognised as National Development under National Planning Framework 4.

SSEN Transmission has aimed to streamline the pre-application consultation and routeing process of each connection to allow stakeholders the opportunity to review the Cluster as a whole, allowing the opportunity to consider the consolidation of infrastructure and construction practices where practicable.

In 2014, the Scottish Ministers granted consent for the construction of two parallel 132 kV trident wood pole OHLs to connect the consented Strathy North wind farm and (at the time) proposed Strathy South wind farm. Construction of one of the OHLs (to connect Strathy North wind farm) was completed in 2015 but the second OHL was not constructed due to delays in Strathy South wind farm receiving its consent. The consent for the OHL connection for Strathy South wind farm has now lapsed.

In 2021 SSEN Transmission commenced optioneering studies to connect the (now) consented Strathy South and Strathy Wood wind farms, plus the proposed Armadale wind farm, to the transmission network at Connagill 275/132 kV substation. At the time, these connections were considered separately with the optimal design solution for each connection being via OHL supported by trident wood pole. SSEN Transmission have since received requests to provide two further connections in the area (for the proposed Melvich and Kirkton wind farms), both of which would connect to Connagill 275/132 kV substation. These additional connection requirements prompted a review of the connection requirements for each project, with the aim of identifying a rationalised approach across the five connections.

SSEN Transmission considered the use of OHL (trident and steel structures) and underground cable options to complete the connection requirement. This review concluded that the optimal rationalised approach should comprise a new 132 kV underground cable to connect Strathy South wind farm substation to Strathy Wood wind farm substation. Thereafter, a new 132 kV OHL supported by steel structures would be constructed between Strathy Wood substation to a 'T' on the existing Strathy North trident wood pole near Dallangwell. This would transport electricity generated by Strathy Wood wind farm initially and would be a temporary arrangement until a new double circuit 132 kV OHL supported by steel

structure would continue the connection between the Strathy North 'T' to Connagill 275/132 kV substation. The structures would be capable of operating at 275 kV in the future, if required. Following completion of this section, Strathy Wood and Strathy North wind farms would be transferred over to the new double circuit 132 kV OHL and redundant parts of the existing trident H-wood pole would be removed, with the exception of the eastern section of the existing trident H-wood pole OHL into Connagill 275/132 kV substation that would be repurposed for the Melvich and Kirkton wind farm connections (with additional short sections of OHL to connect to the wind farms). Armadale wind farm would involve a 132 kV trident wood pole OHL between the wind farm substation to a 'T' on the proposed double circuit 132 kV OHL to complete the connection into Connagill 275/132 kV substation.

To facilitate the five connections, a new switching station would also be required to collect all incoming circuits onto a double busbar before taking these through the 132 kV OHL supported by steel structure. The new switching station is currently at optioneering stage. SSEN Transmission will consult on this proposal separately, although an indicative search area has been selected to the east of the northern part of Strathy Forest.

Analysis of potential route options has been undertaken for the consented Strathy South, Strathy Wood and proposed Armadale connections considering the environmental, technical and economic constraints of each route option to identify an optimal route. A summary of this analysis for each connection is provided within this Consultation Document, and an overall optimal route is included. Comments are sought from stakeholders on the route options considered, and the optimal route identified. Following a review of the consultation responses received on the route options considered and the optimal route identified, SSEN Transmission will confirm a proposed route for each connection, within which the consideration of potential alignment options will be undertaken.

A separate optioneering exercise is underway to consider the optimal alignment for the short section of 132 kV wood pole OHL required for the Melvich and Kirkton connections.

When providing comments and feedback on this Consultation Document, SSEN Transmission would be grateful for your consideration of the questions below:

- Have we adequately explained the need for these Projects?
- Do you feel sufficient information has been provided to enable you to understand what is being proposed on and why?
- Are you satisfied that our approach taken to select our Optimal Routes and design solutions have been adequately explained?
- Do you have any particular concerns or queries on the proposed connection projects?
- Are there any factors, or environmental features, that you consider may have been overlooked during the optimal route selection processes?

1 Introduction

1.1.1 This document has been prepared by ASH design+assessment Ltd. (ASH) on behalf of Scottish and Southern Electricity Networks Transmission (SSEN Transmission). SSEN Transmission, operating under licence held by Scottish Hydro Electric Transmission plc, owns, operates and develops the high voltage electricity transmission system in the north of Scotland and remote islands. This document invites comments from all interested parties on the optimal routes of new transmission infrastructure in the Strathy area of Sutherland, in the north of Scotland, that is required to connect five consented and/or proposed wind farms to the existing transmission network at Connagill 275/132 kV substation. Together, the projects are known as the 'Connagill Cluster Grid Connections'.

1.1.2 This document describes the route selection process undertaken, the route options identified and appraised, and the selection of the optimal route for each connection.

1.1.3 This document forms part of a consultation exercise to provide information on the Connagill Cluster Grid Connections and seek comment from stakeholders and members of the public on the proposals. Further information in relation to public consultation events can be accessed on the project website: www.ssen-transmission.co.uk/projects/project-map/Connagill-Cluster/

2 Project Background and Need

2.1.1 SSEN Transmission has a statutory duty under Schedule 9 of the Electricity Act 1989 to develop and maintain an efficient, co-ordinated and economical transmission system in its licenced areas. SSEN Transmission has obligations to offer non-discriminatory terms for connection to the transmission system.

2.1.2 SSEN Transmission are required to provide grid connections for five wind farms, all located within proximity to each other, in the Strathy area of Sutherland, in the Highlands of Scotland. They all require connection to the transmission network at the Connagill 275/132 kV substation. The wind farms are set out below and illustrated on **Plate 2.1:**

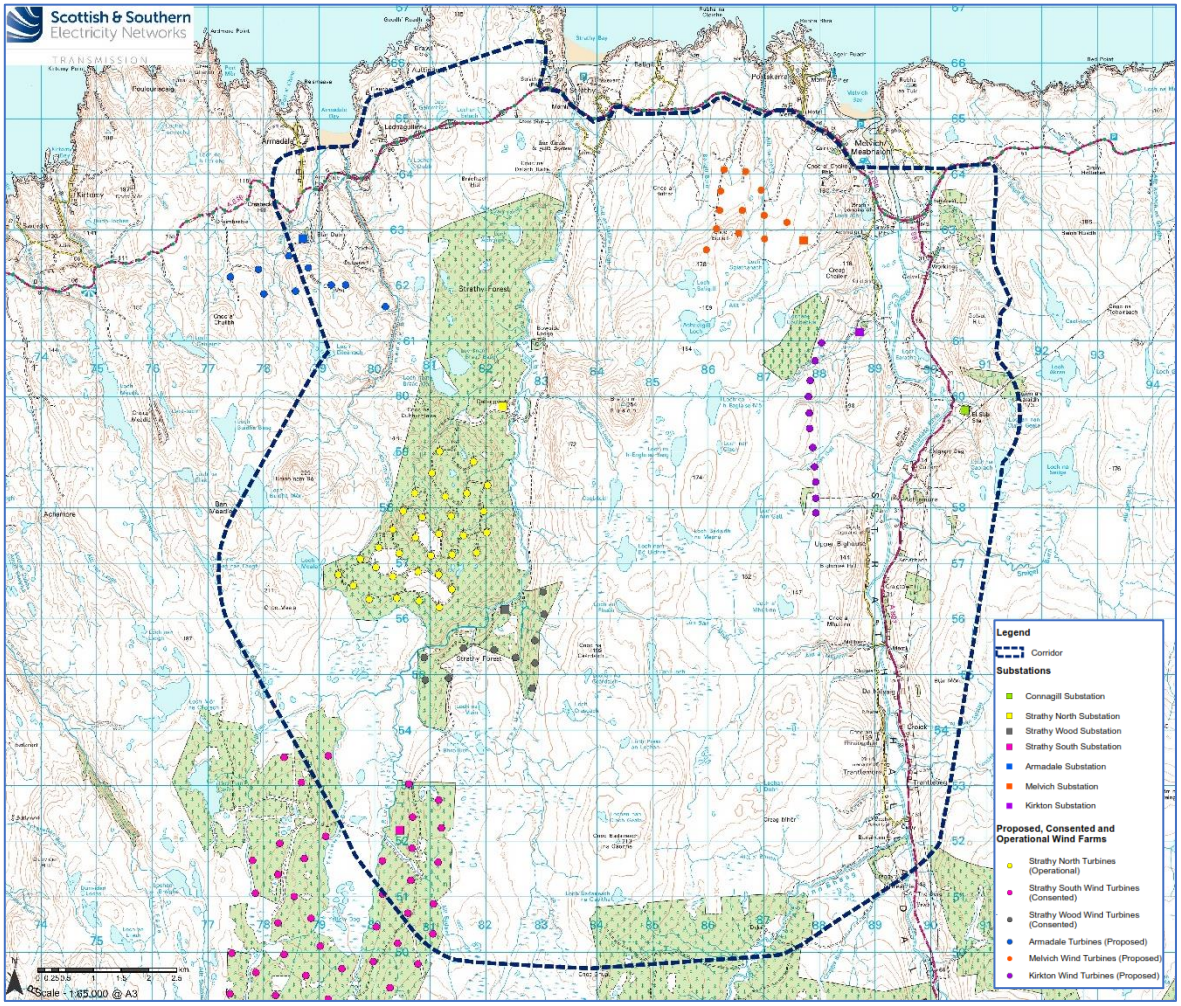
- Consented Strathy South Wind Farm (comprising 39 turbines with 208 MW capacity);
- Consented Strathy Wood Wind Farm (comprising 11 turbines with 62.4 MW capacity);
- Proposed Armadale Wind Farm and Battery Energy Storage System (BESS) (comprising 9 turbines with 85.4 MW capacity);
- Proposed Melvich Wind Farm and BESS (comprising 12 turbines with 99.6 MW capacity); and
- Proposed Kirkton Wind Farm and BESS (comprising 11 turbines with 72.8 MW capacity plus).

2.1.3 The proposed connections are in accordance with agreements between SSEN Transmission, National Grid Electricity System Operator (as operator of the National Grid), and each wind farm developer.

2.1.4 Although the connections are under separate connection agreements, SSEN Transmission has decided to streamline the pre-application consultation and routeing process in order to allow stakeholders to review the connections that make up the Cluster as a whole. This also provides the opportunity to consider the consolidation of infrastructure and construction practices where practicable.

2.1.5 All connections are to be provided at 132 Kilovolts (kV) (132,0000 volts) accommodated on a combination of overhead lines (OHLs) and underground cable.

Plate 2.1: Locations of Wind Farms in the Strathy area



2.2 National Planning Policy

2.2.1 Scotland's fourth National Planning Framework (NPF4) was published by the Scottish Government on 13th February 2023. NPF4 is a long-term strategy for Scotland (to 2045) and is the spatial expression of the Government's Economic Strategy and plans for development and investment in infrastructure. NPF4 forms part of the statutory development plan.

2.2.2 This development would be recognised in NPF4 as a National Development (ND) under ND3 Strategic Renewable Electricity Generation and Transmission Infrastructure'. It therefore forms a vital element to deliver network and grid infrastructure required to deliver the Government's legally binding targets for net zero emissions and renewable energy electricity generation objectives.

3 Project Overview

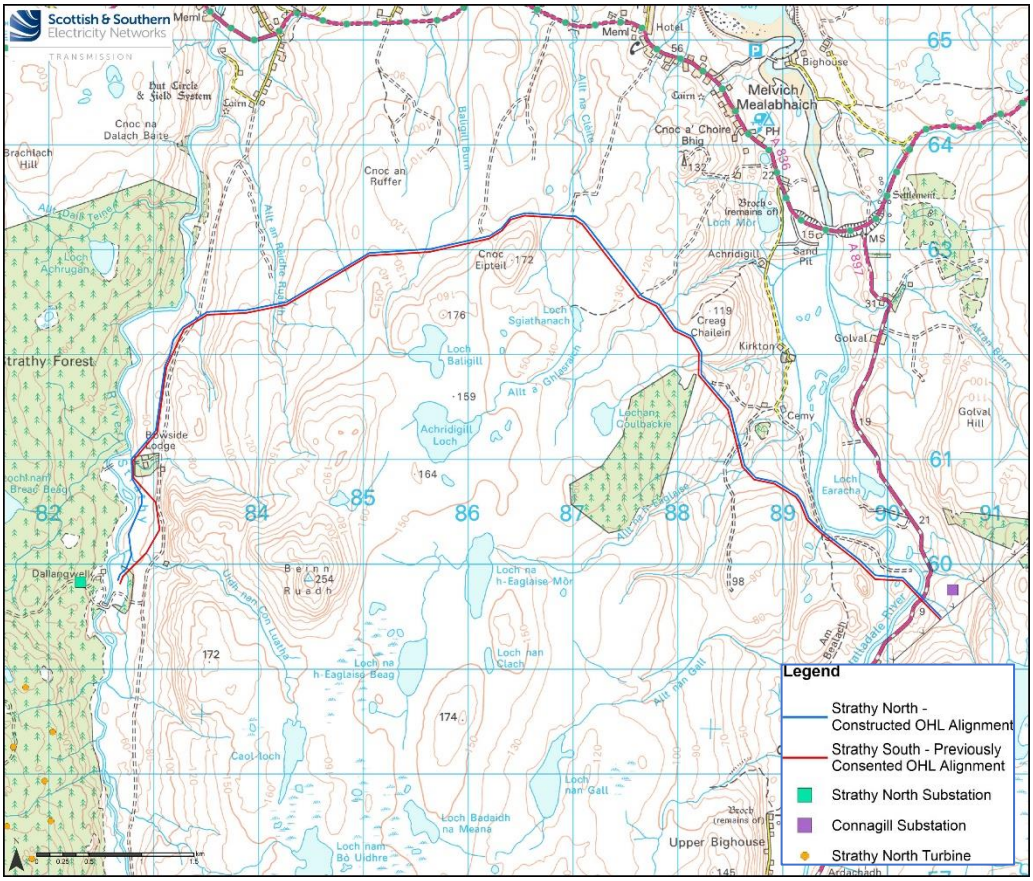
3.1 Project History

3.1.1 In 2013, SSEN Transmission sought consent for the construction of two parallel 132 kV trident wood pole OHL's; one to connect the consented Strathy North Wind Farm to the National Grid and the other to provide a connection for the (at the time) proposed Strathy South Wind Farm. These connections were collectively referred to as Strath Halladale to Dallangwell 132 kV Connection (see **Plate 3.1**).

3.1.2 Consent was granted by the Energy Consents Unit in February 2014 and construction of one of the OHLs (to connect Strathy North Wind Farm to the national grid) was completed in 2015. The second consented OHL was not constructed due to delays in consenting of Strathy South Wind Farm, and as such, the Section 37 consent for the second OHL has now lapsed.

3.1.3 The point of connection consented in 2013 for the Strathy South OHL was to Strathy North Wind Farm, near Dallangwell. The wind farm developer has since opted to change the point of connection to the on-site Strathy South wind farm substation which has resulted in additional studies being required.

Plate 3.1: Consented Strath Halladale to Dallangwell 132 kV Grid Connection



3.1.4 In 2021, SSEN Transmission commenced optioneering studies to connect the consented Strathy Wood, consented Strathy South and proposed Armadale wind farms to the transmission network at Connagill 275/132 kV substation. The optimal technological solution for each of these connections was initially via OHL's supported by trident H-wood pole, and it was on this basis that SSEN Transmission completed a routeing exercise, which was presented at a virtual consultation event in February 2022.

3.1.5 Since the February 2022 consultation, SSEN Transmission have received requests to provide two further connections in the area; for the proposed Melvich and Kirkton projects, both of which would also connect into Connagill 275/132 kV substation. It became clear that the addition of two further OHLs, alongside the Strathy Wood, Strathy South and Armadale connection proposals, as well as the existing Strathy North trident H-wood pole 132 kV OHL, would not be the optimal solution from a technical or environmental perspective, particularly where all connections would converge within the vicinity of Connagill substation. As such, a review of the connection requirements for each project was undertaken with the aim of identifying a rationalised approach across the five connections.

3.2 Technology Solutions

3.2.1 As part of the review to find a rationalised approach, SSEN Transmission considered various technology options and these included:

- Trident double wood 'H' pole OH;
- Steel structures OHL (steel lattice towers or NeSTS Monopole); and
- Trident low profile steel pole OHL.

3.2.2 Consideration has also been given to the potential use of underground cable in areas more constraining to OHL, such as in the vicinity of proposed or consented wind turbines or areas where sensitive bird species are known to be present.

3.2.3 Details of each technology option considered are provided below:

Table 3.1: Technology Solutions

Technology Type	Indicative Height	Indicative Span Length	Opportunities and Constraints
Trident 'H' Wood Pole (see Plate 3.2)	14 – 16 m	60 – 80 m	The reduced height of the wood pole structure compared to a steel lattice or monopole structure would have the benefit of being visually less intrusive and could minimise collision risk with sensitive bird species. The smaller footprint and opportunitiy to utilise temporary access track solutions could in isolation, also minimise land take and reduce potential effects on sensitive habitats and peatlands. However, the use of trident wood pole is not compatible with double circuit configurations and as such separate wood pole OHLs would be required for each connection. This would result in numerous wood pole structures, in places running in paralell, with the potential for significant environmental effects, as well as operation and maintenance challanges. There would also be no opportunity to rationalise or futureproof.
Trident Low Profile Steel Pole (see Plate 3.3)	14 – 16 m	60 – 80 m	As for the trident wood pole OHL, the reduced height compared to a steel lattice or monopole structure would allow the OHL to be less visually intrusive and could minimise potential collision risk with sensitive bird species. The smaller footprint and opportunitiy to utilise temporary access track solutions could also minimise land take and reduce potential effects on sensitive habitats and peatlands. While current design of the steel pole OHL is not compatible with double circuit configuration, the design of conductor that could carry larger loads (OSLO conductor) is underway but is still under testing phase and would not be available ahead of the connection dates agreed for these developments.
Steel Structure (see Plates 3.4 and 3.5)	28 - 44 m	250 m	A steel structure OHL would provide a single support structure to carry two circuits and rationalise the proposed OHLs, thereby reducing the potential effects, including cumulative, of a number of connections crossing this area. Steel structures have greater foundation and land take requirements per structure compared to wood or steel

Technology Type	Indicative Height	Indicative Span Length	Opportunities and Constraints
			trident poles, but have a much greater span length between towers which can provide opportunites to microsite towers away from sensitive habitats or deeper areas of peat, for example, where practicable. However, permanent access is typically required to facilitate safe operational and maintenance activities, particularly in more remote areas. The increased height could present greater collision risk to sensitive bird species, and increase the potential for landscape and visual effects, in comparison to trident OHLs. There is currently no technical approval by SSEN Transmission for a double circuit NeSTS structure. NeSTS structures also have larger foundation requirements compared to more traditional steel lattice structures.
UGC	-	-	The installation of an underground cable would comprise a working corridor approximately 30 m wide, centred on the cable centreline, with new access track(s) created for construction and areas for spoil and storage created within the working corridor. Cable Sealing End (CSE) compounds would be required on an UGC circuit, either to facilitate transition to the substations (for a full UGC circuit) or to an OHL where part UGC solution is utilised. This would result in additional landtake and the potential for environmental effects. Using UGC limits the future flexibility of the network, adding additional connections or increasing circuit ratings is more intrusive than with the equivalent amendments to an OHL. Fault finding and maintenance is far more challenging and time consuming on UGC connections which can lead to longer outages on the network.

Plate 3.2: Trident 'H' wood pole

Plate 3.3: Example Steel Trident pole

Plate 3.4: Example Steel Lattice Tower

Plate 3.5: Example NeSTS Monopole

Proposed Technology Solution

3.2.4 Following a review of the various technology options available, SSEN Transmission concluded that a more rationalised approach could be achieved across the five connection projects. The table below sets out the proposed approach for each connection (see also **Figure 6**).

Table 3.2: Optimal Technology Solutions

Project	Technology Solution	Description
Strathy South and Strathy Wood Wind Farms	132 kV underground cable	From Strathy South Wind Farm on-site substation to a point in the vicinity of Strathy Wood Wind Farm on-site substation.
	132 kV OHL supported by steel structure	From Strathy Wood substation, a new 4.25 km double circuit 132 kV OHL supported by steel structures would be constructed to a 'T' on to the existing Strathy North to Connagill trident H-wood pole OHL near Dallangwell. This would transport electricity generated by Strathy Wood wind farm initially. This arrangement of T-ing onto the existing wood pole OHL would be a temporary arrangement until the next section of connection (as described below) is constructed, at which point electricity generated by Strathy South wind farm would also utilise the OHL.
	132 kV OHL supported by steel structure	To allow for future proofing, a new 12 km double circuit 132 kV OHL supported by steel structures would be constructed to continue the connection between the Strathy North 'T' (at Dallangwell) to Connagill substation. The structures would be capable of operating at 275 kV in the future, if required. Following completion of this section, Strathy Wood and Strathy North would be transfered over to the new structure and redundant parts of the existing trident H-wood pole OHL removed.

Project	Technology Solution	Description
Armadale Wind Farm	132 kV trident wood pole OHL	The works would include a single circuit 15 km 132 kV trident H-wood pole OHL between Armadale wind farm substation to a 'T' onto the proposed double circuit 132 kV OHL. The proposed 132 kV OHL (set out above) would complete the connection into Connagill 275/132 kV substation.
Melvich and Kirkton Wind Farms	132 kV trident wood pole OHL	These works would include a short span (<1 km) of single circuit 132 kV trident wood pole OHL between each wind farm substation and a 'T' on the existing Strathy North to Connagill trident H-wood pole OHL.
Existing Strathy North OHL	132 kV trident wood pole OHL	Once the 132 kV double circuit OHL is constructed, to further rationalise the project, the existing Strathy North to Connagill trident H-wood pole OHL would be removed between Strathy North substation, to a point, yet to be determined, but likely in proximity of Melvich substation. The section of wood pole OHL that would remain in place would be re-purposed for use by the Melvich and Kirkton connections into Connagill 275/132 kV substation.

3.2.5 To facilitate the five connections, a new switching station would also be required to collect all incoming circuits onto a double busbar before taking these through the 132 kV OHL supported by steel structure. The new switching station is currently at optioneering stage. SSEN Transmission will consult on this proposal separately, although an indicative search area has been selected to the east of the northern part of Strathy Forest (see Section 9.2 and **Figure 6**).

3.3 Other Considerations

Forestry Removal

3.3.1 Felling of commercial forestry may be required to enable construction of the proposed grid connections although this will be avoided or minimised where possible.

Access Strategy

3.3.2 Vehicle access is required to each tower or pole location during construction to allow for excavation and placing of concrete foundations and tower / pole installation.

3.3.3 In general, proposed construction access would be taken via the existing public road network and utilise existing forest and estate tracks, as far as practicable, upgraded as required. Installation of new tracks, both temporary and permanent would likely be required, depending on the technology solution. Floating stone road or trackway panel construction (typically a short-term solution) may be installed in sensitive areas such as over deeper areas of peat. Alternatively, helicopters may be used to deliver and construct poles and/or towers in areas where access presents a significant challenge. Using helicopters in this way can minimise the

environmental impact on sensitive habitats and reduces the need for temporary access tracks. However, helicopter delivery is a high-risk activity and presents some limitations. Feasibility is currently being assessed for the best method of access.

3.3.4 For underground cable sections, a temporary haul road is typically constructed along the length of the cable during the construction phase.

3.3.5 Access for operation and general maintenance must also be considered. For steel lattice towers, the preferred access is a permanent track, between 2.5 – 3.0m wide. For wood pole lines, a route suitable for off-road vehicles is acceptable, therefore eliminating the need for a permanent access track.

3.3.6 There is an opportunity to utilise the Strathy South wind farm access track for construction and maintenance access and deliveries, which could significantly reduce new access requirements within this part of the project.

3.4 Programme

3.4.1 It is anticipated that construction of the cluster as a whole would take place in a phased approach over a four year period, following the granting of consents, although detailed programming of each of the connection works would be the responsibility of the Contractor in agreement with SSEN Transmission.

3.5 Biodiversity Net Gain

3.5.1 Biodiversity Net Gain (BNG) is a process which leaves nature in a better state than it started. SSEN Transmission has developed a BNG toolkit based upon the Natural England metric[1], which aims to quantify biodiversity based upon the value of habitats for nature. It is an efficient and effective method for demonstrating whether development projects have been able to maintain or increase the biodiversity value of a development site after construction works.

3.5.2 The BNG toolkit would be applied across the cluster to quantify the overall potential biodiversity impacts; this includes a biodiversity baseline assessment, analysis of habitat losses due to temporary works and permanent structures during construction works, and analysis of biodiversity gains following reinstatement of habitats in areas of temporary construction work.

SSEN Transmission's Biodiversity Ambition

3.5.3 SSEN Transmission is committed to protecting and enhancing the environment by minimising the potential impacts from their construction and operational activities. As part of this

[1] Natural England Biodiversity Metric 2.0 http://publications.naturalengland.org.uk/publication/5850908674228224

approach, SSEN Transmission plc has made commitments within its Sustainability Strategy (2018)2 , Sustainability Plan (2019)3 and RIIO-T2 Business Plan, for new infrastructure projects to:

- Ensure natural environment considerations are included in decision making at each stage of a project's development;
- Utilise the mitigation hierarchy to avoid impacts by consideration of biodiversity in project design;
- Positively contribute to the UN and Scottish Government Biodiversity strategies by achieving an overall 'No Net Loss' on new infrastructure projects gaining consent in 2020 onwards and achieving Net Gain on projects gaining consent in 2025 onwards; and
- Work with their supply chain to gain the maximum benefit during asset replacement and upgrades.

3.5.4 The design and evolution of these grid connection projects will be carried out in line with these commitments.

4 Route Selection

4.1 Overview

4.1.1 The approach to route selection is being informed by SSEN Transmission's guidance *'Procedures for Routeing Overhead Lines and Underground Cables of 132 kV and above'* which provides a framework to ensure environmental, technical and economic considerations are identified and appraised at each stage of the routeing process.

4.1.2 The guidance splits the routeing stage of a project into four principal stages, as follows:

- Stage 0: Routeing Strategy Development;
- Stage 1: Corridor Selection;
- Stage 2: Route Selection; and
- Stage 3: Alignment Selection.

4.1.3 Each stage is an iterative process and involves an increasing level of detail and resolution, bringing cost, technical and environmental considerations together in a way which seeks to achieve the best balance at each stage. The stages carried out can vary depending on the

[2] Delivering a smart, sustainable energy future: The Scottish Hydro Electric Transmission Sustainability Strategy (2018) https://www.ssen-transmission.co.uk/media/2701/sustainability-strategy.pdf
[3] Our Sustainability Plan: Turning Ambition into Action. (2019) SHE Transmission. https://www.ssen-transmission.co.uk/media/3215/our-sustainability-plan-consultation-report.pdf

type, nature and size of a project and consultation is carried out at each stage of the process as appropriate.

4.1.4 The Proposed Development is currently at Stage 2: Route Selection, the objective of which is to identify an optimal route to be taken forward for consultation prior to commencing the alignment selection stage.

Stage 1: Corridor Selection

4.1.5 A Corridor was identified which could encompass a range of feasible route options between the various cluster connection points (see **Figure 1**).

Stage 2: Route Selection

4.1.6 Route options were initially identified for each connection following a desk-based review, informed by site visits to develop an understanding of the area and making use of landform and existing infrastructure corridors, such as the A836 public road and the existing Strathy North to Connagill OHL. In accordance with the steps outlined in the Holford Rules[4] and SSEN Transmission's guidance[5], the following principles were taken into account as far as practicable during the route options stage:

- Avoid if possible major areas of highest amenity value (including those covered by national and international designations and other sensitive landscapes);
- Avoid by deviation, smaller areas of high amenity value;
- Try to avoid sharp changes of direction and reduce the number of larger angle towers required;
- Avoid skylining the route in key views and where necessary, cross ridges obliquely where a dip in the ridge provides an opportunity;
- Target the route towards open valleys and woods where the scale of poles/towers will be reduced and views broken by trees (avoid slicing through landscape types and try to keep to edges and landscape transitions);
- Consider the appearance of other lines in the landscape to avoid a dominating or confusing wirescape effect; and
- Approach urban areas through industrial zones and consider the use of undergrounding in residential and valued recreational areas.

[4] Scottish Hydro Electric Transmission Limited (SHETL). (October 2004). The Holford Rules: Guidelines for the Routeing of New High Voltage Overhead Transmission Lines with NGC 1992 and SHETL 2003 Notes; Revision 1.01

[5] SSEN Transmission (2020). Procedures for Routeing Overhead Lines and Underground Cables of 132 kV and above, Revision 2.0.

4.1.7 Appraisal of the route options was undertaken against a number of environmental, engineering and cost criteria set out within SSEN Transmission guidance[5] using the Red, Amber, Green (RAG) matrix which is provided as **Plate 4** below. An optimal route was then selected for each element of the connection for the purposes of this consultation.

Plate 4: RAG Ratings

Performance	Comparative Appraisal
Most Preferred ↓ Least Preferred	Low potential for the development to be constrained
	Intermediate potential for the development to be constrained
	High potential for the development to be constrained

5 Environmental Baseline

5.1 Baseline Conditions

5.1.1 A baseline study was carried out to identify a broad range of potential constraints and opportunities within the Corridor to be able to inform potential route options for each of the connections. Establishment of the baseline involved the following activities:

- Identification of environmental designated sites and other constraints, utilising GIS datasets available via NatureScot[6] Site Link[7];
- Identification of archaeological designations and other recorded sites, utilising GIS datasets available via Historic Environment Scotland[8,9] and Highland Historic Environment Record (HER)[10];
- SEPA interactive Flood Risk Mapping[11];
- Review of the Highland-wide Local Development Plan (2012)[12] and the Caithness and Sutherland Local Development Plan (CaSPlan) (2018)[13] to identify further environmental constraints and opportunities, such as regional level designations or other locations important to the public;

[6] Scottish Natural Heritage (SNH) became NatureScot on 24 August 2020
[7] SNH. SNHi Site Link. [online] Available at:: https://sitelink.nature.scot/home
[8] Historic Environment Scotland Data Services. Portal. [online] Available at: http://portal.historicenvironment.scot/
[9] Royal Commission on Ancient and Historical Monuments of Scotland. Canmore. [online] Available at:: http://canmore.rcahms.gov.uk/
[10] Highland Council Archaeology Service. Highland Historic Environment Record. [online] Available at: https://her.highland.gov.uk/
[11] Scottish Environmental Protection Agency. SEPA Flood Maps [online] Available at: http://map.sepa.org.uk/floodmap/map.htm
[12] Highland Council (2012), Highland-wide Local Development Plan
[13] Highland Council (2018), Caithness and Sutherland Local Development Plan (CaSPlan)

- Review of landscape character assessments of relevance to the Corridor[14];
- Review of Native Woodland Survey of Scotland and Ancient Woodland Inventory data sets[15];
- Review of Ordnance Survey (OS) mapping (1:50,000 and 1:25,000 and online GIS data sources from OS OpenData) and aerial photography (where available) to identify other potential constraints such as settlement, properties, walking routes, cycling routes etc.;
- Extrapolation of OS GIS data to identify further environmental constraints including locations of watercourses and waterbodies, roads classifications and degree of slope;
- Review of environmental information relating to the wind farm developments across the site; and
- Review of other local information through online and published media such as tourism sites and walking routes[16,17,18].

5.1.2 Desk-based studies were supplemented by high-level walkover assessments of the route options by specialist consultants. These walkover surveys obtained further site data and observations of localised constraints and informed the appraisal of routes.

5.1.3 The environmental baseline within the Corridor is illustrated on **Figures 2.1 – 2.9.**

5.2 Key Sensitivities and Constraints

5.2.1 A summary of key environmental sensitivities and constraints present within the Corridor and relevant to the route options, are set out below.

Environmental Designations

5.2.2 There are a number of natural heritage designations within the Corridor which are afforded recognition or protection within planning policy, as shown on **Figure 2.1.** The key protected areas of relevance to the route options, include:

- Caithness and Sutherland Peatlands Special Protection Area (SPA): contains a large proportion of the Caithness and Sutherland peatlands which form the largest and most intact area of blanket bog in Britain. The SPA qualifies under Article 4.1 of the Directive on the Conservation of Wild Birds, by regularly supporting populations of European importance of the Annex 1 species (e.g. diver, golden eagle, hen harrier, merlin, golden plover, wood sandpiper, short-eared owl and dunlin, common scoter and wigeon) and

[14] NatureScot. (2019). Scottish Landscape Character Types Map and Descriptions [online] Available at: https://www.nature.scot/professional-advice/landscape/landscape-character-assessment/scottish-landscape-character-types-map-and-descriptions
[15] Available at data.gov.uk
[16] Munro Magic [online] Available at: http://www.munromagic.com/
[17] Walk Highlands [online] Available at: http://www.walkhighlands.co.uk/
[18] Scotways [online] Available at: https://www.scotways.com/

further qualifies under Article 4.2 of the Directive by regularly supporting populations of European importance of migratory species (e.g. common scoter and wigeon);

- Caithness and Sutherland Peatlands Special Area of Conservation (SAC): designated for blanket bogs, depressions on peat substrates of the Rhynosporion, otter, natural dystrophic lakes and ponds, northern Atlantic wet heaths with cross-leaved heath, clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels, marsh saxifrage, and transition mires and quaking bogs;
- Caithness and Sutherland Peatlands Ramsar forms one of the largest and most intact areas of blanket bog in the world, including an exceptionally wide range of vegetation and surface pattern types, some of which are unknown elsewhere. These habitats support a diverse range of breeding waterfowl including dunlin;
- Halladale Site of Special Scientific Interest (SSSI) has been designated for blanket bog, breeding bird assemblage and populations of black throated diver and common scoter; and
- Armadale Gorge SSSI designated for woodland, scrub and subalpine dry heath. The woodland is particularly important given its location, extent, the variety of tree species it contains and the diverse age structure of the trees.

5.2.3 A large part of the Corridor forms part of “The Flow Country”, considered to be the largest area of blanket bog in the world. UNESCO (a United Nations organisation) was formally asked by the Flow Country Partnership (a collaboration that includes the Highland Council, NatureScot, RSPB Scotland, University of Highlands and Islands and Wildland Ltd) to consider awarding World Heritage Site (WHS) status, which is an internationally recognised designation given to places of cultural, historical or scientific significance. A decision on the Flow Country’s nomination is expected mid-2024. The Corridor falls partly within the Flow Country: West Halladale Candidate WHS (as shown on **Figure 2.2**).

Water and Soils

5.2.4 There are numerous watercourses and lochs within the Corridor, including the River Strathy and Halladale River which are important fisheries. The Scottish Environmental Protection Agency (SEPA) floodplain mapping shows a floodplain associated with these watercourses, although flood extents are generally confined to the watercourse channels.

5.2.5 Superficial deposits within the Corridor mostly comprise peat, with alluvium and / or glacio-fluvial sand and gravel shown adjacent to larger watercourses. Much of the peat is classified

as Class 1 or Class 2 Peatland byNatureScot[19] and is afforded further protection being part of the Caithness and Sutherland peatlands (see **Figure 2.3**).

Cultural Heritage

5.2.6 Designation is the legal recognition of some of Scotland's most important historic sites, buildings and places and include Scheduled Monuments (SM) and Listed Buildings. Within the Corridor, designated sites tend to be situated along road corridors (the A897 to the east and the A836 to the north), within Strath Halladale or along the north coast, as shown on **Figure 2.4**. The key designated sites of relevance to the route options in terms of potential for direct and indirect visual impact, include:

- Within Strath Halldale; Halladale Bridge hut circles SM; Leathad Carnaich hut circles SM; Millburn barrows SM; and various listed buildings in the environ of Bighouse House and at Smigel Bridge;
- North coast; various listed buildings in the vicinity of the settlement of Strathy including: Strathy Free Church, School and Manse; and
- Armadale Burn Broch SM, a defensive monument most likely to have been placed to maximise views, particularly north towards the sea through the gorge of Armadale Burn and more generally in all directions. The function makes the monument more sensitive to visual impacts which might obstruct lines of sight.

5.2.7 In addition to these designated assets, the Highland Historic Environment Record (HER) contains details of a number of non-designated assets of archaeological and cultural heritage interest within the Corridor. In addition, field survey has identified previously unrecorded features within the Corridor, as illustrated on **Figure 2.4**.

Landscape and Visual

5.2.8 The Farr Bay, Strathy and Portskerra Special Landscape Area (SLA) is a regional level designation applied by The Highland Council which slightly encroaches into the northern part of the Corridor (see **Figure 2.5**).

5.2.9 Wild Land Areas (WLAs) have been defined by NatureScot as those areas comprising the greatest and most extensive areas of wild characteristics within Scotland. Although not a designation, WLAs are given protection within the Planning System. WLA39: East Halladale Flows sits to the east of Strath Halladale, where the eastern edge of the Corridor encroaches slightly into it, as shown on **Figure 2.5**.

[19] Scottish Natural Heritage. (2016). Carbon and Peatland 2016 Map. [online] Available at: http://gateway.snh.gov.uk/natural-spaces/index.jsp

5.2.10 Landscape character within the Corridor is dominated by sweeping moorland broken up by patches of commercial forestry, with Strath Halladale running along the eastern edge. Located to the south of the A836 the area is characterised by a gently undulating and generally smooth landscape. This is a transitional landscape, influenced by the broad moorland of the flow country and the sandy bays and rugged points of the coast. It forms the setting to the surrounding summits, particularly the nearby Bens Griam, the distinctive form and prominence of which are accentuated by the simple, open and expansive nature of the low-lying moorland.

5.2.11 Although the immediate area is sparsely settled, it is influenced by turbines and access tracks of the operational Strathy North wind farm. The availability of access along the coast and through the straths has led to development of the area with settlements forming close to river crossing points and with farms located in more sheltered areas including Strath Halladale. In contrast the interior moorlands are largely uninhabited, but are still influenced by the electrical, communication and transport infrastructure located within them and nearby.

5.2.12 Major infrastructure is present within the Corridor including the 275 kV overhead transmission line that runs through Strath Halladale, past Connagill substation and connects into Dounreay Nuclear Power Station. Existing wind farms, including Strathy North wind farm is also characteristic of the area. Nevertheless, the Corridor and wider area also include areas where there are few contemporary features and impressions of wildness and remoteness are stronger as demonstrated by the identification of WLA39: East Halladale Flows by NatureScot (see **Figure 2.5**).

Recreation

5.2.13 The Corridor borders the A836 to the north which forms part of the North Coast 500 tourist route bringing visitors to the area. The road is also part of National Cycle Route 1 which connects Dover to John O'Groats and continues to the Orkney and Shetland Isles and is 2,793 km long. In addition, the A897 between Helmsdale to Melvich to the east of the Corridor, is also frequently used by tourists.

5.2.14 The River Strathy and Halladale River are popular rivers with anglers. The River Strathy is a spate Salmon River which is fished as part of Bowside Fisheries based at Bowside Lodge. A number of tributaries feed into this river from the site and from some small lochans and it enters the Pentland Firth at Strathy Bay after 19 km. The Halladale River is also a spate salmon river which has its origins in the flow country on the Knockfin Heights to the south of Forsinard and runs for 35 km entering the Pentland Firth at Melvich Bay.

5.2.15 There are several core paths within the Corridor, mainly leading from the A836 north towards the coast. There is one Core Path within the eastern extent of the Corridor: the SU19.03, Kirkton to Upper Bighouse. The path begins at the cemetery close to Kirkton Farm and runs along the west side of the Halladale River where it joins with Bighouse road after

approximately 4.6 km. Scottish Hill Track 334 (formerly 332) is located within the western extent of the Corridor, which begins at Trantlemore, approximately 2 km south of the A897, passing Ben Griam Beg and Loch nam Breac towards the Strathy plantation by Lochstrathy bothy. The path then continues down the glen of the River Strathy, ending at Strathy village.

6 Strathy South and Strathy Wood Grid Connections – Southern Section

6.1 Introduction

6.1.1 This section of the report sets out a description of the route options that were considered for the 'southern section' of the combined Strathy South and Strathy Wood grid connection. The southern section covers the area from the consented Strathy South wind farm substation to (within the vicinity of) the operational Strathy North substation. Section 7 of this report describes the 'northern section' to complete the connection to Connagill 275/132 kV substation. However, one route option considered (SS-SN5, as described in sub-section 6.2) does provide a direct connection from the consented Strathy South wind farm substation to Connagill 275/132 kV substation, although an additional connection between Strathy Wood wind farm substation and Strathy South wind farm substation would also be required.

6.1.2 This is followed by a comparative summary of the potential environmental, technical and economic constraints identified for each route option.

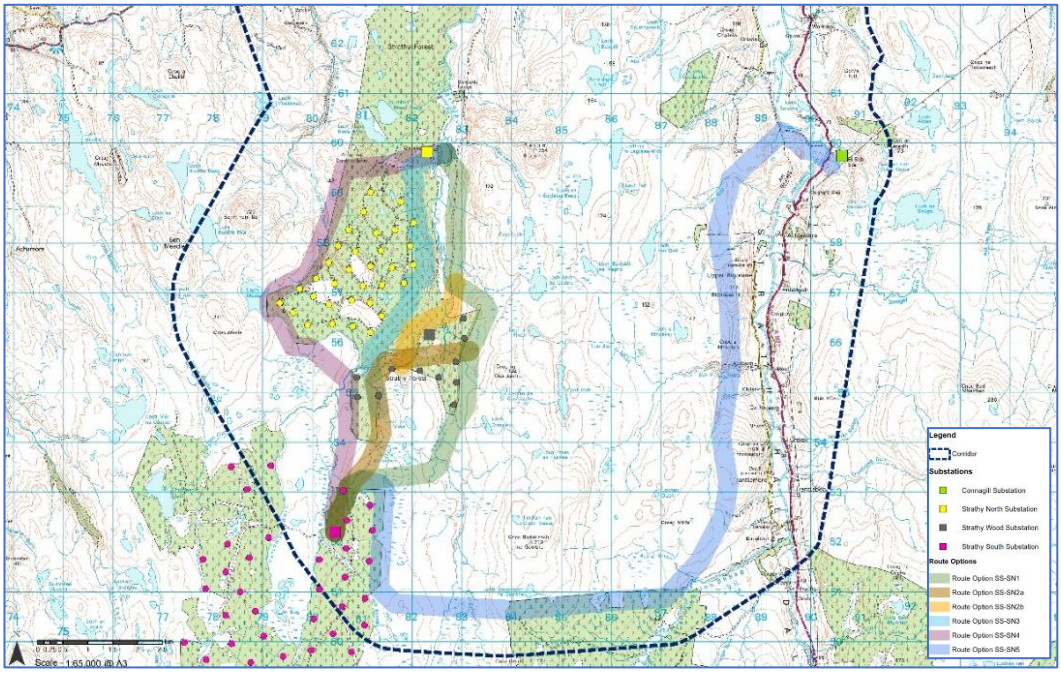
6.2 Description of Routes

6.2.1 SSEN Transmission identified six route options between the Strathy South substation to Strathy North substation, based on initial desk-based review and previous knowledge of the site. A summary of the route options is outlined below and illustrated on **Plate 6.1** and **Figure 3.1.**

- **Route Option SS-SN1:** This route travels in a north, north-east direction from Strathy South wind farm substation for just over 1 km before turning east to the south of Loch a'Bhrollich. The route then travels north/north-east for approximately 3.5 km following the Uair watercourse until it reaches Strathy Forestry plantation, where it follows the forestry boundary. The route then curves to the north-west for 1 km until it joins an existing access track which it follows for around 3.5 km to where the route terminates at the Strathy North substation near Dallangwell.
- **Route Option SS-SN2a:** An alternative option to Route Option SS-SN1, following alongside the existing access track for approximately 5 km where it would cut through the Strathy Forest Plantation, to the south of the consented Strathy Wood substation, and rejoin Route Option SS-SN1 to connect to Strathy North substation.

- **Route Option SS-SN2b**: Similar to Route Option SS-SN2a, however it would continue to be routed along the existing access track and River Strathy, keeping to the north of the consented Strathy Wood substation, where it would rejoin Route Option SS-SN1 to the west of Strathy Forest to connect to Strathy North substation.
- **Route Option SS-SN3**: Approximately 9 km in length, the route overlaps with Route Options SS-SN2a and 2b, travelling for approximately 3 km along the existing access track. Upon reaching 'the chimney', the route would cross the River Strathy and run adjacent to the east of the Strathy North wind turbines, continuing north for approximately 5 km through areas of coniferous forestry and felled plantation. Upon reaching the Strathy North access track, the route would turn north/north-east for approximately 1 km before crossing the River Strathy again and terminating at Strathy North substation.
- **Route Option SS-SN4**: Approximately 12 km in length, this route travels north upon leaving Strathy South substation, running adjacent to the River Strathy for approximately 3 km. The route then crosses the river and heads in a north-west direction for 1 km to reach the southern edge of the Strathy Forest plantation. The route continues north along the west boundary of the plantation for approximately 4.5 km. It then passes in an eastward direction, to the north of the wind turbines, before joining the wind farm access track, crossing the River Strathy and terminating at the Strathy North substation.
- **Route Option SS-SN5**: Approximately 21.5 km in length, this route option would connect the Strathy South wind farm to Connagill 275/132 kV substation directly, by passing the requirement for a connection at Strathy North substation. An additional connection between Strathy Wood and Strathy South would be required. The route initially overlaps with other routes upon leaving the Strathy South wind farm substation before heading in an easterly direction for 1 km. The route then heads south alongside the Strathy Forest plantation for 2.5 km, before turning east for around 7.5 km and then north for a further 16 km running broadly in parallel to the Halladale River. Once the route meets the existing trident pole OHL, it turns south-east for a final 1 km before crossing the Halladale River and terminating at Connagill 275/132 kV substation.

Plate 6.1: Strathy South and Strathy Wood Grid Connection 'Southern Section' Route Options



6.3 Appraisal of Routes

Overview

6.3.1 An appraisal of the Route Options described in sub-section 6.2 has been undertaken, considering the environmental, technical and economic constraints of each prior to arriving at an Optimal Route. A summary of this appraisal is provided below, and **Appendix 1** contains a summary of the comparative RAG ratings for each route option.

6.3.2 As explained in paragraph 3.1.4, initial appraisal of these route options was carried out in 2021, and at that time the Strathy South and Strathy Wood wind farms were assumed to be via separate connections (i.e. on separate infrastructure). The appraisal assumed that wood pole OHL infrastructure would be the optimal technology solution for Route Options SS-SN 1, 4 and 5, with UGC the optimal technology solution for Route Options SS-SN 2a, 2b (as far as the connection point with Route Option SS-SN 1, at which point they would transition to wood pole OHL) and for Route Option SS-SN 3 (for the entirety of its length).

6.3.3 The design choice to utilise UGC for part of the selected route options was primarily driven by the presence of sensitive diver species in the locality, and early consultation with NatureScot whom indicated that OHL in this section would not be appropriate as a result. This applies to all options between Strathy South substation and Strathy Wood substation (including Route Option SS-SN 1). In addition, due to the proximity of the turbines associated with the consented Strathy South and Strathy Wood wind farms (for Routes Options SS-SN 2a and 2b) and the operational turbines of Strathy North wind farm (for Route Option SS-SN 3), these would pose a challenge in selection of an OHL alignment and being able to maintain the required separation distances.

6.3.4 As part of the assessment to rationalise the cluster, a review was carried out to consider consolidating the Strathy South and Strathy Wood connections onto shared infrastructure for the section between Strathy Wood substation and Strathy North substation. Two technology solutions were considered; either a single steel lattice double circuit tower OHL (to carry both connections) or two separate trident wood pole OHLs. Analysis of these options considered the environmental, technical and economic constraints and concluded that combining the connections onto one OHL supported by steel structure was the overall optimal solution. This was primarily due to the standard conductor (UPAS) on a trident wood pole OHL being unable to carry the capacity of the consented Strathy South wind farm (208MW). As such, an alternative conductor (OSLO), which is yet to be technically approved and may not be suitable for trident wood pole OHLs due to its weight, would be required. Whereas an OHL supported by steel lattice tower has conductors that are capable of carrying a much larger capacity, which also provides an opportunity for futureproofing.

6.3.5 The 2021 RAG appraisal of Route Option SS-SN 1, 2a and 2b was revisited to assume that between Strathy Wood substation and Strathy North substation the use of OHL supported by steel lattice tower would be the optimal technology solution (rather than wood pole). The technology solution for Route Option SS-SN 3 remained as UGC for its entirety. However, it was determined that Route Options SS-SN 4 and 5 could only carry one circuit and would not permit infrastructure to be rationalised and therefore both route options were discounted from the appraisal.

6.3.6 The comparative appraisal included in **Appendix 1** therefore covers Route Options SS-SN 1, 2a, 2b and 3, and is summarised below.

Environmental

6.3.7 In selecting the optimal route on environmental grounds, consideration has been given to a number of environmental factors and topic areas. Whilst there are a number of potential constraints that are consistent across all topic areas, the key differentiators to consider in this route selection exercise are highlighted below.

6.3.8 From an environmental perspective, all route options would pass through the Caithness and Sutherland Peatlands SPA, SAC and Ramsar designation, as well as the underlying SSSI designations, with potential to adversely affect their qualifying or notified features. Route Option SS-SN1 would traverse the longest stretch of the protected areas, with a large portion of the southern part of the route within proximity to lochans known to be used by protected diver species. To mitigate the potential for collision risk, this portion of the route would feature UGC (as previously discussed with NatureScot). However, the portion of route that would comprise steel lattice OHL would likely result in a greater loss of sensitive blanket bog habitats (compared to a wood pole OHL) given the larger footprint, construction working area and associated access requirements. Whilst the condition of the peatland habitats are more degraded in proximity to the existing track (i.e. the northern part of Route Option SS-SN1),

there is potential for adverse effects on the designated sites. On this basis, Route Options SS-SN 1 in its entirety is considered least optimal.

6.3.9 Of the remaining routes, Route Option SS-SN 3 traverses the shortest distance of the designations and presents opportunities to avoid adverse effects on the qualifying habitats of the SAC as well as compromising fewer environmental constraints compared to Route Options SS-SN 2a and 2b. However, Route Options SS-SN 2a and 2b also have opportunities to avoid adverse effects on the qualifying habitats of the SAC by selecting an alignment which closely follows the existing access track and associated disturbed land adjacent. Despite all routes crossing areas of blanket bog, an irreplaceable habitat, much of their lengths are routed through plantation.

6.3.10 Route Option SS-SN2a traverses an area of blanket bog that could not be avoided however there are opportunities to design an alignment at the very edge of these areas or through areas of conifer plantation to reduce the severity of impacts. The same applies to Route Option SS-SN 2b, with the additional opportunity to follow the disturbed ground adjacent to the existing track to minimise impacts on blanket bog.

6.3.11 Route Options SS-SN 2a, 2b and 3 pass through woodland, some of which is native. However, it is anticipated that effects could be minimised through careful selection of an appropriate alignment.

6.3.12 Route Option SS-SN 2b has the potential to result in direct impacts on the regionally important early modern settlement of Brarathy (Brae Strathy), north of Strathy Wood substation. However, it is anticipated that remaining features could be avoided by careful siting of infrastructure at alignment stage. In addition, part of the central and eastern sections of Route Option SS-SN 2b falls within a flood extent of the River Strathy and would require careful placement of towers to minimise effects.

6.3.13 On balance, **Route Option SS-SN 3** is determined to be the optimal option on environmental grounds due to it crossing the designated sites for the shortest length. This is followed by Route Options SS-SN 2a and 2b, connecting into the northern part of Route Option SS-SN1, as these options would largely follow the existing track which provides opportunities to minimise new access track infrastructure and avoidance of sensitive habitats.

Engineering

6.3.14 Given the similarities between the route options, many of the engineering constraints are comparable. For the engineering topic areas of major crossings, road crossings, ground conditions (terrain and peat), elevation, pollution areas, contaminated land, communication masts, metallic pipes, and DNO crossings there is no preference between the route options. The angle towers are not considered for this assessment as the underground sections originate from different locations and may lead to inappropriate comparison. Moreover, this

feature is not the driving factor especially in this instance for the route selection compared to other engineering features.

6.3.15 The below engineering topic areas relate to constraints where there are some differences between the route options.

6.3.16 All route options cross, or are situated near to, watercourses and lochans and their associated flood risk areas. Route Option SS-SN 2b is the least optimal in relation to flood risk given its proximity to the River Strathy and the associated flood risk zone. Route Options SS-SN 1, 2a and 3 are the optimal engineering options from a flooding perspective.

6.3.17 Route Option SS-SN 1 along with Route Options SS-SN 2a and 2b are situated within proximity of Scottish Hill Track 344 (which is being upgraded to accommodate the Strathy South wind farm access). However, Route Option SS-SN 2b is in closer proximity to the track for a longer stretch compared to the other options and could serve as an access route for construction and operation of the grid connection. Route Option SS-SN 3 is more distant from this track and all public roads, making it less optimal for access considerations.

6.3.18 Route Option SS-SN 2b, and 3 are situated within 100 m of identified properties and dwellings, notably Braerathy Lodge near Strathy Wood substation and the property at Dallangwell. However, Braerathy Lodge is unoccupied and likely to be demolished based on information gathered during site surveys, and Dallangwell is noted to no longer be under SSE Renewables' ownership but future use is unknown at present. As such, these are not considered to pose notable constraints.

6.3.19 Route Options SS-SN 1 and SS-SN 2b are considered to be optimal choices when considering proximity to wind farms as the required separation distance can be met. Route Option SS-SN 3 is least optimal as it passes through the Strathy North wind farm and while able to maintain the required separation distance from wind turbines due to this route option being UGC in its entirety, instead the construction of an UGC through an operational wind farm would be challenging due to the interface with existing wind turbine cables that would require adequate clearance to enable the required width of the construction corridor. Route Option SS-SN 2a has wind turbines from Strathy Wood wind farm encroaching within the route option that would require to be further assessed at alignment stage.

6.3.20 Route Option SS-SN 1 would require the greatest number of angle towers, given the longer connection, therefore being the least optimal option, while Route Option SS-SN 2b would have the least number of angle towers.

6.3.21 In determining an optimal route on engineering grounds, Route Option SS-SN 2b is broadly preferred because this option is comparatively closest to the existing track for a longer portion of the route length compared to other options which would facilitate in shifting of materials, construction, and maintenance of an OHL. Route Option SS-SN 2b would also require comparatively less angle towers and would be of shorter length compared to other route options.

Cost

6.3.22 UGC is more expensive than OHL supported by steel lattice tower in relation to construction costs, and while all route options would require a section of UGC, given Route Option SS-SN 3 would comprise of UGC for its entirety, this option would have the highest associated capital costs and would be least optimal. Route Option SS-SN3 is also routed for a longer stretch through plantation forestry which would increase the associated costs of felling to enable a sufficient construction working corridor, compensation and developing access. Route Option SS-SN1 has the greatest potential to avoid or minimise felling requirements, being situated largely outwith areas of woodland, however, due to length and access is considered second least optimal. The remaining route options (Route Options SS-SN 2a, and 2b) are comparable and more favourable from a cost standpoint, particularly due to being in closer proximity of the existing access track for a longer stretch.

6.4 Comparative Analysis Summary

6.4.1 **Table 6.1** displays the environmental, engineering and cost appraisal RAG ratings for the route options considered.

Table 6.1: Strathy South and Strathy Wood Grid Connection – Southern Section RAG Ratings

	Category	Sub-Topic	SS-SN 1 Rating OHL (steel structure) and UGC	SS-SN 2A Rating OHL (steel structure) and UGC	SS-SN 2B Rating OHL (steel structure) and UGC	SS-SN 3 Rating UGC
Environmental	Natural Heritage	Designations				
		Protected Species				
		Habitats				
		Ornithology				
		Geology, Hydrology and Hydrogeology				
	Cultural Heritage	Designations				
		Cultural Heritage Assets				
	People	Proximity to Dwellings				N/A
	Landscape and Visual	Designations				
		Character				
		Visual				

	Category	Sub-Topic	SS-SN 1 Rating OHL (steel structure) and UGC	SS-SN 2A Rating OHL (steel structure) and UGC	SS-SN 2B Rating OHL (steel structure) and UGC	SS-SN 3 Rating UGC
	Land Use	Agriculture				
		Forestry				
		Recreation				
	Planning	Policy				
		Proposals				
Engineering	Infrastructure Crossings	Major Crossings (132kV, 275kV, Rail, 200+m wide river, navigable canal, gas or hydro pipeline)				
		Road Crossings				
	Environmental Design	Elevation				
		Pollution Areas				
		Contaminated Land				
		Flooding				
		Route Length				
	Ground Conditions	Terrain				
		Peat				
	Construction / Maintenance	Access				
	Proximity	Clearance Distance				
		Proximity to Windfarms				
		Communication Masts				
		Metallic pipes				
		Urban Environments				

	Category	Sub-Topic	SS-SN 1 Rating OHL (steel structure) and UGC	SS-SN 2A Rating OHL (steel structure) and UGC	SS-SN 2B Rating OHL (steel structure) and UGC	SS-SN 3 Rating UGC
Cost	Capital	Construction, Diversions, Public Road Improvements, Felling, Land Assembly and Consent Mitigations				
	Operational	Inspections and Maintenance				

6.5 Optimal Route

6.5.1 The various constraints and route preferences have been taken into account to reach an optimal route across environmental, engineering and cost considerations.

6.5.2 Whilst Route Option SS-SN 3 has been identified as the optimal environmental option given it traverses the shortest length of the designated sites, from an engineering and cost perspective this option is less favourable. The main reason for this being that Route Option 3 passes through the operational Strathy North wind farm and as the technology solution for this route option would make use of UGC, this makes the interface with the existing wind turbine cables very challenging, particularly to establish the required construction corridor. Similarly, future access for maintenance and operations would require third party permission through the wind farm to access and carry out works, with other route options being less constrained.

6.5.3 Both Route Options SS-SN 2a and SS-SN 2b have reduced presence within the natural heritage designations compared with other options, and they both offer opportunities at Alignment Stage to avoid adverse effects on the qualifying habitats of the SAC by selecting an alignment which closely follows the existing access track and associated disturbed land adjacent. Route Option SS-SN 2b is located closer to the existing access track in the vicinity of Strathy Wood substation compared to Route Option SS-SN 2a, which would provide opportunities to reduce the requirements for new track infrastructure (particularly within the natural heritage designation and the steeper ground to the west and north of Strathy Wood substation). However, it is acknowledged that particular constraints have been identified within Route Option SS-SN 2b, including the regionally important Brarathy township and the proximity to the River Strathy and associated flooding zone. As such, it is considered that both Route Options SS-SN 2a and 2b are taken forward to Stage 3: Alignment Selection stage, to

consider all potential alignment options in the vicinity of Strathy Wood substation, as shown on **Figure 3.2**.

6.5.4 The conclusions of the routeing study recommended that through the constrained section of the Optimal Route, as it passes within the Caithness and Sutherland Peatlands SPA between Strathy South substation and Strathy Wood substation, the connection should utilise underground cable technology to minimise impacts on nearby sensitive qualifying diver species (see **Figure 6**).

7 Strathy South and Strathy Wood Grid Connections – Northern Section

7.1 Background

7.1.1 This section of the report considers the 'northern section' of the Strathy South and Strathy Wood grid connections, which covers the area from within the vicinity of Strathy North substation to Connagill 275/132 kV substation.

7.1.2 As discussed in Section 3, SSEN Transmission gained consent in 2014 for two parallel OHL grid connections; one for Strathy North wind farm and the other for Strathy South wind farm. Only the Strathy North wind farm OHL connection was installed and the consent for the Strathy South wind farm grid connection subsequently lapsed.

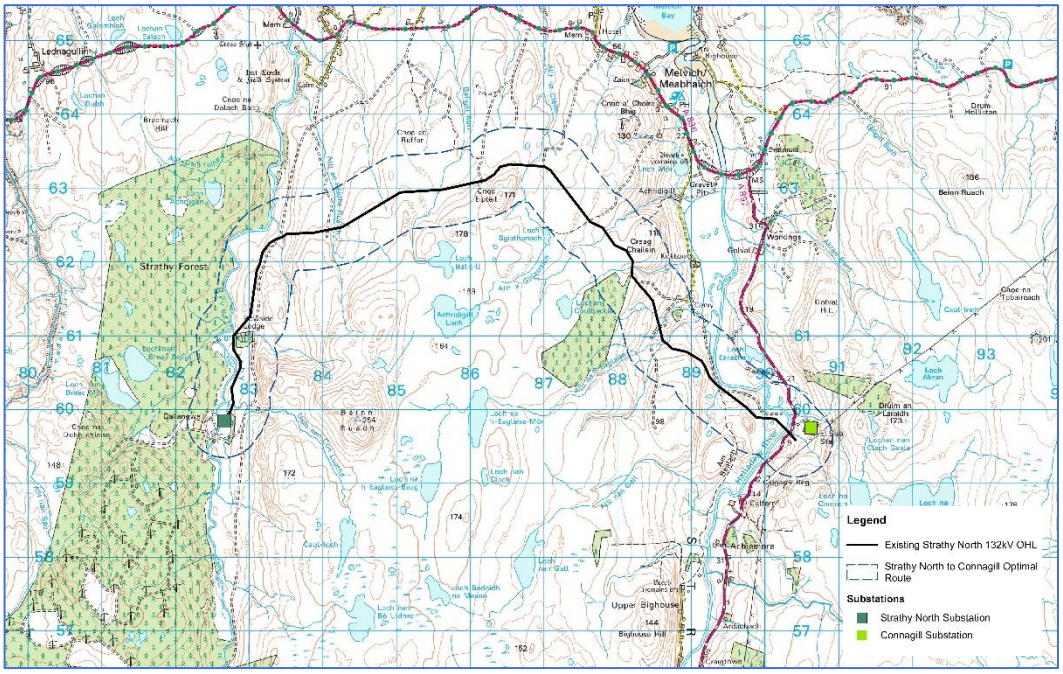
7.1.3 Strathy South wind farm received consent in November 2021 and the wind farm developer changed the point of connection to the transmission network to the on-site Strathy South wind farm substation. This resulted in additional studies being required including a routeing exercise for the Strathy South and Strathy Wood Grid Connection – Southern Section (as set out in Section 6 of this report).

7.1.4 Following the decision to rationalise the Connagill Cluster Grid Connections (as described in Section 3), the solution between the Strathy North substation to Connagill 275/132 kV substation is proposed to comprise a double circuit 132 kV OHL supported by steel structures. A section of this OHL would be capable of operating at 275 kV in the future, if required.

7.2 Appraisal of Optimal Route

7.2.1 A review in 2021 of the routeing exercise that was previously undertaken by SSEN Transmission for Strathy South concluded that the route previously identified, which now follows the route of the existing Strathy North 132 kV OHL, remained optimal (see **Plate 7.1** below). The 2021 review considered that the connection at that time would continue to be a wood pole structure.

Plate 7.1: Strathy South and Strathy Wood Grid Connection 'Northern Section' Optimal Route



7.2.2 As part of the assessment to rationalise the cluster, SSEN Transmission have carried out a further engineering review to consider an OHL supported by steel lattice tower which concluded that the optimal route for a wood pole OHL is also the optimal route for a steel lattice tower OHL. This is shown on **Figure 4.1** as the Strathy South and Strathy Wood Grid Connections 'Northern Section' Optimal Route.

7.2.3 To help further rationalise the cluster and mitigate some of the visual impacts from OHL structures in the area, it is proposed that once this connection is constructed, a large section of the existing Strathy North trident H-wood pole 132 kV OHL would be dismantled and removed (between Strathy North to a point near Melvich substation) and the generation from Strathy North wind farm would join the proposed double circuit 132 kV OHL. The remaining wood pole OHL would be repurposed (see Section 9.1).

7.3 Requirement to Consider Alternative Route Options

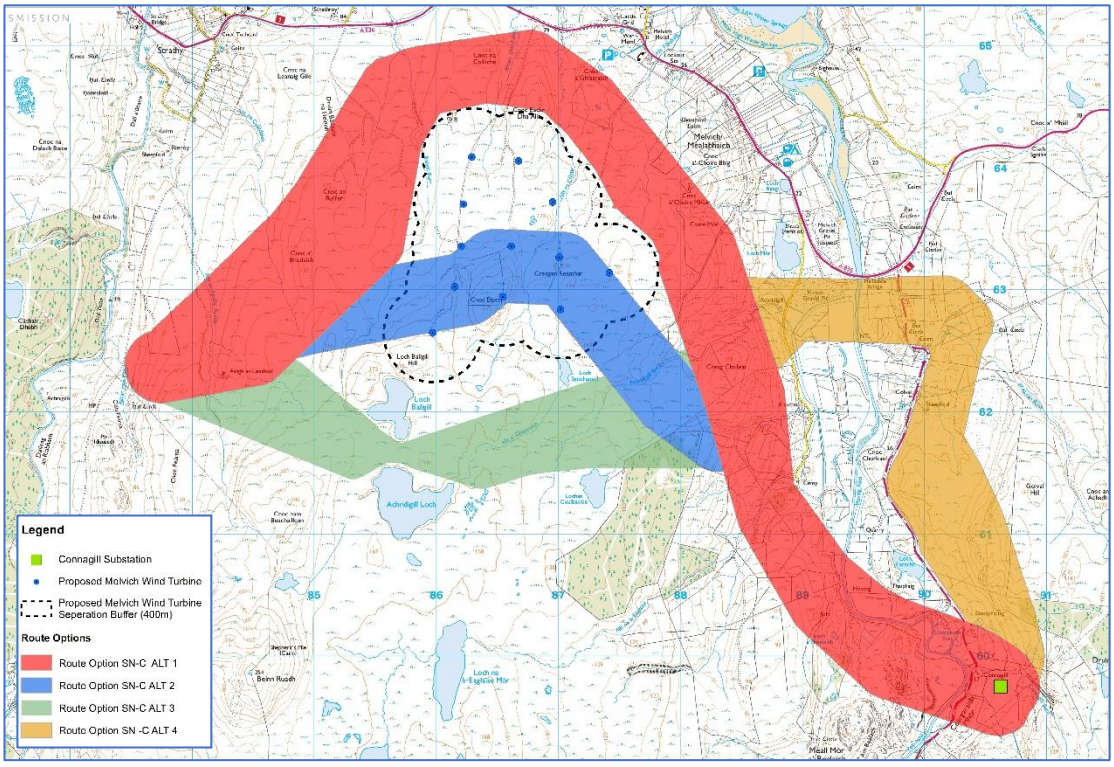
7.3.1 Whilst the Optimal Route presented in **Figure 4.1** is SSEN Transmission's preference, there has been a requirement to consider an alternative route and design solution due to the Optimal Route passing through the proposed Melvich wind farm. The minimum distance required between the proposed wind turbines and a 132 kV OHL could not be maintained along the Optimal Route and, therefore, should Melvich wind farm be granted planning consent, an alternative route or design solution would need to be considered.

7.3.2 To address this constraint, an optioneering exercise for an alternative connection route and design solution has been carried out and four potential alternative route options have been identified, as described below and illustrated on **Plate 7.2**:

- **Route Option SN-C ALT 1:** Route Option SN-C ALT 1 is approximately 11.5 km in length and would be OHL for the entire length. It is routed in a north-easterly direction from its starting point (where it would deviate from the optimal Strathy Wood to Connagill 132 kV OHL to the east of the Alltan nam Muc watercourse). From there it would pass along Cnoc a'Bhodaich and Cnoc an Ruffer, skirting the western extent of the proposed Melvich wind turbines and upon reaching the Scottish Water Distribution Service Reservoir, would travel in an easterly direction crossing the Alltan Domhaich watercourse and to the north of Cnoc Eadar Dha Allt. The route then travels in a south-easterly direction, between the eastern side of the Melvich wind turbines and the telecommunication mast at Cnoc a'Choire Mhor, continuing for approximately 3 km, passing between Lochanbackie woodland and the minor road leading to Kirkton cemetery. For the final stretch before reaching Connagill substation, the route crosses a meandering section of the Halladale River, and the A897 road. A short section of UGC would be required to enter into Connagill 275/132 kV substation and a CSE would be required to enable the transition from OHL to UGC.
- **Route Option SN-C ALT 2**: Route Option SN-C ALT 2 would largely follow the optimal Strathy Wood to Connagill 132 kV OHL, traversing directly through the proposed Melvich wind turbines using UGC for approximately 2 km. Once beyond the wind turbines, the UGC would rejoin either Route Option SN-C ALT 1 or 4, to complete the connection to Connagill substation as OHL. A short section of UGC would be required to enter into Connagill 275/132 kV substation. To enable transition from OHL to UGC, cable sealing end (CSE) compounds would be required at either end of the UGC section, along with the construction of permanent joint bays / link boxes at regular intervals along the UGC. Permanent access would be required to CSE compounds. If delivered in conjunction with Route Option SN-C ALT 1 this route option would be approximately 9 km in length.
- **Route Option SN-C ALT 3:** Route Option SN-C ALT 3 would be an OHL for its entire length. It is routed in a south-easterly direction from where it would deviate from the optimal Strathy Wood to Connagill 132 kV OHL, for approximately 2 km, routed to the south of the proposed Melvich wind turbines. From this point, the route would head in a slight north-easterly direction between Loch Sgiathanach and Coulbackie plantation, before joining Route Option SN-C ALT 1 or SN-C ALT 4, in proximity to Creag Chailein. A short section of UGC would be required to enter into Connagill 275/132 kV substation and a CSE would be required to enable the transition from OHL to UGC. If delivered in conjunction with Route Option SN-C ALT 1 the route option would be approximately 8.5 k m in length.
- **Route Option SN-C ALT 4:** Route Option SN-C ALT 4 would be an alternative connection into Connagill substation for Route Options SN-C 1, 2 or 3. It would be an OHL for its entire length and would extend for approximately 12 km (assuming it would be in combination with Route Option SN-C ALT 1). Between Coire Mor and Creag

Chailein and around the Achridigill Burn, the route would take an easterly direction, crossing the Halladale River and A897 to the south of the A836, in proximity to the Kirtkton Gravel Pit and Halladale Bridge. Once across the A897, the route would head in a southerly direction for approximately 3 km, alongside the A897 road, before crossing the Connagill Burn and approaching Connagill substation from the north.

Plate 7.2: Strathy South and Strathy Wood Grid Connection – Northern Section Alternative Route Options



7.4 Appraisal of Alternative Routes

Overview

7.4.1 An appraisal of the alternative Route Options has been undertaken, considering the environmental, technical and economic constraints of each route prior to arriving at an Optimal Alternative Route.

7.4.2 A summary of the appraisal is provided below, and **Appendix 2** contains a summary of the comparative RAG ratings for each alternative route option.

Environmental

7.4.3 Given that Route Option SN-C ALT 3 is directly within the Caithness and Sutherland Peatlands SPA, SAC and Ramsar site and the West Halladale SSSI, this option is least optimal given the potential to adversely affect these designations.

7.4.4 Of the remaining options, Route Option SN-C ALT 4 is routed through a denser area of archaeological assets and would be in closer proximity to the Halladale Bridge hut circles scheduled monument. It would encroach into the 100 m buffer of several properties within Strath Halladale and when in combination with Route Option SN-C ALT 1 for its initial part, would appear as a prominent feature in views from the north, and in views within the strath. As a result, Route Option SN-C ALT 4 is less optimal for the connection into Connagill 275/132 kV substation.

7.4.5 Route Option SN-C ALT 1 is the most northerly of the route options considered, and in closest proximity to the settlement between the A836 and the coast, potentially appearing more prominent in views from built and outdoor receptors, particularly users of the North Coast 500. It would also be seen as a prominent feature within the backdrop to the Farr Bay, Strathy and Portskerra SLA. Route Option SN-C ALT 1 would also be closest in proximity to listed buildings in Strathy and at Bighouse, and while the visual impact on the setting of these designated sites is considered to be low, given their protected status, the potential for negative impacts needs to be acknowledged. The visibility of an OHL breaking the skyline would likely occupy the same arc of horizon as Melvich wind turbines, which may contribute to a cumulative impact. However, Route Option SN-C ALT 1 would be completely outwith the Caithness and Sutherland Peatlands SPA, SAC and Ramsar site and the West Halladale SSSI and being the most northerly of all route options, offers more limited disturbance to qualifying bird species of the SPA given the increased distance from it.

7.4.6 Route Option SN-C ALT 2 proposes to use UGC for a 2 km section of this route, which offers opportunities for restoration of habitats along the UGC in the long term (notwithstanding habitat loss associated with link boxes and cable sealing end compounds that would be required for the UGC section). It should be noted that this route option does pass through a very short extent of the Caithness and Sutherland Peatlands SAC, SPA and Ramsar and West Halladale SSSI, which could be avoided at alignment stage. From a landscape and visual perspective, the OHL element of Route Option SN-C ALT 2 would appear slightly less prominent in views from Strathy and the western part of the A836 within the Corridor, however, the towers would appear prominent within Strath Halladale and at the strath crossing, as for all route options.

7.4.7 On balance, it is therefore considered that **Route Option SN-C ALT 2** is the optimal environmental option for the alternative route option, prior to joining with Route Option SN-C ALT 1 for the connection into Connagill 275/132 kV substation. However, if other factors preclude the use of this option, Route Option SN-C ALT 1 would be the next optimal option.

Engineering

7.4.8 Given the similarities between the route options, many of the engineering constraints are comparable. For the engineering topic areas of major crossings, road crossings, elevation,

pollution areas, contaminated land, proximity to wind farms, metallic pipes, and DNO crossings there is no preference between the route options.

7.4.9 Route option SN-C ALT 3 is considered the least optimal route from an engineering perspective given it would be routed through areas of deep peat resulting in construction challenges. Also, given it is located further south, and at a greater distance from existing roads and tracks compared to other route options, it would be less optimal for access considerations. Significant works would also be required to divert an OHL from Route Option SN-C ALT 3 to the indicative Strathy Switching station search area.

7.4.10 Route Option SN-C ALT-2 would require construction of a 275 kV double circuit cable sealing end (CSE) compound at each end of the UGC section. This would be very challenging from an operational and maintenance perspective given it is predominately within deep peat. The existence of peat would necessitate the utilisation of stabilised backfill along the entire UGC corridor, leading to a significant escalation in the overall capital cost. A permanent access track capable of bearing heavy long vehicle loads to the CSE compounds would need to be constructed. Furthermore, at the terminal end of Route Option SN-C ALT-2 (as would be the case for Route Option SN-C ALT 1 and SN-C ALT-3) there would likely require an UGC entry into Connagill 275/132 kV substation that would necessitate the construction of a third CSE compound. This would be further assessed at alignment stage. Considering the challenging terrain, requirement for several CSE compounds and the potential challenges associated with future access and maintenance within a third party wind farm boundary; this option is less optimal.

7.4.11 All route options cross, or are situated near to, watercourses and their associated flood risk areas, with all options crossing the Halladale River. However, Route Option SN-C 4 is the least optimal in relation to flood risk as in comparison to other route options it would have a greater length within a flood zone, where it deviates from Route Option SN-C ALT 1. This route option is also the longest connection length and would require a greater number of angle towers. Despite it being in close proximity to existing public roads and tracks, meaning existing access, although limited, would be available, it would be situated within 100 m of identified properties and dwellings within Strath Halladale; therefore being less optimal.

7.4.12 On balance, it is therefore considered that **Route Option SN-C ALT 1** is the optimal route on engineering grounds. Being closer to the existing public roads and tracks would require less additional infrastructure to enable access and while all options would pass through peat, Route Option SS-SN ALT 1 is anticipated to traverse a slightly shorter length of deeper peat, making an OHL less challenging to construct.

Cost

7.4.13 As Route Option SN-C ALT 4 is the longest alternative route option, it is considered to be least optimal from a cost perspective.

7.4.14 Despite Route Option SN-C ALT 1 being the second longest, it is considered to be of similar cost as Route Option SN-C ALT 2, given Route Option SN-C ALT 2 requires a 2 km UGC section at a significantly higher cost per km when compared to steel lattice towers. Furthermore, to facilitate the UGC section, at least two CSE compounds, with associated capital costs, are required.

7.4.15 Route Option SN-C ALT 3 is considered to be the optimal route option from a capital cost perspective as it is the shortest, most direct route without the requirement for an UGC section.

7.4.16 During the operational phase of the project, Route Options SN-C ALT 1, 3 and 4 all perform similarly from an inspection and maintenance cost perspective. The UGC section of Route Option SN-C ALT 2 poses increased challenges for inspection and maintenance. Should a fault on the UGC section occur, the localisation and repair are relatively much greater than an OHL and it could result in a significantly longer period of loss of supply resulting in operational constraints for generators connected to it.

7.5 Comparative Analysis Summary

7.5.1 **Table 7.1** displays the environmental, engineering and cost appraisal RAG ratings for the route options considered.

Table 7.1: Strathy South and Strathy Wood Grid Connection – Northern Section Alternative RAG Ratings

	Category	Sub-Topic	SN-C ALT 1 Rating	SN-C ALT 2 Rating	SN-C ALT 3 Rating	S SN-C ALT 4 Rating
Environmental	Natural Heritage	Designations				
		Protected Species				
		Habitats				
		Biodiversity				
		Ornithology				
		Geology, Hydrology and Hydrogeology				
	Cultural Heritage	Designations				
		Cultural Heritage Assets				
	People	Proximity to Dwellings				
	Landscape and Visual	Designations				
		Character				
		Visual				
	Land Use	Agriculture				
		Forestry				
		Recreation				

	Category	Sub-Topic	SN-C ALT 1 Rating	SN-C ALT 2 Rating	SN-C ALT 3 Rating	S SN-C ALT 4 Rating
	Planning	Policy				
		Proposals				
Engineering	Infrastructure Crossings	Major Crossings (132kV, 275kV, Rail, 200+m wide river, navigable canal, gas or hydro pipeline)				
		Road Crossings				
	Environmental Design	Elevation				
		Pollution Areas				
		Contaminated Land				
		Flooding				
		Route Length				
	Ground Conditions	Terrain				
		Peat				
	Construction / Maintenance	Access				
		Angle Towers				
	Proximity	Clearance Distance				
		Proximity to Windfarms				
		Communication Masts				
		Metallic pipes				
		Urban Environments				
Cost	Capital	Construction, Diversions, Public Road Improvements, Felling, Land Assembly and Consent Mitigations				
	Operational	Inspections and Maintenance				

7.6 Optimal Alternative Route

7.6.1 Taking the various constraints and route preferences into account, the optimal alternative route is considered to be **Route Option SN-C ALT 1**.

7.6.2 Route Option ALT SN-C ALT 4 has the longest connection length and would require a greater number of angle towers. This route option is also situated within 100 m of dwellings within Strath Halladale and routed through a denser area of archaeological assets and closer

proximity to the Halladale Bridge hut circles scheduled monument and is therefore less optimal from an engineering, environmental and cost perspective.

7.6.3 Although Route Option SN-C ALT 3 has the shorter overall length of the connection, and the requirement for fewer angle towers and additional infrastructure compared to other route options, from an environmental perspective it is the least optimal option. This is primarily due to Route Option SN-C ALT 3 falling directly within the Caithness and Sutherland SAC, SPA, Ramsar and underlying West Halladale SSSI, and the potential impact on the qualifying features of these sites. The topography along this route is much flatter, allowing deeper peats to form which provides more sensitive habitat and more challenging conditions for construction. Being the most southerly option, and further from the public roads, there is minimal to no existing access opportunities for much of the route, which would require the construction of additional infrastructure within the protected areas.

7.6.4 Route Option SN-C ALT 2 was considered the slightly more optimal environmental option, given it is the shortest in length and the proposed use of UGC for a section of this route offers opportunities for restoration of habitats along the UGC in the long terms (notwithstanding habitat loss associated with link boxes and CSE compounds that would be required at either end of the UGC section). The use of UGC may also appear slightly less prominent in views from the north, albeit this is not the most sensitive part of the landscape. However, there are a number of engineering challenges associated with Route Option SN-C ALT 2 which makes it less favourable, including the construction of an UGC through a landscape of deep peat, and the lack of existing access opportunities. There are also higher associated capital costs of constructing an UGC (with associated infrastructure), which are significantly higher compared to all other route options.

7.6.5 Overall, **Route Option SN-C ALT 1** is considered the Optimal Alternative Route. It is completely outwith the protected areas and being the most northerly of all route options, offers more limited disturbance to qualifying bird species of the SPA given the increased distance from it. While it does bring development in closer proximity to settlement in the north and west, a robust review at alignment stage will consider options to mitigate some of the key effects. It should be recognised that this alternative connection would only proceed should the proposed Melvich Wind Farm gain planning approval, in which case, this OHL would be seen in combination with much larger wind turbine infrastructure.

7.6.6 If Melvich wind farm does not gain consent and is not constructed, it is proposed that an OHL alignment would be brought forward as per the route previously identified as optimal in 2021 (see **Figure 4.1**). It is proposed, therefore, to progress both the Strathy South and Strathy Wood Grid Connections 'Northern Section' Optimal Route Option (**Figure 4.1**) and the Alternative Optimal Route Option (**Figure 4.3**) through the alignment selection stage, and it is anticipated that both options would be included in the Section 37 consent applications.

8 Armadale Grid Connection

8.1 Introduction

8.1.1 This section provides an overview of the route options selected for the 132 kV OHL connection between Armadale wind farm substation to a tee-in point on the Optimal Route of the Strathy North to Connagill 132 kV OHL (see Section 7). The tee-in point is still to be confirmed but would likely to be in the vicinity of the indicative Strathy Switching Station (see Section 9.2). This is followed by a summary of the potential environmental, technical and economic constraints identified for each route option.

8.1.2 As noted in **Table 3.2**, trident H-wood poles are the optimal technology option for this connection and the appraisal has assumed that OHL options will feature this technology.

8.2 Description of Routes

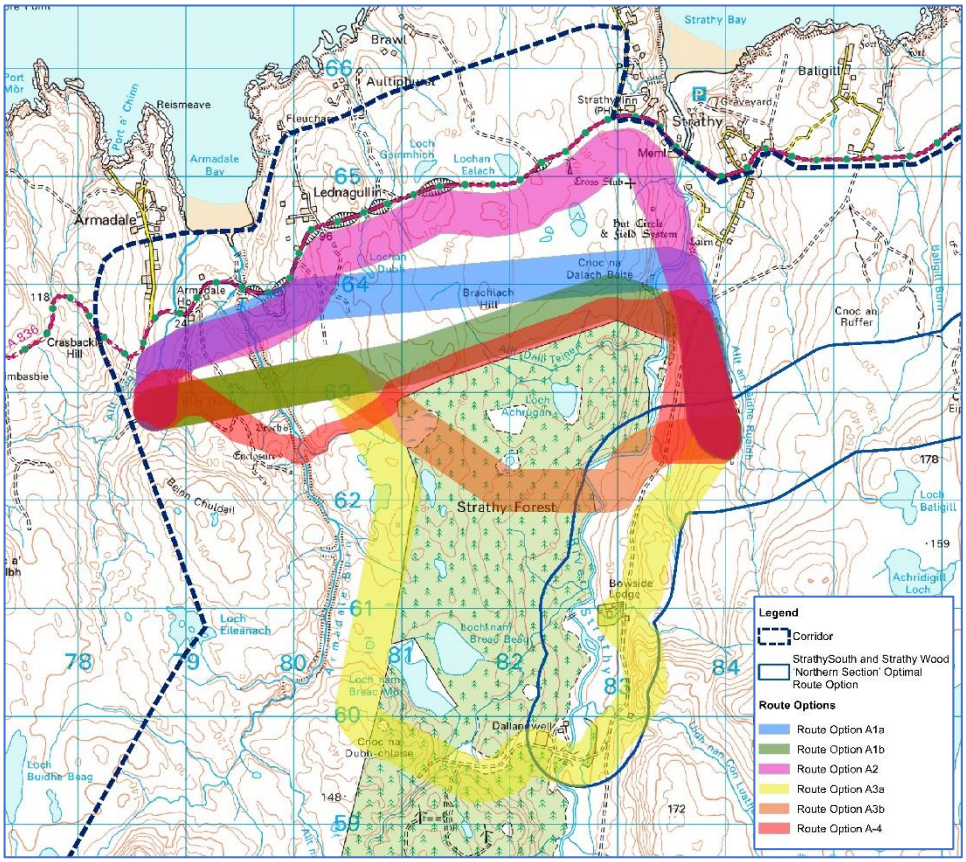
8.2.1 SSEN Transmission identified five route options based on initial desk-based review and previous knowledge of the site. A summary of the route options is outlined below and illustrated on **Plate 8.1** and **Figure 5.1**.

- **Route Option A-1a:** Upon leaving the Armadale wind farm on-site substation this route option travels in a north-easterly direction, to the south of the A836. After crossing the Armadale Burn, the route option would extend in a generally easterly direction, parting from the A836, crossing open moorland to the north of Strathy Forest. It then continues east, around Cnoc na Dalach Baite and crosses the River Strathy to the south of the Dail A'Bhaite hut circle, and the settlement of Strathy. The route would then run south between the River Strathy (to the west) and the Allt an Reidhe Ruaidh watercourse (to the east) in the vicinity of existing access tracks before tee-ing onto the Strathy North to Connagill 132 kV double circuit steel lattice OHL in the vicinity of the indicative switching station search area. The total length of this route option would be approximately 7.5 km.
- **Route Option A-1b:** Represents the most central and direct option being considered at approximately 6.7 km in length. Upon leaving the Armadale wind farm on-site substation this route option travels in an easterly direction for approximately 1 km before crossing the Armadale Burn and heading towards Strathy Forest, whereby it runs adjacent to the northern edge of the forest boundary for approximately 2.5 km. It would then cross the River Strathy before following the same route as Route Option A-1a to tee onto the Strathy North to Connagill 132 kV double circuit steel lattice OHL in the vicinity of the indicative switching station search area.
- **Route Option A-2:** This route would travel parallel to the A836 on its southern side for approximately 4 km. Upon reaching the River Strathy, the route would head south, following parallel on its eastern side before crossing the river to the south of the scattered settlement of Strathy. At this point it would follow the same route as Route

Option A-1a to tee onto the Strathy North to Connagill 132 kV double circuit steel lattice OHL. The total length of this route option would be approximately 8.8 km.

- **Route Option A-3a:** Represents the most southerly and longest option being considered at approximately 11.4 km. The route would travel east for approximately 1 km, crossing the Armadale Burn and heading towards the north-western corner of Strathy Forest. The route would then travel south along the western edge of Strathy Forest with the Armadale Burn on its west for approximately 4 km. The route would enter Strathy Forest at Cnoc na Dubh-Chlaise where it would turn east, and travel through the forest approaching the area surrounding Strathy North substation. The route would exit the forest by Dallangwell. After crossing the River Strathy, it would begin to travel north, in parallel to the built and proposed OHLs, teeing onto the Strathy North to Connagill 132 kV double circuit steel lattice OHL in the vicinity of the indicative switching station search area.
- **Route Option A-3b:** Represents an alternative, shorter branch of Route Option A-3a. This route would initially follow the same route as Option A-3a before entering Strathy Forest at its north-western corner. It would travel in a south-easterly direction for approximately 1 km, before turning to travel in an easterly direction exiting the forest and immediately crossing the River Strathy. The route would then travel in a north-easterly direction between the river and an access track before it would tee onto the Strathy North to Connagill 132 kV double circuit steel lattice OHL in the vicinity of the indicative switching station search area. Total length of the connection is 6.2 km.
- **Route Option A-4**: Route Option A-4 would travel in a generally eastern direction for approximately 5 km, passing to the north of Strathy Forest before turning south for approximately 1.5 km towards its termination point. Due to the various known constraints in the area, the route option width varies between 150 m and 450 m. Upon leaving the Armadale Wind Farm on-site substation this route option would travel in a southeasterly direction, to the south of the A836 for approximately 1.5 km. After crossing Armadale gorge and burn, the route option would turn to travel northeast and head towards Strathy Forest, whereby it would run adjacent to the northern edge of the forest boundary. Route Option A-4 would then cross the River Strathy and turn directly south to travel southwards with the River Strathy to its west and the Allt an Reidhe Ruaidh watercourse to its east and would encompass the existing access track to Strathy North Wind Farm. It would tee onto the Strathy North to Connagill 132 kV double circuit steel lattice OHL in the vicinity of the indicative switching station search area. Total length of connection is approximately 6.9 km.

Plate 8.1: Armadale Route Options



8.3 Appraisal of Routes

Overview

8.3.1 An appraisal of the Route Options has been undertaken, considering the environmental, technical and economic constraints of each prior to arriving at an Optimal Route. A summary of this appraisal is provided in this section of the report. Reference should also be made to **Figures 2.1 - 2.9** as well as **Appendix 3**, which contains a summary of the RAG ratings for each Route Option.

Environmental

8.3.2 From an environmental perspective, given that Route Option A-3a crosses approximately 5 km of the Caithness and Sutherland Peatlands SPA, SAC and Ramsar site, and Lochan Buidhe Mires SSSI, and would cross into some of the West Halladale SSSI, this option is least optimal.

8.3.3 Of the five remaining options (Route Options A-1a, A-1b, A-2, A-3b and A-4), all options would be required to cross the Armadale Gorge SSSI. Within the northern section of the Corridor, where the route options are proposed to cross the SSSI, only small fragments of the qualifying habitats of the SSSI are present and therefore there is potential to avoid damage

and loss of protected habitats by targeting the placement of poles, at alignment selection stage, in non-qualifying habitats.

8.3.4 Route Option A-2 is routed through a dense area of archaeological assets, several of which are classed as regional significance, and it would also encroach into a regional landscape designation. Although the surrounding area is influenced by existing electrical infrastructure, Route Option A-2 would bring development in closer proximity to the A836 and settlements along it, which could impact on the perceived openness of the landscape to the south and be visible from several built and outdoor receptors, particularly users of the NC500, thus making this route option more sensitive in terms of landscape character and visual amenity, compared to Route Options A-1a, A-1b,A-3b and A-4.

8.3.5 Route Option A-1a is slightly more sensitive to the effects on landscape character given that it is routed across moorland and an OHL in this area may affect the perceived openness of the landscape; despite existing electrical infrastructure being present that influences the current landscape. Whereas Route Option A-1b, A-3b and A-4 would keep development further from the A836 and the settlements along it, with views of Route Option A-1b and A-4 being backclothed by Strathy Forest.

8.3.6 While Route Option A-3b passes through a section of forestry, which reduces sensitivity on landscape character to a degree, it would involve felling a wayleave though a commercial conifer plantation in an area not currently disturbed by development and would require the need for compensatory planting. It may also interact with an area of ancient woodland. . It is therefore considered less favourable in environmental terms.

8.3.7 All options apart from Route Option A-4 cross to the north and within the key vista of the Armadale Gorge broch scheduled monument. The view northwards, up the gorge to the coast, has been identified as a key vista from this defensive site. An OHL would place a modern element in an otherwise relatively unaltered setting. Whereas Route Option A-4, although in closer proximity to the broch, approaches the broch from the west. This vista has not been identified as significant to the monument and is less likely to intervene in intervisibility between the monument and the contemporary settlement, it is therefore considered more optimal. However, it is acknowledged that Route Option A-4 would bring development in closer proximity to the designated areas to the south, albeit not directly within.

8.3.8 On balance, Route Option A-4 would set development back from the A836 and settlements to the north, with views being backclothed by the forestry beyond, and would avoid development being within the key vista of the Armadale Gorge broch scheduled monument; it is therefore considered the optimal route option from an environmental perspective.

Engineering

8.3.9 Given the similarities between the route options, many of the engineering constraints are comparable. For the engineering topic areas of ground conditions (terrain and peat),

elevation, contaminated land, metallic pipes, urban environments, there is no preference between the route options.

8.3.10 The below engineering topic areas relate to constraints where there are some differences between the route options. From an engineering perspective, variations in constraints relate primarily to major crossings, flooding, access, angle structures, proximity to dwellings, proximity to wind farms and communication masts.

8.3.11 From an engineering perspective, Route Options A-3a and A-3b are in proximity to the existing Strathy North trident-H wood pole 132 kV OHL for approximately 2 km and 1 km of their route lengths respectively. Route Option A-3a would potentially intersect the Optimal Route of the Strathy North to Connagill 132 kV double circuit steel lattice OHL. This may present construction and future maintenance challenges.

8.3.12 The average elevation across all routes is relatively similar and all cross gently undulating terrain. However, Route Options A-3a and A-3b would encounter a greater number of undulations compared to Route Options A-1a and A-2, thereby presenting greater challenges in terms of constructability.

8.3.13 Route Options A-1a, A-2 and A-3a cross a greater number of existing access tracks and therefore would require greater clearances to be achieved. However, these tracks are not heavily used and would provide the benefit of good access opportunities during construction.

8.3.14 Each of the routes are required to cross the River Strathy however, Route Option A-2 would follow the length of the river for the longest stretch and is therefore at a higher risk to flooding with constructability also likely to be challenging. Route Options A-1a, A-1b, A-3b and A-4 all cross perpendicular to the rivers meaning they are not subject to any significant flood risk. The crossing of the Armadale Gorge appears less challenging for Route Option A-4 in comparison to other options. In addition, Route Option A-2 follows in closer proximity to the A836 and the settlements alongside the road, thereby bringing development closer to a greater number of properties.

8.3.15 Route Option A-3a requires the greatest number of angle structures, followed by Route Option A-2 with all other options having a similar number. OHLs with a high number of angles supports tend to be more difficult to construct, due to the number of angle pull throughs, and often require more extensive access. As such, a route option with a large number of angle supports, such are Route Option A-3a is at a greater risk of being constrained.

8.3.16 From the comparison carried out certain aspects of each route option have some issues, however it is apparent that Route Option A-3a has several issues that make the route unfeasible mainly due to the undulating terrain and crossing the optimal route of the Strathy North to Connagill 132 kV double circuit steel lattice OHL. All other options appear to be technically feasible although Route Option A-3b could be challenging to navigate along the final section due to the terrain conditions. Route Option A-1a and A-2 appear to have similar number of constraints, however as Route Option A-2 is situated along the A836 and also

encroaches into the flooding zone of the River Strathy for a longer stretch, makes the route less favourable. Route Option A-4 appears to have the least number of constraints out of all the routes considered.

8.3.17 In conclusion, although certain aspects of each route option have engineering challenges, i.e.. relating to the proximity to residential properties and greater encroachment into flooding zones for Route Option A-2 and terrain challenges for Route Option A-3b, overall the optimal route is considered to be Route Option A-4.

Cost

8.3.18 From a cost perspective, Route Option A-1b is considered to be the optimal option as it is the shortest and most direct route and would not encroach into any areas of forestry negating the need for felling and compensatory planting costs.

8.3.19 Route Option A-4 is marginally longer than Route Option A-1b with similar constraints, as such it is considered to be the second preferred route option. Route Option A-1a shortly follows Route Option A-4 as the third preferred route option.

8.3.20 Route Option A-2 is the second longest route of all options and would require the most amount of existing distribution crossings, although would not encroach into any areas of forestry. Whereas Route Option A-3b, whilst being the shortest option, would require felling of an area of undisturbed conifer plantation and its associated compensatory planting requirements.

8.3.21 Route Option A-3a is the least optimal option from a cost standpoint as it is significantly longer than other options, it would result in greatest constructability costs, and would require felling of coniferous plantation and compensatory planting, albeit through an area that has already been extensively felled. Consequently, Route Option A-3a would require increased capital in comparison with other options.

8.4 Comparative Analysis Summary

8.4.1 **Table 8.1** displays the environmental, engineering and cost appraisal RAG ratings for the route options considered.

Table 8.1: Armadale Grid Connection – RAG Ratings

	Category	Sub-Topic	A-1a Rating	A-1b Rating	A-2 Rating	A-3a Rating	A-3b Rating	A-4 Rating
Environmental	Natural Heritage	Designations						
		Protected Species						
		Habitats						
		Ornithology						

		Geology, Hydrology and Hydrogeology						
	Cultural Heritage	Designations						
		Cultural Heritage Assets						
	People	Proximity to Dwellings						
	Landscape and Visual	Designations						
		Character						
		Visual						
	Land Use	Agriculture						
		Forestry						
		Recreation						
	Planning	Policy						
		Proposals						
Engineering	**Infrastructure Crossings**	Major Crossings (132kV, 275kV, Rail, 200+m wide river, navigable canal, gas or hydro pipeline)						
		Road Crossings						
	Environmental Design	Elevation						
		Contaminated Land						
		Flooding						
	Ground Conditions	Terrain						
		Peat						
	Construction / Maintenance	Access						
		Angle Structure						
	Proximity	Clearance Distance						
		Proximity to Windfarms						
		Communication Masts						
		Metallic pipes						
		Urban Environments						
Cost	**Capital**	Construction, Diversions, Public Road Improvements, Felling, Land Assembly and Consent Mitigations						

	Operational	Inspections and Maintenance						

8.5 Optimal Route

8.5.1 Taking the various constraints and route preferences into account, on balance it is considered unanimously from an environmental, engineering and cost preference, that **Route Option A-4** is the optimal option to be taken forward to alignment stage, as illustrated on **Figure 5.2.**

8.5.2 Upon connecting onto the proposed Strathy North to Connagill 132 kV steel lattice OHL, the connection would be completed to the transmission network at Connagill 275/132 kV substation.

9 Other Proposals in the Cluster

9.1 Melvich and Kirkton Wind Farm Connections

9.1.1 SSEN Transmission have agreed to provide two further grid connections in the area; one for the proposed Melvich wind farm, which consists of 12 turbines and a BESS (99.6 MW), and the other for the proposed Kirkton wind farm, which consists of 11 turbines and a BESS (72.8 MW). Both proposals are located approximately 1 km south-east and 2 km south of the settlement of Melvich, respectively.

9.1.2 It is anticipated that both Melvich and Kirkton would connect onto the existing and repurposed Strathy North 132 kV trident wood pole OHL for onward connection to Connagill 275 / 132 kV substation.

9.1.3 An optioneering exercise is underway to consider the optimal alignment for the short section of 132 kV wood pole OHL that would be required between each proposed wind farm substation and the existing Strathy North 132 kV trident wood pole OHL.

9.2 Strathy Switching Station

9.2.1 All wind farms associated with the Connagill Cluster Grid Connections require connection into the transmission network at Connagill 275/132 kV substation. This has resulted in the need for the construction of a new switching station which would collect all the power generated from the wind farms before onward transfer to Connagill 275/132 kV substation via the double circuit 132 kV OHL supported by steel lattice towers. Without a switching station, there would be multiple OHLs from each wind farm, all following a similar corridor, connecting into Connagill 275/132 kV substation, which could lead to both technical and environmental challenges. The operational impact of several tandem connections would also add constraint

onto the network, whereas a switching station would limit these impacts, allowing for a network that can be operated and managed efficiently.

9.2.2 SSEN Transmission is currently at early optioneering stage for the proposed Strathy Switching Station, but a technically preferred search area has been selected, as shown on **Figure 6**. This element of work will be consulted on separately in due course.

10 Summary and Next Steps

10.1.1 SSEN Transmission is required to construct new transmission infrastructure for five consented and/or proposed wind farms to the existing transmission network at Connagill 275/132 kV substation. The five connections under consideration are the consented Strathy South and Strathy Wood wind farms and the proposed Armadale, Melvich and Kirkton wind farms. Together the projects are known as the 'Connagill Cluster Grid Connections' and are recognised as National Development under National Planning Framework 4.

10.1.2 This Consultation Document sets out the proposed technology solutions to complete the connections, and provides environmental, technical and economic analysis of the potential route options, prior to arriving at an optimal solution.

10.1.3 SSEN Transmission has sought to identify a rationalised approach to complete the connection requirements. This approach, together with the analysis of the different options, has led to the following optimal solution across the connection projects:

- **Strathy Wood and Strathy South Grid Connection** ('Southern Section' between Strathy South substation and Strathy North substation): 132 kV underground cable and 132 kV double circuit steel structure OHL. The Optimal Route would be *Route Option SS-SN 2a or 2b.*
- **Strathy Wood and Strathy South Grid Connection** ('Northern Section' between Strathy North substation and Connagill 275/132 kV substation): 132 kV double circuit steel structure OHL. The structures would be capable of operating at 275 kV in the future, if required.
    - The Optimal Route (assuming Melvich wind farm does not gain consent and is not constructed) would be as per the 2014 section 37 consent for the Strathy South Grid Connection (which has now lapsed), which runs parallel to the existing Strathy North 132 kV wood pole OHL.
    - The Optimal Alternative Route (assuming Melvich wind farm does gain consent and is constructed) would be *Route Option SN-C ALT 1.*
- **Armadale Grid Connection**: 132 kV Trident 'H' Wood Pole OHL. The Optimal Route would be *Route Option A-4*.

- **Existing Strathy North Grid Connection**: The existing 132 kV Trident 'H' wood pole OHL would be removed between Strathy North substation to a point yet to be determined, but likely in proximity of Melvich substation. Strathy North would be moved over to the 132 kV double circuit steel structure OHL.
- **Melvich and Kirkton Grid Connections**: The existing Strathy North 132 kV Trident 'H' wood pole OHL between Melvich substation to Connagill 275/132 kV substation would be repurposed. A short section of 132 kV trident 'H' wood pole OHL would be required between each wind farm substation and the existing 132 kV Trident 'H' wood pole OHL.

10.1.4 The optimal routes across all projects are shown on **Figure 6.**

10.1.5 Comments are sought from stakeholders on the route options considered, and the optimal routes identified.

10.1.6 Consultation events will be held on **30 November 2023** at **Strathy Village Hall** and the responses received from this event, and those sought from statutory consultees and other key stakeholders, will inform further consideration of route options prior to identification of a proposed route to take forward to the next stage in the routeing process (alignment selection).

10.1.7 All comments on the route selection process are requested by 12 January 2024. Following consultation events and a review of consultation responses, a Report on Consultation will be produced which will document the consultations received, and the decisions made in light of these responses to inform the selection of a proposed route for each section of the cluster.

10.1.8 Following the identification and confirmation of a proposed route, further technical and environmental surveys will be undertaken to identify an optimal alignment for each connection, after which further consultation will be carried out.