



**SP ENERGY  
NETWORKS**

# **The Kendoon to Tongland 132kV Reinforcement Project**

**Underground cable study  
summary report**

**Appendix 3**

**July 2020**

## Appendix 3: Appraisal of Preferred Underground Cable Route vs Overhead Line Route

## Appendix 3

### The Kendoon to Tongland 132kV Reinforcement Project

#### Appraisal of Preferred Underground Cable Route vs Overhead Line Route

The appraisals set out in the tables below comprise:

- A desk based review of the environmental constraints associated with the preferred underground cable (UGC) route options for key sections of the KTR Project route as identified in the Stage 2 Report (Appendix 2) prepared by Cable Consulting International (CCI) Ltd, which was informed by an environmental review of a number of different options undertaken by LUC. The UGC will require additional 'reactive compensation' equipment to be installed at substations both within and outside the study area. The environmental implications of this are detailed in the appraisal tables below. In summary, if undergrounded, sections UGC 2 (Kendoon to Glenlee), UGC 4 (Bennan, Slogarie and Laurieston Forests) and UGC6 (Glenlee to Tongland) would all require the installation of reactive compensation equipment. The specification and location of the reactive compensation equipment required is set out in the appraisal below.
- A review of the equivalent section of overhead line route proposed as part of the KTR Project (the 'OHL Option'), informed by desk and field survey undertaken for the Environmental Impact Assessment (EIA) of the KTR Project where relevant. It should be noted that where an UGC doesn't directly correlate to a specific overhead line ("OHL" or overhead line are used interchangeably) connection in full, then the appraisal of the OHL only considers the environmental effects arising for the equivalent section of OHL between the two sealing end compound and terminal tower locations.
- An 'Environmental Summary' sets out the environmental preference based on a comparison of the potential environmental effects associated with the preferred underground cable route section against the relevant equivalent overhead line section of the KTR Project.
- A 'Technical Appraisal' setting out the main points of engineering difficulty as referred to within the CCI Optioneering Report (Appendix 1) and Technical Report (Appendix 2) and a technical appraisal of the relevant sections of overhead line section of the KTR Project.
- An 'Economic' summary of lifetime costs associated with the preferred cable option and proposed overhead line for each section.
- SPEN's overall conclusion on the type of connection is preferred for each section, whether overhead or underground. These conclusions have been made in consideration of SPEN's statutory and licence duties as the holder of a transmission licence (refer to section 2 of SPEN's Underground Cable Study Summary Report).

The appraisal is based on the OHL and cable routeing principles as set out in SPEN's published summary document outlining the approach taken to routeing transmission infrastructure (*Major Infrastructure Projects: Approach to Routeing and Environmental Impact Assessment*, SPEN 2015). This document is available at [www.spendgsr.co.uk](http://www.spendgsr.co.uk).

1. As set out within the SPEN *Approach to Routeing and Environmental Impact Assessment* document, there is very little established environmental guidance on the routeing of underground electricity transmission cables, therefore, for each connection the relative performance of the various options are appraised against regional and local level environmental criteria presented below.
2. Where an environmental factor was not located within the study area, or did not influence the appraisal, it is not included within the relevant appraisal tables below. In addition to the environmental criteria, the length of the UGC/OHL section is also considered in the appraisals below. The main environmental appraisal criteria is presented in the following table.

#### Appraisal Criteria

Criterion	Sub-criteria	Objectives
<b>Biodiversity and Geological Conservation</b>	Special Protection Areas Special Areas of Conservation* Sites of Special Scientific Interest SNH Priority Peatland Habitats (Classes 1, 2 and 3)	To seek to avoid/reduce, as far as practical, effects on designated sites of ecological or geological conservation importance.  To seek to avoid/reduce, as far as practical, effects on ornithological species of high conservation value.  To seek to avoid/reduce loss of peatlands in accordance with Scottish Planning Policy (SPP).
<b>Landscape and Visual Amenity</b>	National Scenic Areas* Regional Scenic Areas Landscape Character Visual amenity from residential properties (Residential Visual Amenity) Tourism and Recreation (e.g. Sustrans routes, Core Paths, long distance trails, tourist attractions and recreational areas such as golf courses)	To seek to avoid/reduce, as far as practical, effects on designated landscapes.  To contribute to the understanding of likely landscape and visual sensitivities within different areas for routeing the UGC.  To seek to avoid/reduce, as far as practicable, potential effects on views from residential receptors.  To seek to avoid/reduce, as far as practicable, potential effects on formal/informal recreational areas and tourism features.
<b>Cultural Heritage</b>	Scheduled Monuments Listed Buildings Category A, B and C Inventory Gardens and Designed Landscapes* Conservation Areas Archaeologically Sensitive Areas Non-Inventory Gardens and Designed Landscapes	To seek to avoid/reduce, as far as practical, direct effects on designated features of cultural heritage interest.
<b>Forestry and Woodland</b>	Forestry (commercial), Ancient and Semi Natural Woodland and Native Woodland	To seek to avoid/reduce, as far as practical, effects of forestry, particularly areas of ancient woodland and native woodland, and on future forestry operations.
<b>Flood Risk</b>	Flood zones and waterbodies	To cross flood zones at their narrowest point to minimise locating UGC within flood zones.

\* The extent and geographical location of these features or designations are such that they have not informed the identification or appraisal of route options.

3. The appraisal has been undertaken against a future baseline scenario, whereby the decommissioning and removal of the existing N and R routes has been completed. In other words a 'blank sheet' approach has been adopted where the presence of existing 132kV overhead transmission lines is not considered. Further assumptions made as part of the appraisal have been included in the appraisal tables where applicable. A preference for either the UGC or OHL for each section has been identified within the appraisal tables. The preference has been informed by the environmental criteria considered as well as cost and SPEN's statutory and licence duties<sup>1</sup>. The preference for each section has also been considered against the overall KTR Project routeing objective.

<sup>1</sup> SPEN, the trading name for Scottish Power Energy Network Holdings Limited which owns and operates the electricity transmission and distribution networks in central and southern Scotland through its wholly-owned subsidiaries SP Transmission plc (SPT) and SP Distribution plc (SPD). SP Transmission plc is the holder of a transmission licence. The references within this EIA Report to SPEN in the context of statutory and licence duties should be read as applying to SP Transmission plc

**Table 1: UGC and OHL Comparison - Polquhanity to Kendoon**

Criterion	Sub-Criteria	UGC1B	OHL Option
Section Description	N/A	CCI Cable Route with OHL into Kendoon substation. No reactive compensation equipment required.	Polquhanity to Kendoon OHL Option
KTR Tower Numbers	N/A	N230 – PK10 (OHL from Tower PK10 to PK37)	N230 – PK37
Approximate Length of Route (km)	N/A	2.93 km (UGC = 2.40km and OHL = 0.53km) <sup>2</sup>	2.99 km
Landscape and Visual Amenity	<b>Regional Scenic Areas (RSA)</b>	The UGC will be located wholly within the Galloway Hills RSA. Beyond localised landscape and visual effects arising during construction, significant long-term effects associated with the sealing end compounds at Polquhanity and Kendoon will arise during operation, however these will not compromise the integrity of the locally designated landscape as a whole or undermine the rationale for its designation.	The OHL will be wholly located within the Galloway Hills RSA. Localised significant landscape and visual effects are anticipated to arise during construction and operation of the OHL to a similar extent to that of the existing N Route, whilst the OHL will appear in some views towards the core area of the RSA in views from the Glenkens Valley. However, it is not considered that these effects will compromise the integrity of the locally designated RSA as a whole or undermine the rationale for its designation.
	<b>Landscape Character / Landscape Features</b>	The UGC follows the road carriageway of the A713 between Polquhanity and Dundee, deviating from the A713 to the west, crossing the Polmaddy Burn adjacent to Polmaddy Bridge via HDD, before crossing into enclosed pasture/grazing within the Upper Dale (165) LCT west of the A713. Key characteristics of the LCT will be unlikely to be adversely affected.  Creation of the sealing end compound and overhead line connection into Kendoon from west of the A713 will result in localised significant effects on the LCT.  Permanent loss of landscape features is unlikely, however temporary disturbance and reinstatement to stone dykes is likely to be required.  Significant effects on the Upper Dale LCT will not occur during operation following restoration of any construction related disturbance which arises.	The OHL is located solely within the Upper Dale (165) LCT (Medium capacity) <sup>3</sup> . The OHL follows a broadly parallel alignment approximately 300m to the west of the existing 132kV OHL (N Route).  In its northern extent, the OHL will pass through simple landcover of rough pasture farmland before entering the coniferous forestry of the Galloway Forest Park near Gordon's Knowe to avoid residential properties to the south, and generally following the grain of the landscape until south of Dundee where the OHL will deviate eastwards to cross the Water of Dundee/Water of Ken to access Kendoon substation.  Significant effects on the Upper Dale LCT will occur, extending to a localised area similar to that of the existing N Route.
	<b>Visual Amenity / Tourism and Recreation</b> (e.g. Sustrans routes, Core Paths, long distance trails, tourist attractions and recreational areas such as golf courses)	The UGC follows the Galloway Tourist Route/A713 and will cross the Bardenoch Trail head (Core Path) to the west of Dundee and the Dundee Hill Trail head (Core Path) to the north at the point at which they meet the A713/The Galloway Tourist Route.  The route will pass close to the licensed caravan/campsite adjacent to the property of Hawkrigg.  Beyond short-term effects on visual amenity arising during construction, long-term visual effects on views and visual amenity of recreational and tourist receptors using these routes will not occur.	The OHL will cross the Bardenoch Trail (Core Path) to the west of Dundee, and whilst the OHL is located within the eastern periphery of the Galloway Forest Park it does not intersect with the FCS Promoted trails at Polmaddy. The OHL will be partly visible from the Galloway Tourist Route which follows the A713, however the OHL will generally be located further from the road than the alignment of the existing R Route until it will cross the road south of Dundee.  The route will pass close to the licensed caravan/ campsite adjacent to the property of Hawkrigg, however the OHL will be located beyond the alignment of the existing R Route to the west.  Significant localised visual effects are anticipated to occur, however these will largely be within the extents of the effects arising in relation to the existing OHL (N Route) between Polquhanity and Kendoon.
	<b>Residential Visual Amenity</b>	No effects on residential visual amenity will occur following completion of construction and restoration works associated with the UGC between Polquhanity and the terminal tower near Dundee.  The introduction of the sealing end compound, terminal tower and overhead line connection into Kendoon substation is likely to result in significant visual effects from residential properties at the southern extent of Dundee and properties at Kendoon.	A dispersed pattern of scattered farmsteads and properties exists between Polquhanity and Dundee, generally located along the A713, with various viewing orientations and outlooks informed by local topography and vegetation. The OHL runs broadly parallel to the alignment of the existing 132kV OHL (N Route), passing through existing coniferous woodland west of these residential properties. The felling of this intervening woodland to create the OHL wayleave and removal of associated areas of forestry at risk of potential wind throw will afford views of the proposed OHL from residential

<sup>2</sup> Option UGC1B incorporates a short section of OHL. However, references to the UGC are to the overall cable route with OHL unless the context indicates otherwise.<sup>3</sup> Judgements in relation to landscape capacity derived from Appendix 3 in The Kendoon to Tongland Reinforcement Project: Routeing and Consultation Document was published in October 2016

Criterion	Sub-Criteria	UGC1B	OHL Option
			<p>properties albeit at a greater distance than those of the existing N Route. These views will remain until the areas of forestry lost due to windthrow are restocked (in line with the exercise of powers in the Forestry and Land Management (Scotland) Act 2018 and associated regulations) which will enclose and screen views of the proposed towers and OHL.</p> <p>South of the access road to Polmaddy the OHL will pass west of the community of Dundee, deviating from the alignment of N Route which follows the A713 and appears in the principal views of residential properties to the west and east of the road (and will be removed following construction of the proposed OHL).</p> <p>On crossing the Water of Ken, the OHL will follow the alignment of the existing 132kV OHL, passing slightly further north-west and avoiding the residential property of Stonebyres and its curtilage.</p> <p>The introduction of the overhead line connection into Kendoon substation is likely to result in significant visual effects from residential properties at the southern extent of Dundee and properties at Kendoon.</p>
<b>Cultural Heritage</b>	<b>Scheduled Monuments<sup>4</sup></b>	<p>There is one Scheduled Monument, Dundee Castle (SM2476) approximately 250m east of the UGC. The principal views from Dundee Castle are to the west.</p> <p>However, it is not anticipated that the Scheduled Monument will be affected during or post-construction.</p>	<p>There are two Scheduled Monuments, Dundee Castle (SM2476) and Polmaddy medieval and post-medieval settlement (SM5391) within 2km. The principal views from Dundee Castle are to the west. Polmaddy settlement is a promoted heritage site and has been raised as a sensitive asset by D&amp;G Council in relation to the potential effect on its setting. Polmaddy settlement is located on a south-facing slope surrounded by large swathes of commercial forestry.</p> <p>Intervening topography and commercial forestry would mostly screen views to the proposals and the setting of the settlement is unlikely to be adversely affected.</p>
	<b>Listed Buildings Category A, B and C</b>	<p>There are seven Listed Buildings located within 2km, comprising: three Category B Listed Buildings and four Category C Listed Buildings. No adverse effects are anticipated as a result of either the UGC or OHL on the setting of Listed Buildings.</p>	
	<b>Archaeologically Sensitive Areas (ASA)</b>	<p>Two ASAs lie within 2km of the UGC and OHL, Polharrow Burn ASA and Bardennoch – Garryhom ASA. Polharrow Burn ASA has been raised as a sensitive asset by D&amp;G Council in relation to the potential effect on its setting. It is considered that the setting of the ASAs would not be adversely affected by either the UGC or OHL proposals.</p>	
<b>Forestry and Woodland</b>	<p><b>Ancient Woodland (AWI)</b> <b>Native Woodland (NWSS)</b> <b>Forestry (NFI)</b></p>	<p>The UGC avoids forestry for much of its length by running alongside the existing A713 carriageway. However, the OHL section of this connection also will pass through an area of NWSS adjacent to Kendoon substation.</p>	<p>Felling would be required, including areas of AWI and NWSS in the vicinity of Kendoon substation. Substantial felling would be required where the OHL will pass through coniferous forestry at the eastern periphery of the Galloway Forest Park in the vicinity at Polmaddy, although these areas do not include NWSS and AWI.</p> <p>An additional area of woodland felling is required east of the OHL wayleave south of Polquhanity identified as being at risk of wind throw. Areas of forestry lost due to windthrow will be restocked in line with the exercise of powers in the Forestry and Land Management (Scotland) Act 2018 and associated regulations.</p>
<b>Flood Risk</b>	<b>Flood Zones and Waterbodies</b>	<p>1B crosses two areas within the 1/200yr and 1/1000yr flood risk zones; one area adjacent to Dundee where the route diverts from the A713 into the adjacent fields for the HDD crossing of the river, and one to the west of Kendoon where the Water of Deugh meets the Water of Ken.</p>	<p>The OHL will cross two areas within the 1/200yr flood risk zone (one to the west of Polmaddy, close to Polmaddy Ford and one to the south-west of Kendoon, which is where the Water of Deugh meets the Water of Ken). These flood risk zones cannot be avoided during routeing; however they can be spanned by the OHL.</p>

<sup>4</sup> It should be noted that the appraisal criteria for the underground cable differed from that used for the overhead line as for the cable only Scheduled Monuments within 250m were identified as there will be limited effect on setting as the result of a buried cable, with direct effects being the key potential issue of concern. In the case of the overhead line, a 2km buffer was used.

Criterion	Sub-Criteria	UGC1B	OHL Option
		<p>The route crosses a number of watercourses. Whilst most of these already crossed by the A713, it is recommended that the route in the vicinity of Kendoon is reviewed to rationalise this and minimise the number of crossings if possible. As this section is where the OHL section of this route is located there may be the option to span flood zones.</p>	
<p><b>Environmental Summary</b></p>	<p>There is not a substantial difference in the length of the UGC and OHL.</p> <p>The UGC would result in significant localised landscape effects on the Upper Dale (165) LCT as a result of the introduction of the sealing end compound and terminal tower to facilitate the transition between OHL and UGC. Significant visual effects would arise in relation to the introduction of the terminal tower in the vicinity of Dundough and the A713. However, the OHL would have a greater impact on landscape character and visual amenity as a whole with significant effects on the Upper Dale LCT, extending to a localised area similar to that of the existing N Route, while the introduction of the OHL into Kendoon substation is likely to result in significant visual effects from residential properties at the southern extent of Dundough and properties at Kendoon.</p> <p>Both the UGC and OHL cross Core Paths and recreational routes. For the OHL there is the potential to span Core Paths and recreational routes at these locations, however significant visual effects for users of these Core Paths will occur for short sections in close proximity to the OHL.</p> <p>Both the UGC and OHL cross two areas within the 1/200yr and 1/1000 yr flood risk zones. However, the OHL can span these areas if required.</p> <p>Substantially less forestry felling would be required for the UGC as it parallels the existing A713 carriageway for much of its length.</p> <p><b>On balance, the environmental preference between Polquhanity and Kendoon is the UGC option. As well as reducing effects on landscape and visual receptors and residential amenity, the UGC would have a lesser impact on surrounding cultural heritage features, including the setting of nearby Scheduled Monuments. However, very localised significant landscape and visual effects will arise from the introduction of a sealing end compound and terminal tower to facilitate the transition between OHL and UGC if the UGC option is taken forward. Substantially less felling would be required for the UGC than the OHL.</b></p>		
<p><b>Technical Appraisal</b></p>	<p>In order to provide the same capability as the OHL system, that is a summer rating of 1830Amps and a winter rating of 2110Amps for each 132kV circuit, each UGC circuit will need to consist of two cables per phase and in a three-phase system this means 6 cables in total for each circuit. Therefore, to establish the same required capacity as the OHL system a total of 12 power cables are needed.</p> <p>The UGC1 cable route starts at the cable sealing end compound at Tower N230 in Polquhanity, heads southeast across arable/pastoral land before following the A713 south, through Polmaddy and Dundough. Once south of Dundough:</p> <ul style="list-style-type: none"> <li>• One circuit (6 cables) would leave the A713 and head southwest to a cable sealing end compound at Tower PK10 where the remainder of the circuit into Kendoon substation would be completed using OHL from PK10.</li> <li>• The second circuit (also 6 cables) would continue southward on the A713 to join with the northern end of the cable circuit from Glenlee substation (installed under UGC2 to tower sealing end compound PK33 near Glenlee).</li> </ul> <p>A ducted cable installation within pastoral land (0.83km) and within the A713 carriageway (1.57km) would be required. The pastoral land may contain peat which may affect cable conductor sizes. The installation of cables in carriageway and verge would require temporary lane closures and traffic management; both carriageways would be required to carry cables. Where cables are off-road then haul/access roads would be required. Engineering difficulties which would require the crossing of windfarm cables at Polquhanity and a burn crossing at Polmaddy where use of the existing road bridge may not be practicable. The presence of rock beneath a thin soil covering with slow installation progress at increased cost is a risk. Extension of the existing cable termination compound would be required at Polquhanity together with the construction of a new cable termination compound at PK10 tower position.</p> <p>A cable system also has different characteristics from an OHL system and long cable routes tend to increase system voltage especially when the network is lightly loaded. High system voltage has an impact on system security and quality of supplies and potentially could damage equipment. SPEN has a license obligation to maintain system voltage within defined limits and often with long cable routes additional equipment is required (normally termed as reactive compensation) to maintain system voltage within the standard limits. However, for this option studies have shown this is not required.</p>		

Criterion	Sub-Criteria	UGC1B	OHL Option
<b>Economic Appraisal</b>		Underground cabling double circuit, two cable per phase, route length of 2.40km (including 0.53km of OHL) gives an estimated total installed costs of £17.65 M with a per kilometre cost of £7.35 M/km.	A new L7c double circuit tower line, two wires per phase, route length of 2.9km gives an estimated total installed cost of £4.55 M with a per kilometre cost of £1.52 M/km.
<b>Conclusions</b>		<p>The appraisal found that the overall environmental benefits that would be experienced from a predominantly underground cable solution, in comparison with an overhead line, would be a reduction on effects on landscape and visual receptors, residential amenity, cultural heritage features and forest and woodland resource. However, very localised significant landscape and visual effects will arise from the introduction of a sealing end compound and terminal tower to facilitate the transition between OHL and UGC.</p> <p>The appraisal also found that installation of UGC 1 would be technically feasible although specific difficulties would be encountered in relation to the complexities of undertaking a continuous cable excavation through areas of peat and shallow bedrock, traffic management and lane closures on the A713 and crossing of existing underground services.</p> <p>The economic appraisal outlined above shows that an underground cable in this section would be 3.88 times greater than the proposed overhead line route with a projected cable cost being £17.65M and overhead line cost of £4.55M. This represents an overall projected difference in cost of <b>£13.1M</b>.</p> <p><b>In consideration of the above, SPEN's preference is to progress with an overhead line option between Polquhanity and Kendoon. It is acknowledged by SPEN that the underground option is technically feasible and, on balance, environmentally preferable. Nevertheless, UGC1B does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.</b></p> <p><b>Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project<sup>5</sup> which is:</b></p> <p><i><b>"To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it."</b></i></p> <p><b>SPEN believe that proceeding with an overhead line solution for the Polquhanity to Kendoon section is a conclusion which remains consistent with the overall KTR Project routeing objective.</b></p>	

<sup>5</sup> Refer to SPEN's Routeing and Consultation documents at [www.spendgsr.co.uk](http://www.spendgsr.co.uk)

**Table 2: UGC and OHL Comparison – Kendoon to Glenlee**

Criterion	Sub-Criteria	UGC2B	OHL Option
<b>Section Description</b>	N/A	CCI Cable Route with OHL into Kendoon and Glenlee substation.  Reactive compensation equipment would be required at Glenlee substation. This would be located directly adjacent to the proposed extension to Glenlee substation to the south-west.  The compound would be 17m x 13m and would require 40m of 3.5m wide Type 1 access road.	Kendoon to Glenlee OHL Option
<b>KTR Tower Numbers</b>	N/A	PK10 – PK33 (OHL from PK33 to Glenlee substation)	Kendoon substation to Glenlee substation
<b>Approximate Length of Route (km)</b>	N/A	8.33 km (UGC = 7.20km and OHL = 1.13km) <sup>6</sup>	7.92 km
<b>Landscape and Visual Amenity</b>	<b>Regional Scenic Areas (RSA)</b>	The UGC will be located wholly within the Galloway Hills RSA. Beyond localised landscape and visual effects arising during construction, significant long-term effects associated with the sealing end compounds at Kendoon and Glenlee will arise during operation, however these will not compromise the integrity of the locally designated landscape as a whole or undermine the rationale for its designation.  The proposed location of the reactive compensation compound is also within the Galloway Hills RSA.	The OHL will be wholly located within the Galloway Hills RSA. Localised significant landscape and visual effects are anticipated to arise during construction and operation of the OHL to a similar extent to that of the existing R Route, whilst the OHL will appear in some views towards the core area of the RSA in views from the Glenkens Valley. However, it is not considered that these effects will compromise the integrity of the locally designated RSA as a whole or undermine the rationale for its designation.
	<b>Landscape Character / Landscape Features</b>	The UGC Follows the road carriageway of the A713 and A762 between Kendoon and Glenlee substation, within the Upper Dale LCT. Key characteristics of the LCT are unlikely to be adversely affected.  Permanent loss of landscape features is unlikely, however temporary disturbance and reinstatement of stone dykes and woodland may occur where the cable route will pass through areas of enclosed pasture/grazing between the sealing end compound and the A713 near Dundelugh, and between the A762 and the sealing end compound near Waterside.  Significant effects on the Upper Dale LCT will not occur during operation following restoration of any construction related disturbance which arises.  The reactive compensation compound would extend the footprint of proposed Glenlee substation extension into enclosed farmland and would not result in any loss of landscape features.	The OHL is located within the Upper Dale (Valley) LCT (Medium capacity) following a broadly parallel alignment to the existing 132kV OHL (R Route) on the western side of the Glenkens Valley, approximately 220m to the west at its most distant point. The presence of the existing OHL has altered the character of this side of the valley, which locally increases the capacity of the landscape to accommodate OHL development.  The existing 132kV OHL is evident from across the Glenkens Valley, however the steel tower OHL follows the grain of the landscape, avoiding the higher ground on the western side of the valley, generally appearing backclothed against the landform beyond. The scale of the Galloway hills diminishes both the scale and perceptibility of the existing OHL. The OHL broadly follows the alignment of the existing OHL, contouring across the mid-slopes of the valley avoiding residential properties and potential skylining, whilst utilising opportunities for backclothing wherever possible.  Significant effects on the Upper Dale LCT will occur, extending to a localised area similar to that of the existing R Route.
	<b>Visual Amenity / Tourism and Recreation</b>  (e.g. Sustrans routes, Core Paths, long distance trails, tourist attractions and recreational areas such as golf courses)	The UGC follows the Galloway Tourist Route/A713 for much of its length. The route will cross the Southern Upland Way to the north-west of St John's Town of Dalry and then the Glenlee Core Path where it will cross the Coom Burn to the north of Glenlee substation.  Beyond short-term effects on visual amenity arising during construction, long-term visual effects on views and visual amenity of recreational and tourist receptors using these routes will not occur.	The OHL broadly follows the route of the Galloway Tourist Route/A713, following a parallel alignment to the existing OHL located to the west of the A713. Key views from the tourist route across the Glenkens Valley to the east and long distant views towards the Cairnmore of Carsphairn to the north-east will be unaffected. The OHL will cross the route of the Southern Upland Way (SUW) long distance footpath (and Core Path) west of Earlstoun hydro power station. Effects will be experienced in the context of other infrastructure associated with the power station, and in close proximity of the alignment of the existing 132kV OHL (to be removed). The OHL also will cross the Glenlee Core Path which follows Coom Burn; however, views of the OHL will be in the context of the Glenlee substation and hydro power station.

<sup>6</sup> Option UGC2B incorporates a short section of OHL. However, references to the UGC are to the overall cable route with OHL unless the context indicates otherwise.



Criterion	Sub-Criteria	UGC2B	OHL Option
			Significant localised visual effects are anticipated to occur, however these will largely be within the extents of the effects arising in relation to the existing OHL (R Route) between Kendoon and Glenlee.
	Residential Visual Amenity	<p>No effects on residential visual amenity will occur following completion of construction and restoration works associated with the cable route between the terminal tower sealing end compound near Dundough and terminal tower and sealing end compound near Waterside.</p> <p>The introduction of the sealing end compound, terminal tower and overhead line connection into Kendoon substation will result in significant visual effects from residential properties at the southern extent of Dundough and properties at Kendoon.</p> <p>The introduction of the sealing end compound terminal tower and overhead line connection into Glenlee substation is unlikely to result in significant visual effects from residential properties due to distance and intervening woodland and vegetation.</p> <p>The reactive compensation compound will be largely imperceptible from nearby residential properties and landscape mitigation proposals are proposed for Glenlee substation.</p>	<p>A dispersed pattern of scattered farmsteads and properties is located along the corridor of the A713 on the west side of the valley, with properties generally orientated to afford views east across the Glenkens Valley. Across the Water of Ken from Kendoon substation, the OHL will pass close to the property of Stonebyres, but without passing directly over the residential property or its curtilage.</p> <p>Once west of the Water of Ken, the OHL follows the alignment of the existing OHL (R Route) and will pass within 150m of the residential properties of Stroangassel Farm and Carsfad Cottage, with a minor deviation near Polharrow Bridge to locate the OHL further west of the residential property of Inverharrow.</p> <p>More distant views of the OHL will be possible across the Glenkens Valley from the settlement of St John's Town of Dalry, however visibility of the OHL will be in a similar context to that of the existing 132kV OHL (to be removed), i.e. largely backclothed against the landform beyond.</p> <p>Significant localised visual effects on views from residential properties are anticipated to occur, however these will largely be within the extents of the effects arising in relation to the existing OHL (R Route) between Kendoon and Glenlee, and limited to properties in close proximity to the existing R Route and Kendoon Substation, at Dundough and Kendoon.</p>
Cultural Heritage	Scheduled Monuments <sup>7</sup>	N/A	<p>Four Scheduled Monuments lie within 2km of the OHL; Dundough Castle (SM2476), Polmaddy medieval and post medieval settlement (SM5391), Dalry Mote (SM1117) and Earlstoun Castle, which is also a Category A Listed Building. Dalry Mote is also a promoted heritage site. Earlstoun Castle, Polmaddy settlement and Dalry Motte have all been raised as sensitive assets by D&amp;G Council. The OHL would be seen in views across the Water of Ken from Dalry Mote, although following the existing OHL route (to be removed).</p> <p>The proposals will not result in significant adverse effects on the setting of the monuments.</p>
	Listed Buildings Category A, B and C	<p>There are 34 Listed Buildings within 2km of the UGC, including a number of Category B listed buildings directly adjacent to the route in the area around Allangibbon, Glenlee S/S and Polharrow Bridge, which itself is Category B listed. There are also a number of Category C Listed Buildings adjacent to the A713.</p> <p>Following the optioneering process detailed in the CCI Optioneering Assessment (Cable Study ER1003 Rev C), the diversion of the route on to Polharrow burn crossing was identified as the preference over continuing along the A713. The options in this location are to use the old road bridge as a cable bridge, with the cables installed on the old bridge within surface mounted troughs. Alternatively, a self-supporting cable bridge or cable bridge mounted to the side of the current carriageway bridge could be considered.</p> <p>Should 2B be taken forward, further advice will be required from an archaeologist as Listed Building consent may be required depending on the extent of the works.</p>	<p>There are 27 Listed Buildings within 2km of the OHL, including: one Category A Listed Building; 20 Category B Listed Buildings; and six Category C Listed Buildings. These include Category A Listed Earlstoun Castle which has been raised as a sensitive asset by HES in relation to the potential effect on its setting.</p> <p>No adverse effects are anticipated as a result of the OHL on the setting of Listed Buildings.</p>

<sup>7</sup> It should be noted that the appraisal criteria for the underground cable differed from that used for the overhead line as for the cable only Scheduled Monuments within 250m were identified as there will be limited effect on setting as the result of a buried cable, with direct effects being the key potential issue of concern. In the case of the overhead line, a 2km buffer was used.

Criterion	Sub-Criteria	UGC2B	OHL Option
		Glenlee Power Station and Bridge Category B Listed Buildings are located approximately 100m north of the proposed location of the reactive compensation compound at Glenlee substation.	
	<b>Archaeologically Sensitive Areas (ASA)</b>	The UGC will pass immediately to the east of Polharrow Burn ASA and will not directly or indirectly affect it.	The OHL will cross the eastern edge of Polharrow Burn ASA following the route of the existing 132kV OHL (to be removed). Polharrow Burn has been raised as a sensitive asset by D&G Council in relation to the potential effect on its setting.  The OHL will cross a not particularly sensitive part of the ASA and the route alignment will not have a significant adverse effect on the ASA.
	<b>Garden and Designed Landscapes and Non-Inventory Designated Landscapes</b>	There are six NIDLS within 2km of the UGC, including Knocknalling (within 100m), Glenlee Park, Earlstoun Castle, Garroch, and Hannaston.  The UGC would not result in any effects on these assets.	The OHL partly overlaps the eastern edge of Knocknalling NIDL, following the route of the existing 132kV OHL (to be removed). The NIDL has been raised as a sensitive asset by D&G Council in relation to the potential effect on its setting. It is considered that the OHL would not adversely affect the setting of the NIDL.  In addition, there are four other NIDLS within 2km of the route option, of which three; Earlstoun Castle, Garroch and Glenlee Park have been raised as sensitive assets by D&G Council in relation to the potential effect on their settings. It is considered that the OHL would not adversely affect the setting of these NIDLS.
<b>Forestry and Woodland</b>	<b>Ancient Woodland (AWI)</b> <b>Native Woodland (NWSS)</b> <b>Forestry (NFI)</b>	The UGC avoids forestry for much of its length by running alongside the existing A713 and A762 carriageway  The proposed location of the reactive compensation compound is not located in forestry or woodland.	There are areas of NWSS scattered across the OHL route which will require felling. The OHL section of this connection to the north will pass through an area of NWSS adjacent to Kendoon substation. Whilst the OHL section to the south will pass through two separate areas of NWSS to the north of Glenlee substation. In particular areas of NWSS at Hag Wood and areas of both NWSS and AWI at Knocknalling.  An additional area of woodland felling is required either side of the OHL wayleave at Hag Wood identified as being at risk of wind throw. Areas of forestry lost due to windthrow will be restocked in line with the exercise of powers in the Forestry and Land Management (Scotland) Act 2018 and associated regulations.
<b>Flood Risk</b>	<b>Flood Zones and Waterbodies</b>	The UGC will cross four areas within the 1/200yr and 1/1000yr flood risk zone: one area to the south of Kendoon substation, one to the north of Polharrow Bridge, one south of Earlstoun Loch in the carriageway of the A762, and one to the north of Glenlee in the vicinity of Coom Burn.  The route will cross a number of watercourses. Whilst most of these already crossed by the A713 and A762 and would be difficult to avoid without considerable revisions.  The reactive compensation compound is proposed in an area which is within the 1/200yr flood risk zone.	The OHL will cross three areas within the 1/200yr and 1/1000 flood risk zone (one to the southwest of Kendoon, where the Water of Deugh meets the Water of Ken, one to the south of Carsfad Loch, which is a section of the Water of Ken and one to the immediate north-east of Glenlee, where Garroch Burn meets Coom Burn). These flood risk zones cannot be avoided during routeing. The Water of Ken to the south of Carsfad Loch (approximate width 310m at its narrowest point), and the area where Garroch Burn meets Coom Burn, to the immediate northeast of Glenlee (approximate width 305m at its narrowest point) are both in excess of the average span length.
<b>Environmental Summary</b>	<p>The UGC will be longer than the OHL as it follows the route of the existing Galloway Tourist Route/A713 for the majority of its length.</p> <p>The UGC would result in significant localised effects on the Upper Dale (165) LCT resulting from the introduction of the sealing end compound and terminal tower to facilitate the transition between OHL and UGC. No significant visual effects in relation to the UGC are anticipated. The OHL would have a greater impact on landscape character and visual amenity as a whole with significant effects on the Upper Dale LCT, extending to a localised area similar to that of the existing R Route, while significant visual effects will occur, including localised visual effects on views from residential properties. However, these will largely be within the extents of the effects arising in relation to the existing OHL (R Route) between Kendoon and Glenlee and would be limited to properties in close proximity to the existing R Route and Kendoon Substation at Dundeuigh and Kendoon.</p> <p>Both the UGC and OHL will cross tourist and recreational routes, including the Southern Upland Way. Careful consideration will be required to minimise disruption during cable construction, such as the use of Horizontal Directional Drilling (HDD) techniques. For the OHL there is the potential to span Core Paths and recreational routes at these locations.</p> <p>The UGC is unlikely to have any effects on surrounding cultural heritage features. The OHL will cross the eastern edge of Polharrow Burn ASA and overlaps the eastern edge of Knocknalling NIDL; however no significant adverse effects are considered likely.</p>		

Criterion	Sub-Criteria	UGC2B	OHL Option
	<p>The UGC requires less felling than the OHL as it parallels the existing A713 and A762 carriageway for much of its length.</p> <p>The UGC will cross more flood risk zones than the OHL, however most of these already crossed by the A713 and A762.</p> <p><b>Overall the environmental preference between Kendoon and Glenlee is the UGC option. As well as reducing effects on landscape and visual receptors, and residential amenity, the UGC would have a lesser impact on surrounding cultural heritage features, including the setting of surrounding Scheduled Monuments, NIDL and ASA, albeit that there may be effects on Polharrow Bridge from the UGC option. However, very localised significant landscape and visual effects will arise from the introduction of a sealing end compound and terminal tower to facilitate the transition between OHL and UGC. Less felling would be required for the UGC than the OHL.</b></p>		
<b>Technical Appraisal</b>	<p>In order to provide the same capability as the OHL system, that is a summer rating of 1830Amps and a winter rating of 2110Amps for each 132kV circuit, each UGC circuit will need to consist of two cables per phase and in a three-phase system this means 6 cables in total for each circuit. Hence to establish the same required capacity as the OHL system a total of 12 cables are needed.</p> <p>From the northern end, UGC2 cable route consist of two circuits (6 cables per circuit):</p> <ul style="list-style-type: none"> <li>• Kendoon Substation to Glenlee Substation (via new cable compounds located at PK10 and PK33) and,</li> <li>• Polquhanity (cable compound at N230) to Glenlee Substation (via new cable compounds located at tower PK33).</li> </ul> <p>The Kendoon Substation to Glenlee Substation circuit starts at the cable sealing end compound at Tower PK10, adjacent to Kendoon substation, heads southeast across arable/pastoral land before following the A713 south, past Carsfad Loch and Earlstoun Loch. South of Earlstoun Loch the cable route continues down the A762, passing Earlstoun power station before leaving the carriageway south of Craigubble wood and heading southwest across arable/pastoral land and terminating in a proposed cable sealing end compound at Tower PK33.</p> <p>UGC2 section also includes the southern end of the Polquhanity to Glenlee circuit where the route continues south (from UGC1 without leaving the road and entering the cable sealing end compound at PK10) along the A713 until it parallels the Kendoon to Glenlee circuit in the A713 carriageway and continues along the same route to PK33.</p> <p>A ducted cable installation within pastoral land (0.90 km) and within the A713/A762 carriageway (6.30 km) would be required. The pastoral land may contain peat which may affect cable conductor sizes. The installation of cables in carriageway and verge would require temporary lane closures and traffic management; both carriageways would be required to carry cables. Where cables are off-road then haul/access roads would be required. Engineering difficulties include three water crossings at Polharrow Burn, Earlstoun Dam and Earlstoun power station. If an engineering solution is not found / acceptable for these crossings a substantial portion of the cable route as envisaged may not be feasible. The cable installation would cross 1 in 200-year risk flood zones some seasonal working may be necessary in such areas. There is a risk that the presence of rock beneath a thin soil covering slowing installation progress will increase costs. The cables would terminate into a cable termination (cable sealing end) compound located at PK33.</p> <p>A cable system also has different characteristics from an OHL system and long cable routes tend to increase system voltage especially when the network is lightly loaded. High system voltage has an impact on system security and quality of supplies and potentially could damage equipment. SPEN has a license obligation to maintain system voltage within defined limits and often with long cable routes additional equipment is required (normally termed as reactive compensation) to maintain system voltage within the standard limits. In this option reactive compensation will be required at Glenlee substation. The substation will need to be extended further to accommodate the additional equipment.</p>	<p>The proposed overhead line will consist of 7.92km of new L7c towers carrying two 132kV circuits, a circuit on each side of the tower. A circuit consists of three phases with each phase strung with two conductors. Hence in total the tower will carry six conductor on each side (total of 12 wires) and an earth wire between tower peaks strung with twin phase conductors (12 wires) and an equivalent optical phase ground wire (OPGW) earth conductor between tower peaks. The route will consist of 24 towers with an average span length between towers of 312m with the average tower height of 32 meters.</p> <p>This solution will provide a rating of pre-Fault Continuous - Summer: 350MVA / Spring/Autumn: 385MVA / Winter: 405MVA &amp; OHL Ratings Post-Fault Continuous - Summer: 420MVA / Spring/Autumn: 460MVA / Winter: 480MVA</p> <p>This solution will provide a summer rating of 1830Amps and a winter rating of 2120Amps for each circuit. This is based on twin UPAS conductors (2x300mm<sup>2</sup>) per phase operating at 75°C.</p> <p>The existing towers at PK10 and PK33 between Kendoon &amp; Glenlee will be the start and end-point for this new section.</p> <p>The proposed overhead line route traverses mainly through the forest estate. The line crosses over various forestry roads/ track, roads, rivers and distribution overhead lines. During the wiring works conductors required to over-sail obstacles would require specific mitigation such as temporary lane closures, traffic management &amp; potential distribution outages (further detail on the technical factors surrounding the OHL can be found in chapter 5 of the EIA report further detail on this can be found in chapter 5 of the EIA report).</p>	
<b>Economic Appraisal</b>	Underground cabling double circuit, two cable per phase, route length of 7.20km gives and estimated total installed costs of £47.72 M with a per kilometre cost of £6.62 M/km.		A new L7c double circuit tower line, two wires per phase, route length of 7.92km gives an estimated total installed cost of £9.53 M with a per kilometre cost of £1.20 M/km.
<b>Conclusions</b>	<p>The appraisal found that the overall environmental benefits that would be experienced from an underground cable, in comparison with an overhead line, would be a reduction on effects on landscape and visual receptors, residential amenity and cultural heritage features. However, very localised significant landscape and visual effects will arise from the introduction of a sealing end compound and terminal tower to facilitate the transition between OHL and UGC.</p> <p>The appraisal also found that UGC 2B would be technically feasible although specific difficulties might be encountered in relation to water crossings. Traffic management and lane closures on the A713 and A762 would also be required.</p> <p>The economic appraisal outlined above shows that the cost of an underground cable in this section would be 5.01 times greater than the proposed overhead line route with a projected cable cost being £47.72M and overhead line cost of £9.53M. This represents an overall projected difference in cost of <b>£38.19M</b>.</p>		

Criterion	Sub-Criteria	UGC2B	OHL Option
			<p>In consideration of the above, SPEN's preference, is to progress with an overhead line option between Kendoon and Glenlee. It is acknowledged by SPEN that the underground option is technically feasible and, on balance, environmentally preferable.</p> <p>Nevertheless, UGC2B does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.</p> <p>Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project<sup>8</sup> which is:</p> <p><i>"To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it."</i></p> <p>SPEN believe that proceeding with an overhead line solution for the Glenlee to Kendoon section is a conclusion which remains consistent with the overall KTR routeing objective.</p>

<sup>8</sup> Refer to SPEN's Routeing and Consultation documents at [www.spendgsr.co.uk](http://www.spendgsr.co.uk)

**Table 3: UGC and OHL Comparison – Queen’s Way Crossing**

Criterion	Sub-Criteria	UGC3A	OHL Option
Section Description	N/A	CCI Cable Route	Queen’s Way Crossing OHL Option
KTR Tower Numbers	N/A	GT08 – GT21	GT08 – GT21
Approximate Length of Route (km)	N/A	4.33 km	3.72 km
Landscape and Visual Amenity	<b>Regional Scenic Areas (RSA)</b>	The UGC will be located wholly within the Galloway Hills RSA. Beyond localised landscape and visual effects arising during construction, significant long-term effects associated with the sealing end compounds located north and south of the Queen’s Way Crossing/A712 are likely to arise during operation, however these will not compromise the integrity of the locally designated landscape as a whole or undermine the rationale for its designation.	The OHL will be wholly located within the Galloway Hills RSA. Localised significant landscape and visual effects are anticipated to arise during construction and operation of the OHL. Whilst the OHL will appear in some views towards the core area of the Galloway Hills in views from east of the Glenkens Valley, it is not considered that these effects will compromise the integrity of the locally designated RSA as a whole or undermine the rationale for its designation.
	<b>Landscape Character / Landscape Features</b>	<p>The UGC will pass through the Foothills with Forest (176) and Rugged Uplands with Forest (181) LCTs. Key characteristics of these large scale LCTs are unlikely to be adversely affected.</p> <p>Permanent loss of landscape features is unlikely; however temporary disturbance and reinstatement of stone dykes and woodland may occur where the cable route will pass through enclosed pasture/grazing north of the Queen’s Way/A712.</p> <p>The cable corridor will pass through existing enclosed pasture/grazing, east of Peal Hill, and commercial forestry south of the A712 creating a permanent and perceptible linear feature within this area of the Galloway Forest Park.</p> <p>Very localised significant effects on the Foothills with Forest LCT and Rugged Uplands with Forest LCT will occur during operation, from the construction and introduction of sealing end compounds and terminal towers. No significant effects related to the UGC corridor will persist through the operational phase following restoration of any construction related disturbance which arises.</p>	<p>The OHL will pass through the Rugged Granite Uplands with Forest (181) LCT (Medium capacity) and Foothills with Forest (176) LCT (Higher capacity).</p> <p>The OHL follows higher ground to the west of the Glenkens Valley, utilising routeing opportunities within the shallow valley west of Shiel Hill and Fintloch Hill to minimise skylining of the OHL in views from the east. The presence of local topography to the east of the route, and coniferous woodland along a large proportion of the OHL will minimise the visibility of the OHL as it continues southwards, before crossing the A712/Queens Way.</p> <p>The OHL will pass through simple landcover of enclosed pasture and rough grazing before entering extensive coniferous woodland south of the A712. The extensive coniferous woodland offers opportunities for screening and backclothing the OHL, whilst avoiding the higher ground of Peal Hill and Cairn Edward Hill.</p> <p>Very localised significant effects on the Foothills with Forest LCT and Rugged Uplands with Forest LCT will occur, extending to a localised area. The LCTs as a whole will not be significant effected by the introduction of the OHL.</p>
	<b>Visual Amenity / Tourism and Recreation</b>  (e.g. Sustrans routes, Core Paths, long distance trails, tourist attractions and recreational areas such as golf courses)	<p>The northern sealing end compound and terminal tower will be located adjacent to the New Galloway West Core Path (516).</p> <p>The UGC will cross the Robert the Bruce Trail and a section of the Galloway Kite Trail (between New Galloway and Clatteringshaws Loch) which corresponds to the Queen’s Way / the A712 between New Galloway and Newton Stewart, crossing the road perpendicular to the north of Peal Hill. South of the Queen’s Way the route will pass through the Galloway Forest Park.</p> <p>At its southern extent it will cross, and subsequently runs broadly parallel to, a section of the Raiders road to Kenmuir Link Core Path (142), where views of the southern sealing end compound and terminal tower will result in significant effects.</p> <p>As well as short-term effects on visual amenity arising during construction, long-term significant visual effects on views and visual amenity experienced by recreational receptors are also likely as a result of the introduction of the sealing end compounds and terminal towers and felling of a permanent wayleave adjacent to the Raiders Road Kenmuir Link Core Path to the south of Peal Hill.</p>	<p>Distant views of the OHL will be perceptible from elevated sections of the Southern Upland Way as it crosses higher ground on the eastern and western side of the Glenkens Valley, however, the OHL would be seen at a distance of c.4km and in the context of the existing BG Route between Glenlee and Newton Stewart, and infrastructure of the Glenlee hydro power station.</p> <p>Outward views of the OHL are limited from the Galloway Tourist Route (A713) on the east side of the Glenkens Valley due to intervening landform and the presence of coniferous woodland west of the A762. Sections of the Galloway Kite Trail within the Glenkens Valley (following the A713) will experience distant and partially screened views of this section of the OHL.</p> <p>The OHL route will run parallel with the New Galloway West (516) Core Path to the north of the Queen’s Way, from where significant visual effects will be experienced by recreational users of this short walking route.</p> <p>The route will cross the Robert the Bruce Trail and a section of the Galloway Kite Trail (between New Galloway and Clatteringshaws Loch) which follow the A712 between New Galloway and Newton Stewart, to the north of Peal Hill. At its southern extent the OHL section then will pass into dense coniferous woodland before crossing perpendicular to the Raiders road to Kenmuir Link Core Path (142).</p>

Criterion	Sub-Criteria	UGC3A	OHL Option
			Significant visual effects are anticipated for recreational users of the New Galloway West and Raiders Road Kenmuir Link Core Paths, while there will only be intervening glimpses of the OHL from Robert the Bruce Trail and a section of the Galloway Kite Trail which follow the A712/Queen's Way when travelling east and west along a short section of the A712 with minimal opportunity for extended sequential views.
	Residential Visual Amenity	Effects on residential visual amenity predicted in relation to the northern sealing end compound and terminal tower located north-west of the residential property of Airie (views possible from access track and curtilage); however significant effects are considered unlikely to occur.	<p>To the north the OHL will pass close to a small number of scattered properties and farmsteads on the west side of the Glenkens Valley, including Airie Cottage, however the principal views of these properties are generally east, south-eastwards towards the valley or are contained by woodland screening.</p> <p>South of the A712 the OHL will pass through generally uninhabited coniferous woodland, however, the OHL will pass to the east of the property of Darsalloch, north-west of Peal Hill, but will avoid the principal north, north-east facing views from the property.</p> <p>More distant views of the OHL from properties within the settlement of New Galloway are unlikely to occur due to the presence of intervening landform and woodland where the route will pass west of Peal Hill.</p> <p>Significant localised visual effects on views are not anticipated to occur from the property of Darsalloch. Following establishment of existing intervening woodland to the east of the property (south of Knocknairling Burn) and the replanting of areas identified for windthrow felling south-east of the property residual visual effects on views from this property will further reduce.</p>
<b>Cultural Heritage</b>	<b>Listed Buildings Category A, B and C</b>	Within 2km of the UGC there are 23 Listed Buildings centred on the town of New Galloway: 11 Category B Listed Buildings; and 12 Category C Listed Buildings. No adverse effects are anticipated on the setting of Listed Buildings.	
	<b>Conservation Areas</b>	One Conservation Area, New Galloway, lies within 2km of both the UGC and OHL. Neither the UGC nor OHL would not result in any adverse effects on this asset.	
	<b>Garden and Designed Landscapes and Non-Inventory Designated Landscapes</b>	Within 2km of both the UGC and OHL there are two NIDLs: Glenlee Park and Kenmure Castle. Both of these NIDLs have been raised as sensitive assets by the D&G Council in relation to the potential effect on their settings. It is considered that the setting of the NIDLs would not be adversely affected by the proposals.	
<b>Forestry and Woodland</b>	<b>Ancient Woodland (AWI)</b> <b>Native Woodland (NWSS)</b> <b>Forestry (NFI)</b>	The most southern section of the UGC route runs through areas of both NFI and NWSS on the eastern flanks of the Peal Hill. To the north of Peal Hill the route utilises a natural wayleave to avoid two areas of AWI to the east and west. The most southerly extent of 3A is located in existing forestry access tracks, thereby avoiding the need for additional felling in this location.	<p>Significant felling would be required for this section of the OHL in particular to the south of the Queen's Way, including areas of NWSS and AWI located on the northern flanks of Peal Hill. With regards to Peal Hill woodland affected by this route option; the AWI area on the north of the hill is conifer woodland.</p> <p>An additional area of woodland felling is required either side of the OHL wayleave on the north-western flanks of Peal Hill identified as being at risk of wind throw. Areas of forestry lost due to windthrow will be restocked in line with the exercise of powers in the Forestry and Land Management (Scotland) Act 2018 and associated regulations.</p>
<b>Flood Risk</b>	<b>Flood Zones and Waterbodies</b>	The UGC will cross the Knocknairling Burn which is within the 1/200yr and 1/1000yr flood risk zones to the north of Peal Hill (Knocknairling Burn).	<p>The OHL will cross the Knocknairling Burn which is within the 1/200yr and 1/1000yr flood risk zone to the north of Peal Hill (Knocknairling Burn).</p> <p>This flood risk zone cannot be avoided during routeing, however it can be easily spanned as it is less than the average OHL span length of 250m.</p>
<b>Environmental Summary</b>	<p>The UGC will be approximately 0.61 km longer than the OHL.</p> <p>The UGC would likely have very localised significant effects on the LCT as a result of the need for a sealing end compound and terminal tower to facilitate the transition between OHL and UGC. Although no significant effects related to the UGC corridor will persist through the operational phase, where the UGC passes through commercial forestry south of the A712 this will result in a permanent and</p>		

Criterion	Sub-Criteria	UGC3A	OHL Option
	<p>perceptible linear feature within this area of the Galloway Forest Park. The OHL will also likely result in localised significant effects on the LCT, however, the LCTs as a whole will not be significantly effected by the introduction of the OHL.</p> <p>The UGC would likely have long-term significant visual effects on views and visual amenity experienced by recreational receptors as a result of the introduction of the sealing end compounds and terminal towers and felling of a permanent wayleave adjacent to the Raiders Road Kenmuir Link Core Path to the south of Peal Hill. In relation to the OHL, significant visual effects are also anticipated for recreational users of the Raiders Road Kenmuir Link Core Path as well as the New Galloway West. Following mitigation, no significant effects are anticipated in relation to the visual amenity of residential receptors for either the OHL or UGC.</p> <p>Both the UGC and OHL will cross tourist and recreational routes which correspond to the Queen's Way. For the OHL there is the potential to span Core Paths and recreational routes at these locations.</p> <p>Neither the UGC nor OHL are considered likely to have any significant effects on cultural heritage features.</p> <p>Both the UGC and OH would require felling on the eastern and western slopes of Peal Hill respectively. Comparatively however, the UGC will affect less forestry and will avoid areas of AWI through utilising existing wayleaves and forest breaks.</p> <p>Both the UGC and OHL cross one small area within the 1/200yr and 1/1000yr flood risk zones (Knocknairling Burn).</p> <p><b>On balance, the environmental preference for the crossing of the Queen's Way is the UGC option. As well as somewhat reducing effects on landscape and visual receptors and residential amenity, the UGC would have a lesser impact on forestry. However, long-term significant visual effects on views and visual amenity will still be experienced by recreational receptors, while substantial felling adjacent to the Raiders road to Kenmuir Link Core Path will also be required.</b></p>		
<p>Technical Appraisal</p>	<p>In order to provide the same capability as the OHL system, that is a summer rating of 735Amps and a winter rating of 865Amps for each 132kV circuit, each UGC circuit will need to consist of a single cables per phase and in a three-phase system this means 3 cables in total for each circuit. Hence to establish the same required capacity as the OHL system a total of 6 cables are needed.</p> <p>The UGC3 cable route starts at tower GT08 and heads southeast, down Achie Hill to the Queen's Way crossing, avoiding areas containing peat habitats and outcropping rock. The approximate Queen's Way crossing location was selected as a position with minimal surface elevational change across the proposed HDD position for the Queen's Way crossing. The cable route would continue south around the east side of Peal Hill, following existing forest tracks where possible, before turning to the southwest and terminating at GT21.</p> <p>A ducted cable installation of 2.16km in pastoral land and 2.17km in forestry would be required. The forestry and pastoral land may contain peat which may affect cable conductor sizes. Areas of steep incline would require cable anchoring systems to avoid unwanted cable movement in service. The installation of cables in forest tracks and verge would require temporary track closures and traffic management. Where cables are off-road and/or existing tracks may not be used then haul/access roads would be required. Working in the forestry areas with limited widths, transverse slopes, rock outcrops and peat will present practical engineering difficulties. The crossing under the A712 is also of significant length and may be an engineering challenge depending on subsoil conditions. The cable installation would cross a 1 in 200 year flood zone in the vicinity of the A712 and Knocknairling Burn; some seasonal working may be necessary. Haul road access from the A712 to the southern section of the route including a haul road crossing of Knocknairling burn would be required. Forestry clearance would be required to permit the cable working swathe in some areas. All cable system earthing equipment and fibre pits would need to be mechanically protected in forestry (e.g. by use of substantial bollards). Where soft ground exists cables and joints would need to be mechanically protected from wheel penetration of forestry machinery. The presence of rock beneath a thin soil covering leading to slow installation progress, at increased cost, would be a construction risk. Cables would terminate onto cable sealing end platforms mounted on suitable OHL tower designs located at GT08 and GT21.</p> <p>A cable system also has different characteristics from an OHL system and long cable routes tend to increase system voltage especially when the network is lightly loaded. High system voltage has an impact on system security and quality of supplies and potentially could damage equipment. SPEN has a license obligation to maintain system voltage within defined limits and often with long cable routes additional equipment is required (normally termed as reactive compensation) to maintain system voltage within the standard limits. However, for this option studies have shown this is not required.</p>		<p>The proposed overhead line will consist of 3.72km of new L4 towers carrying two 132kV circuits, a circuit on each side of the tower. A circuit consists of three phases with each phase strung with a single conductor. Hence in total the tower will carry three conductor on each side (total of 6 wires) and an earth wire between tower peaks. The route will consist of 14 towers with an average span length between towers of 280m with the average tower height being 30 meters.</p> <p>This solution will provide a summer rating of 735Amps and a winter rating of 865Amps for each circuit. This is based on a single SYCAMORE conductor (1x250mm<sup>2</sup>) per phase operating at 65°C.</p> <p>This section will run from tower GT08 &amp; GT21 at the Queensway crossing</p> <p>The proposed overhead line route traverses mainly through the forest estate. The line crosses over various forestry roads/ track, roads, rivers and distribution overhead lines. During the wiring works conductors required to over-sail obstacles would require specific mitigation such as temporary lane closures, traffic management &amp; potential distribution outages (further detail on the technical factors surrounding the OHL can be found in chapter 5 of the EIA report).</p>
<p>Economic Appraisal</p>	<p>Underground cabling double circuit, one cable per phase, route length of 4.33km gives and estimated total installed costs of £15.22 M with a per kilometre cost of £3.52 M/km.</p>		<p>A new L4 double circuit tower line, single wires per phase, route length of 3.72km gives an estimated total installed cost of £4.49 M with a per kilometre cost of £1.21 M/km.</p>

Criterion	Sub-Criteria	UGC3A	OHL Option
Conclusions		<p>The appraisal found that the overall environmental benefits that would be experienced from an underground cable, in comparison with an overhead line, would be a reduction on effects on landscape and visual receptors and forestry. However, long-term significant visual effects on views and visual amenity will still be experienced by recreational receptors, while substantial felling adjacent to the Raiders road to Kenmuir Link Core Path will also be required.</p> <p>The appraisal also found that the UGC 3 would be technically feasible although specific difficulties might be encountered in relation to water crossings, topography and areas of peat and shallow bedrock. Traffic management and lane closures on the A712 would also be required.</p> <p>The economic appraisal outlined above shows that the costs of an underground cable in this section would be 3.38 times greater than the proposed overhead line route with a projected cable cost being £15.22M and overhead line cost of £4.49M. This represents an overall projected difference in cost of <b>£10.72M</b>.</p> <p><b>In consideration of the above, SPEN's preference, by virtue of the economic impact, is to progress with an overhead line option across the Queen's Way Crossing. It is acknowledged by SPEN that the underground option is technically feasible and, on balance, environmentally preferable. Nevertheless, UGC3A does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.</b></p> <p><b>Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project<sup>9</sup> which is:</b></p> <p><i><b>"To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it."</b></i></p> <p><b>SPEN believe that proceeding with an overhead line solution across the Queen's Way is a conclusion which remains consistent with the overall KTR routeing objective.</b></p>	

<sup>9</sup> Refer to SPEN's Routeing and Consultation documents at [www.spendgsr.co.uk](http://www.spendgsr.co.uk)



**Table 4: UGC and OHL Comparison – Bennan, Slogarie and Laurieston Forests**

Criterion	Sub-Criteria	UGC4C	OHL Option
<b>Section Description</b>	N/A	<p>CCI Cable Route</p> <p>Reactive compensation equipment would be required at Glenlee, Newton Stewart and Glenluce:</p> <ul style="list-style-type: none"> <li>At Glenlee, the compound would be located directly adjacent to the proposed extension to Glenlee substation to the south-west. The compound would be 17m x 13m and would require 40m of 3.5m wide Type 1 access road.</li> <li>At Newton Stewart, the compound would be located directly adjacent to the existing Newton Stewart substation to the south. The compound would be 40m x 30m and would require 120m of 5m wide Type 1 access road.</li> <li>At Glenluce, the compound would be located directly adjacent to the existing Glenluce substation to the north. The compound would be 40m x 30m and would require 70m of 5m wide Type 1 access road.</li> </ul>	Bennan, Slogarie and Laurieston Forests OHL Option
<b>KTR Tower Numbers</b>	N/A	GT25 – GT78	GT25 – GT78
<b>Approximate Length of Route (km)</b>	N/A	16.00 km	14.43 km
<b>Biodiversity and Geological Conservation</b>	<b>SSSI Sites</b>	<p>The UGC runs directly adjacent to the Laughenghie and Airie Hills SSSI at Stroan Loch. Further to the south the route also runs adjacent to the east of the Woodhall Loch SSSI designated for beetles, Caddisfly, Fen Meadow and Oligotrophic loch freshwater habitat.</p> <p>As the UGC is proposed within is an existing access track to the north and A762 to the south it will be possible to avoid locating infrastructure within the SSSIs.</p> <p>The reactive compensation compounds are not located within or close to any SSSIs.</p>	The OHL will pass inside of 1 km from the Laughenghie and Airie Hills SSSI and may include breeding and foraging areas used by the qualifying species. This cannot be avoided during route alignment.
	<b>SNH Priority Peatland Habitats (Class 1 and 2)</b>	N/A	The OHL will pass through Class 1 habitat at two locations (west of Mossdale Flow and immediately adjacent to the A762 at Beoch Moor). Opportunities exist to avoid/span the class 1 peatland habitats during the alignment stage.
<b>Landscape and Visual Amenity</b>	<b>Regional Scenic Areas (RSA)</b>	<p>The UGC will be located predominantly within the extents of the Galloway Hills RSA. Beyond localised landscape and visual effects arising during construction, significant long-term effects associated with the sealing end compound located within Bennan Forest north-west of Stroan Loch (GT25) and the creation of the UGC route wayleave through Bennan Forest are likely to arise during operation. However, these effects will not compromise the integrity of the locally designated landscape as a whole or undermine the rationale for its designation.</p> <p>The reactive compensation compound at Glenlee is located within the Galloway Hills RSA. The compounds at Newton Stewart and Glenluce are not located within any designated landscape areas.</p>	The OHL through Bennan and Slogarie Forests will be predominantly located within the Galloway Hills RSA. Localised significant landscape and visual effects are anticipated to arise during construction and operation of the OHL. However, whilst the OHL will appear in some views experienced by receptors from within the RSA, including towards the core area of the Galloway Hills from unforested or elevated areas of the Galloway Forest Park, these effects will not compromise the integrity of the locally designated landscape as a whole or undermine the rationale for its designation.
	<b>Landscape Character / Landscape Features</b>	<p>The UGC will pass through the Rugged Uplands with Forest (181), Foothills with Forest (176) and the Drumlin Pastures (169) LCTs. Key characteristics of these large scale LCTs are unlikely to be adversely affected.</p> <p>The cable corridor will pass through existing commercial forestry within the Bennan forest area broadly following existing forestry access tracks and the disused railway line to the east of Stroan Loch, however some new sections of</p>	<p>The OHL will pass through the Rugged Uplands with Forest (181) (Medium capacity), Foothills with Forest (176) (Higher capacity) and the Drumlin Pastures (169) (Medium capacity) LCTs.</p> <p>The OHL will pass through commercial forestry and open ground within the Bennan Forest, and the presence of local topography to the east, and coniferous woodland along a large proportion of the route will minimise the visibility of the OHL as it continues southwards through Slogarie and</p>

Criterion	Sub-Criteria	UGC4C	OHL Option
		<p>wayleave will create a permanent and perceptible linear feature within this area of the Galloway Forest Park.</p> <p>The cable route then follows the road carriageway of the A762 between Mossdale and Dinnance, before passing into enclosed pasture/grazing west of the A762.</p> <p>Introduction of terminal towers is likely to result in very localised significant effects on the LCT, however their position within surrounding commercial forestry (tower location GT25) and in proximity to woodland shelterbelts (tower location GT78) will limit their perceptibility across the wider landscape.</p> <p>Permanent loss of landscape features unlikely, however temporary disturbance and reinstatement to stone dykes likely to be required.</p> <p>Very localised significant effects on the Rugged Uplands with Forest and Drumlin Pastures LCTs will occur from the construction and operation of the sealing end compounds and terminal towers. No significant effects related to the UGC corridor will persist through the operational phase following restoration of any construction related disturbance which arises.</p> <p>None of the reactive compensation compounds would result in the loss of any landscape features. At Glenlee and Newton Stewart the compounds extend into existing farmland.</p>	<p>Laurieston Forests. The areas of extensive coniferous woodland offer opportunities for screening and backclothing of the OHL, whilst avoiding the higher ground of Cairn Edward Hill.</p> <p>To the south the OHL avoids the higher ground of Slogarie Hill and Kenick Hill, minimising the opportunity for skylining of the OHL in views from the Glenkens Valley to the east. The presence of coniferous forestry provides opportunities for backclothing and screening the OHL before it emerges from the forest and enters open farmland west of the A762 south of Laurieston.</p> <p>Localised significant effects on the Foothills with Forest, Rugged Uplands with Forest and Drumlin Pastures LCTs will occur. The LCTs as a whole will not be significantly affected by the introduction of the OHL.</p>
	<p><b>Visual Amenity / Tourism and Recreation</b></p> <p>(e.g. Sustrans routes, Core Paths, long distance trails, tourist attractions and recreational areas such as golf courses)</p>	<p>From north to south the UGC runs along the Raiders Road Kenmuir Link Core Path (142) as far as the Stroan Loch viaduct, a section of which also forms part of the Galloway Kite Trail.</p> <p>The northern extent of this route will pass through the eastern extent of the Galloway Forest Park, following a section of the Raiders Road Forest Drive/Raiders Road to Mossdale Core Path (143) between Upper Gairloch and Stroan Loch along which felling of woodland currently managed as long-term retention and the creation of a permanent wayleave will be necessary.</p> <p>The route diverts to the east to the A762 at Mossdale utilising the corridor of the Mossdale to Gatehouse Station Railway Walk. Turning to the south the route then follows the A762/Galloway kite trail before terminating at GT78, west of the A762.</p> <p>As well as short-term effects on visual amenity arising during construction, long-term significant visual effects on views and visual amenity experienced by recreational receptors are also likely as a result of the introduction of the northern sealing end compound and terminal tower positioned near the Raiders Road Kenmuir Link Core Path (142) to the south of Peal Hill.</p> <p>In addition, long-term visual effects on views and visual amenity of recreational and tourist receptors are also likely as a result of the felling of a permanent wayleave adjacent to a section of the existing forest track which forms part of the Raiders Road Forest Drive/Raiders Road to Mossdale Core Path. For the disused railway at Stroan Viaduct works will be restricted to the working width of the railway cutting or embankment.</p>	<p>There will be very limited visibility of the OHL from the Galloway Tourist Route (A713) on the east side of the Glenkens Valley due to intervening landform and the presence of coniferous woodland on the eastern periphery of the Galloway Forest Park.</p> <p>The OHL will pass through dense coniferous woodland running broadly parallel with the route of the Raiders Road Forest Drive/Raiders Road to Mossdale Core Path (143) (at a distance of beyond 300m through much of this section, but within 100m for a short section at the eastern extent) south-eastwards towards Stroan Loch and the A762. Views of the OHL experienced from this promoted off road tourist drive and Core Path will be possible, with visibility dependant on the presence, retention and future management of the intervening coniferous woodland currently managed as long-term retention.</p> <p>The OHL will cross the Raiders Road east of Ross Hill, crossing the line perpendicular within an area of coniferous woodland. Due to intervening landform and the presence of dense coniferous woodland, there will be limited visibility from the promoted viewpoint at Bennan Hill from which the key focus of the available views are east, south-east across Loch Ken, where the existing 132kV OHL is visible on the east side of the Glenkens Valley. The upper portions of towers will be visible beyond intervening topography forestry in views from the Stroan Loch and Stroan Viaduct, however, the key views west across the loch from the eastern shore and adjacent picnic area will be largely unaffected.</p> <p>The OHL will cross a number of Core Paths, however the route will generally cross perpendicular to these walking and cycling routes, minimising the opportunities for extended sequential views from these routes, which predominantly pass through coniferous woodland where more distant views of the OHL will be limited.</p> <p>The OHL passes in close proximity to the promoted Buzzard Walk (No. 17) which follows a short loop around the northern and eastern shores of Stroan</p>

Criterion	Sub-Criteria	UGC4C	OHL Option
			<p>Loch, from which close up views of the OHL will be possible where open views exist.</p> <p>The route will cross two Core Paths to the east and south of Stroan Loch (Stroan Bridge Link and Mossdale to Gatehouse station railway walk (485)) and a further Core Path, Airie, near Mossdale (153). However, views will be short-lived as the OHL will pass over these routes perpendicularly.</p> <p>The route will cross the FCS promoted Black Water Riverside Walk which follows a circular path southward from Stroan Viaduct along the Black Water of Dee before heading back north through coniferous woodland. Views of the OHL from the riverside section of the walk will be possible, and from a short section of the trail as it will pass through the woodland to the east. Within Laurieston Forest the OHL will pass close to the promoted trails and picnic site near Kenick Burn, where views of the towers will be limited by the presence of dense forestry south of the minor road between Laurieston and Gatehouse of Fleet.</p> <p>Significant visual effects will be experienced by recreational and tourist receptors using core paths and promoted assets within the Galloway Forest Park during construction and operation of the proposed OHL. These will be limited to views experienced from locations in close proximity the proposed OHL, with wider visibility often limited by the presence of intervening forestry.</p>
	<p><b>Residential Visual Amenity</b></p>	<p>The sealing end compound and terminal tower at GT78 are likely to be visible from Edgarton Cottage, but effects on views from this property are unlikely to be significant due to distance and the presence of intervening landform and woodland to the north-east of property. Views of the sealing end compound and terminal tower from the nearby properties of Dinnance and Gatehouse to the north will be screened by intervening blocks of forestry west of the A762.</p> <p>At Glenlee, the reactive compensation compound will be largely imperceptible from nearby properties. At Newton Stewart, the presence of additional infrastructure will be visible in views from nearby residential properties and cemetery. At Glenluce, the reactive compensation compound introduces substation infrastructure west of North Street and extends the presence of infrastructure in close proximity to neighbouring residential property and cemetery.</p>	<p>To the north the OHL will pass through generally uninhabited coniferous woodland passing through a sparsely populated area of the Galloway Forest Park.</p> <p>From residential properties at Mossdale, there will be distant views of the OHL to the west, from where the perceptibility of towers will be limited by the orientation of properties (generally south, south-easterly) and the presence of intervening landform and coniferous woodland.</p> <p>A small number of properties are located within the vicinity of Slogarie and Laurieston Forests, the nearest of which are located within or accessed via the grounds of Slogarie NIDL, including Slogarie House, Coach House, Keepers Cottage and Rose Cottage. Principal views from these properties will be unaffected, and views west towards the route are generally contained by intervening landform and the presence of coniferous and broadleaf woodland. South of Slogarie, the OHL will pass through commercial forestry absent of habitation.</p> <p>The OHL will be visible in views north from the properties of Edgarton Cothouse and Edgarton Cottage, however effects on views from these properties will not be significant due to distance and the presence of intervening landform and woodland. Views of the OHL from the nearby properties of Dinnance and Gatehouse to the north will be screened by intervening blocks of forestry west of the A762.</p>
<p><b>Cultural Heritage</b></p>	<p><b>Scheduled Monuments<sup>10</sup></b></p>	<p>There are two Scheduled Monuments, Edgarton Mote Fort (SM1119) and Little Duchrae Fort (SM1077) located approximately 365m south west and within 25m respectively. The principal views from Edgarton Mote are to the south; therefore, at this distance visibility would be reduced by intervening topography. Duchrae Fort is located immediately adjacent to the A762 carriageway.</p>	<p>Three Scheduled Monuments; Edgarton Mote, fort (SM1119), Little Duchrae fort (SM1077) and Bargatton Farm cairn (SM1002). Edgarton Mote, fort and Bargatton Farm cairn have been raised as sensitive assets by HES in relation to the potential effect on their setting. Edgarton Mote fort is located in an area of open moorland just west of Edgarton farm. Views are afforded from the mote to the surrounding landscape, principally to the south. The OHL would pass the</p>

<sup>10</sup> It should be noted that the appraisal criteria for the underground cable differed from that used for the overhead line as for the cable only Scheduled Monuments within 250m were identified as there will be limited effect on setting as the result of a buried cable, with direct effects being the key potential issue of concern. In the case of the overhead line, a 2km buffer was used.

Criterion	Sub-Criteria	UGC4C	OHL Option
		<p>No adverse effects are anticipated on the Scheduled Monuments as a result of the UGC.</p> <p>There are no Scheduled Monuments close to any of the reactive compensation compounds.</p>	<p>fort in these views, however the OHL would not result in a significant adverse effect on its setting.</p> <p>Bargatton Farm cairn stands in open moorland with views to the surrounding landscape, principally to the south, south-east overlooking Bargatton Loch. The proposed OHL would be a new element in the surrounding landscape of the cairn, visible in the principal views, c. 1.4km away, however the OHL would not result in a significant adverse effect on its setting.</p>
	<b>Listed Buildings Category A, B and C</b>	<p>There are a number of Category B and C listed buildings directly adjacent to the route adjacent to the A762 in the areas around Hensol Lodge, Little Duchrae and Laurieston. No adverse effects are anticipated as a result of the UGC.</p> <p>Glenlee Power Station and Bridge Category B Listed Buildings are located approximately 100m north of the proposed location of the reactive compensation compound. There are no cultural heritage features located close to the proposed location of the compounds at Newton Stewart or Glenluce.</p>	<p>There are 11 Listed Buildings within 2km of the OHL including: six Category B Listed Buildings and five Category C Listed Buildings. No long-term significant adverse effects are anticipated as a result of the OHL on the setting of Listed Buildings.</p>
	<b>Archaeologically Sensitive Areas (ASA)</b>	<p>The UGC runs immediately adjacent to the west of the Grobdale ASA. No adverse effects are anticipated as a result of the UGC.</p> <p>The reactive compensation compounds are not located in ASAs.</p>	<p>Grobdale ASA lies within 2km of the OHL. The OHL will pass to the north of the ASA on the opposite side of the valley through an area of commercial forestry being approximately 800m from the northern edge of the ASA at its closest point. The OHL then turns south around Stroan loch where it will cross the eastern extent of Grobdale ASA (at Stroan Hill). Within the ASA, where the route will cross Stroan Hill, are the ruins of a post medieval farmstead and field system and remains of an earlier (medieval) township (MDG8225 &amp; MDG8226) along with elements of earlier land-use, such as small groups of clearance cairns and a prehistoric burnt mound.</p> <p>The remains form a well-preserved archaeological landscape that has considerable time-depth and are recorded as being of national importance in the D&amp;G Council HER. Although the OHL would cross the ASA it would be on the edge of the ASA and away from the nationally important cultural heritage remains in a less sensitive part of the ASA, removing any potential direct effect on the upstanding archaeological remains. The presence of the OHL crossing the ASA would result in a significant effect on the setting of both the ASA and the nationally important settlement remains.</p> <p>There is one additional ASA, Loch Mannoich, within 2km of the OHL. Here the OHL would be present to the north/east of the ASA partially passing through an area of commercial forestry. The proposed route would be principally screened from the ASA by intervening topography and would therefore not have a significant adverse effect the setting of the ASA.</p>
	<b>Garden and Designed Landscapes and Non-Inventory Designated Landscapes</b>	<p>UGC4C runs immediately to the west of Hensol House NIDL and further to the south runs through Laurieston Hall NIDL. However the route is within the public highway at these locations therefore no long-term significant adverse effects are anticipated as a result of the UGC.</p>	<p>Within 2km of the OHL there are three NIDLs, Slogarie, Hensol House and Laurieston Hall. All three NIDLs have been raised as sensitive assets by D&amp;G Council in relation to the potential effect on their settings. It is considered that the setting of the NIDLs would not be adversely affected by the OHL.</p>
<b>Forestry and Woodland</b>	<p><b>Ancient Woodland (AWI)</b></p> <p><b>Native Woodland (NWSS)</b></p> <p><b>Forestry (NFI)</b></p>	<p>The northerly section of UGC will pass through substantial forestry comprising the eastern extents of the Galloway Forest Park made up of predominantly commercial forestry but will also intersect areas of AWI, NWSS and NFI particularly to the west of Cairn Edward Hill.</p> <p>To the south of Mossdale the UGC avoids forestry by running alongside the existing A762 carriageway before terminating west of the road at the proposed tower position of GT78.</p>	<p>The northerly section of UGC will pass through substantial forestry comprising the eastern extents of the Galloway Forest Park made up of predominantly commercial forestry but will also intersect areas of AWI, NWSS and NFI particularly to the west of Cairn Edward Hill. Areas of felling of both NWSS and NFI would be required, whilst areas of AWI to the north of Stroan Loch are avoided.</p> <p>To the south of Stroan Loch the OHL will pass through Laurieston Forest, again, a substantial area of forestry made up of predominantly commercial forestry</p>

Criterion	Sub-Criteria	UGC4C	OHL Option
		<p>The proposed locations of the reactive compensation compounds are not within forestry or woodland.</p>	<p>but will also intersect areas of AWI, NWSS and NFI. The OHL will cross areas of both NWSS and AWI to the east of Lochenebreck Loch on the southern flanks of Kenick Hill.</p> <p>Additional area of woodland felling is required either side of the OHL wayleave within the Galloway Forest Park including the east of Hind Craig Hill, to the east of Cairn Edward Hill and to the east of Stroan loch. Additional felling for windthrow is also required east of Slogarie Hill. Areas of forestry lost due to windthrow will be restocked in line with the exercise of powers in the Forestry and Land Management (Scotland) Act 2018 and associated regulations.</p>
Flood Risk	Flood Zones and Waterbodies	<p>The UGC will cross two areas within the 1/200yr and 1/1000yr flood risk zone to the north of Woodhall Loch where the UGC will cross the River Dee and to the north-west of Laurieston.</p> <p>The reactive compensation compound at Glenlee is located within the 1/200yr and 1/1000yr flood risk zones.</p> <p>The reactive compensation compounds at Newton Stewart and Glenluce are not proposed in locations at risk of flooding.</p>	<p>This OHL will cross two areas within the 1/200yr and 1/1000yr flood risk zone (one to the south-west of Mossdale – the River Dee, and one within the Laurieston Forest, the Kenick Burn). These flood risk zones cannot be avoided during routeing; however, they can be easily spanned as they are narrower than the average span length of 250m.</p>
<b>Environmental Summary</b>	<p>The UGC will be approximately 1.5 km longer than the OHL.</p> <p>The UGC is not located in peatland; the OHL will cross two areas of Class 1 SNH Priority Peatland Habitat.</p> <p>The UGC would likely have very localised significant effects on the Rugged Uplands with Forest and Drumlin Pastures LCTs as a result of the need for a sealing end compound and terminal tower to facilitate the transition between OHL and UGC. Although no significant effects related to the UGC corridor will persist through the operational phase, where the UGC passes through the Bennan Forest this will result in a permanent and perceptible linear feature within this area of the Galloway Forest Park. Effects of the UGC will be reduced through routeing within the curtilage of the existing carriageway of the A762 for part of its southern section. The OHL will also likely result in localised significant effects on the LCTs, however, the LCTs as a whole will not be significantly affected by the introduction of the OHL.</p> <p>The UGC would likely have long-term significant visual effects on views and visual amenity experienced by recreational receptors as a result of the introduction of the sealing end compounds and terminal towers and felling of a permanent wayleave adjacent to a section of the existing forest track which forms part of the Raiders Road Forest Drive/Raiders Road to Mossdale Core Path. In relation to the OHL, significant visual effects are also anticipated for recreational and tourist receptors using core paths and promoted assets within the Galloway Forest Park during construction and operation of the proposed OHL. These will be limited to views experienced from locations in close proximity to the proposed OHL, with wider visibility often limited by the presence of intervening forestry. No significant effects are anticipated in relation to the visual amenity of residential receptors for either the OHL or UGC.</p> <p>Both the UGC and OHL will cross tourist and recreational routes, including the Raider’s Road. For the OHL there is the potential to span Core Paths and recreational routes at these locations.</p> <p>The UGC is unlikely to result in effects on surrounding cultural heritage features and avoids the Grobdale ASA. The OHL will cross the eastern extent of Grobdale ASA (at Stroan Hill) resulting in a minor impact on the ASA and the nationally important settlement remains during construction. The OHL will result in a minor effect on the setting of Bargatton Farm cairn Scheduled Monument.</p> <p>On balance, the UGC will result in a lesser impact on forestry than the OHL through utilisation of existing wayleaves and forest breaks, however the UGC route would result in loss of woodland situated along the corridor of the Raiders Road Forest Drive currently managed as long-term retention.</p> <p>Both the UGC and OHL cross two areas within the 1/200yr and 1/1000yr flood risk zones.</p> <p><b>On balance the environmental preference for the Bennan, Slogarie and Laurieston Forests is the UGC option. As well as reducing effects on landscape and visual receptors, and residential amenity the UGC would have a lesser impact on surrounding cultural heritage features, including the setting of surrounding Scheduled Monuments and Grobdale ASA. Furthermore, less felling would be required for the UGC than the OHL. However, long-term significant visual effects on views and visual amenity will still be experienced by recreational receptors, while substantial felling where the UGC parallels adjacent to the Raiders Road Forest Drive/Raiders Road to Mossdale Core Path between Upper Gairloch and Stroan Loch will also be required.</b></p>		
<b>Technical Appraisal</b>	<p>In order to provide the same capability as the OHL system, that is a summer rating of 735Amps and a winter rating of 865Amps for each 132kV circuit, each UGC circuit will need to consist of a single cables per phase and in a three-phase system this means 3 cables in total for each circuit. Hence to establish the same required capacity as the OHL system a total of 6 cables are needed.</p> <p>UGC4 cable route starts at tower GT25 and heads south through Galloway forest park following the Raiders Road, circumnavigating Stroan Loch until it reaches the Stroan viaduct. Here the cable route turns east out of the forest area, via the dismantled railway line between the Stroan viaduct and Mossdale, where it heads south on the A762. The cable</p> <p>The proposed overhead line will consist of 14.4km of new L4 towers carrying two 132kV circuits, a circuit on each side of the tower. A circuit consists of three phases with each phase strung with a single conductor. Hence in total the tower will carry three conductors on each side (total of 6 wires) and an earth wire between tower peaks strung with single phase conductors (6 wires) and an equivalent optical phase ground wire (OPGW) earth conductor between tower peaks. The route will consist of 55 towers with an average span length between towers of 280m with the average tower height being 30 meters.</p>		

Criterion	Sub-Criteria	UGC4C	OHL Option
	<p>route remains in the carriageway heading south through Laurieston until it leaves the carriageway close to Camelon Bridge and turns southwest where it dissects the proposed OHL route and terminates at tower GT78.</p> <p>A ducted cable installation of 7.44 km in carriageway, 0.76 km in arable/pastoral land and 7.80 km in forestry (includes the disused railway section) would be required. The regions of forestry may contain peat and affect cable conductor sizes. Regions of steep incline would require cable anchoring systems to avoid unwanted cable movement in service. Forestry clearance would be required to permit the cable working swathe in some areas. All earthing equipment and fibre pits would need to be mechanically protected within forestry confines (e.g. using substantial bollards). Where soft ground exists cables and joints would need to be mechanically protected from wheel penetration of forestry machinery. The installation of cables in forest tracks and verge as well as the dismantled railway track would require temporary closures and traffic management. Disruption to traffic routes to some properties would occur during the works on the disused railway. Where cables are off-road and/or existing tracks may not be used then haul/access roads would be required (7.40km estimated). The installation of cables in carriageway and verge would require temporary lane closures and traffic management. The cable route will pass through the settlement of Laurieston on the A762 which would cause some disruption due to temporary road narrowing, loss of parking, traffic management, noise, hazard mitigations and risk to existing services during carriageway works. The cable crossings which would require engineering study include the crossings beneath the River Dee near Hensol Bridge. The cable installation would pass through a number of flood zone risk (1 in 200 year) areas at water crossing locations; some seasonal working may be necessary. There is a risk that in some areas the presence of rock beneath a thin soil covering will slow installation progress and increase costs. Cables would terminate onto cable sealing end platforms mounted on suitable OHL tower designs located at GT25 and GT78.</p> <p>A cable system also has different characteristics from an OHL system and long cable routes tend to increase system voltage especially when the network is lightly loaded. High system voltage has an impact on system security and quality of supplies and potentially could damage equipment. SPEN has a license obligation to maintain system voltage within defined limits and often with long cable routes additional equipment is required (normally termed as reactive compensation) to maintain system voltage within the standard limits. In this option reactive compensation will be required at our substations in Glenlee, Newton Stewart and Glenluce. All substations will need to be extended to accommodate the additional equipment.</p>		<p>This solution will provide a summer rating of 735Amps and a winter rating of 865Amps for each circuit. This is based on a single SYCAMORE conductor (1x250mm<sup>2</sup>) per phase operating at 65°C.</p> <p>This solution will provide a rating of Pre-Fault Continuous - Summer: 141MVA / Spring/Autumn: 157MVA / Winter: 166MVA &amp; OHL Ratings Post-Fault Continuous - Summer: 168MVA / Spring/Autumn: 186MVA / Winter: 198MVA</p> <p>This section will run from tower GT25 &amp; GT78 near Bennan, Slogarie &amp; Laurieston.</p> <p>The proposed overhead line route traverses mainly through the forest estate. The line crosses over various forestry roads/ track, roads, rivers and distribution overhead lines. During the wiring works conductors required to over-sail obstacles would require specific mitigation such as temporary lane closures, traffic management &amp; potential distribution outages (further detail on the technical factors surrounding the OHL can be found in chapter 5 of the EIA report further detail on this can be found in chapter 5 of the EIA report).</p>
<p><b>Economic Appraisal</b></p>		<p>Underground cabling double circuit, one cable per phase, route length of 16.00km gives an estimated total installed costs of £53.37 M with a per kilometre cost of £3.34 M/km.</p>	<p>A new L4 double circuit tower line, single wires per phase, route length of 14.4km gives an estimated total installed cost of £13.43 M with a per kilometre cost of £0.93 M/km.</p>
<p><b>Conclusions</b></p>	<p>The appraisal found that the overall environmental benefits that would be experienced from an underground cable, in comparison with an overhead line, would be a reduction on effects on landscape and visual receptors, residential amenity surrounding cultural heritage features and forestry. However, long-term significant visual effects on views and visual amenity will still be experienced by recreational receptors, while substantial felling where the UGC parallels adjacent to the Raiders Road Forest Drive/Raiders Road to Mossdale Core Path between Upper Gairloch and Stroan Loch would also be required.</p> <p>The appraisal also found that the UGC 4 would be technically feasible although specific difficulties might be encountered in relation to water crossings, topography and areas of peat and shallow bedrock. Traffic management and lane closures on the A762 would also be required.</p> <p>The economic appraisal outlined above shows that the costs of an underground cable in this section would be 3.97 times greater than the proposed overhead line route with the projected cable cost being £53.37M and overhead line cost of £13.43M. This represents an overall projected difference in cost of <b>£39.93M</b>.</p> <p><b>In consideration of the above, SPEN's preference, by virtue of the economic impact, is to progress with an overhead line option through the Bennan, Slogarie and Laurieston forests. It is acknowledged by SPEN that the underground option is technically feasible and, on balance, environmentally preferable. Nevertheless UGC4C does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.</b></p> <p><b>Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project<sup>11</sup> which is:</b></p> <p><b><i>"To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it."</i></b></p>		

<sup>11</sup> Refer to SPEN's Routeing and Consultation documents at [www.spendgsr.co.uk](http://www.spendgsr.co.uk)

Criterion	Sub-Criteria	UGC4C	OHL Option
	<b>SPEN believe that proceeding with an overhead line solution through the Bennan, Slogarie and Laurieston forests is a conclusion which remains consistent with the overall KTR routeing objective.</b>		

**Table 5: UGC and OHL Comparison – A75 Crossing**

Criterion	Sub-Criteria	UGC5A <sup>12</sup>	OHL Option
Section Description	N/A	CCI Cable Route	A75 Crossing OHL Option
KTR Tower Numbers	N/A	GT97 – GT104	GT97 – GT104
Approximate Length of Route (km)	N/A	2.20 km	2.78 km
Landscape and Visual Amenity	<b>Regional Scenic Areas (RSA)</b>	Distant views of the sealing end compounds located south and north of the A75 will theoretically be possible from the Galloway Hills RSA to the north (c.4km) and from the Solway Coast RSA to the east, south-east (c.5km). Landscape and visual effects on receptors within the RSA will not be significant at this distance and the effects will not compromise the integrity of these locally designated landscapes or undermine the rationale for their designation.	Distant views of the OHL will theoretically be possible from the Galloway Hills RSA to the north (c.4km) and from the Solway Coast RSA to the east, south-east (c.5km). Landscape and visual effects on receptors within the RSA will not be significant at this distance and the effects will not compromise the integrity of these locally designated or undermine the rationale for their designation.
	<b>Landscape Character / Landscape Features</b>	The UGC will pass through the Drumlin Pastures (169) LCT although key characteristics of the LCT will not be adversely affected.  The UGC corridor will pass through enclosed pasture/grazing to the north and south of the A75. Introduction of the sealing end compounds terminal towers may result in very localised significant effects on the LCT, however their position in relation to adjacent landform and blocks of woodland will limit perceptibility across the wider landscape and no significant effects on the LCT as a whole will occur.  Permanent loss of landscape features is unlikely, however temporary disturbance and reinstatement to stone dykes is likely to be required. Significant effects on the Drumlin Pastures LCT will not occur during operation of the UGC following restoration of any construction related disturbance which arises.	The OHL is located solely within the Drumlin Pastures (169) LCT (Medium capacity). The OHL closely follows the alignment of the existing R Route (132kV) OHL which locally increases the capacity of the landscape to accommodate OHL development.  The OHL from the north of Upper Balannan will pass over slightly elevated ground to the east and south, utilising opportunities for backclothing or screening of the OHL by the small wooded hill west of the minor road between Upper Balannan and Dunlop, before it deviates southwards along the alignment of the existing R Route south of the A75.  The simple landcover of pasture farmland with linear field boundaries offers opportunities to tie into the existing landscape pattern, whilst utilising the presence of woodland for screening and backclothing as the OHL approaches the A75.  South of the A75, the route ascends the gentle slopes where a small number of towers will appear skylined as the route follows the alignment of the existing OHL onto the elevated plateau to the south.  Significant effects on the Drumlin Pastures LCT will occur, extending to a localised area similar to that of the existing R Route.
	<b>Visual Amenity / Tourism and Recreation</b>  (e.g. Sustrans routes, Core Paths, long distance trails, tourist attractions and recreational areas such as golf courses)	Visibility of sealing end compounds and terminal towers (tower GT97 and GT104) to the north and south of the A75 will be largely imperceptible in views experienced by receptors travelling west and east along this road, whilst the cable corridor will cross this busy road route between Dumfries and Stranraer.  Beyond short-term effects on visual amenity arising during construction, long-term visual effects on views and visual amenity of recreational and tourist receptors using these routes will not occur.	The OHL largely follows the existing OHL (R Route) which is perceptible at distance in views from Barstobrick Hill, and Neilson's Monument, however they will be very small feature in the view at this distance.  No significant visual effects are anticipated to occur for tourist or recreational receptors using promoted or recreational routes.
	<b>Residential Visual Amenity</b>	Although terminal tower at GT97 is located in relatively close proximity to Upper Balannan Farm, effects on residential visual amenity are unlikely to be significant due to the presence of intervening landform and large-scale agricultural buildings to the north, north-east of the property.	Closely following the alignment of the existing 132kV OHL, the route will pass within approximately 150m of the farmstead property of Upper Balannan, however the OHL will avoid the principal views south, south-west from the property, and views will be limited to those available north, north-east from the property and its curtilage between intervening large-scale agricultural buildings.  Only a small-scale change in views will result from the replacement of the existing R Route by the proposed OHL, which will not result in significant visual effects on views from residential properties.

<sup>12</sup> UGC5A as appraised reflects the movement of tower GT97 in the revised position as shown in Figure 73 of Appendix 2.



Criterion	Sub-Criteria	UGC5A <sup>12</sup>	OHL Option
Cultural Heritage	Scheduled Monuments <sup>13</sup>	N/A	There are two Scheduled Monuments, Park stone circle (SM1039) and Kirkcormarck motte (SM1122) within 2km of both the OHL. The OHL would not result in significant adverse effects on the setting of these assets.
	Listed Buildings Category A, B and C	There are four Listed Buildings within 2km of both the UGC and OHL, including: one Category A Listed Building, and four Category B Listed Buildings. No adverse effects are anticipated on the Listed Buildings as a result of either the UGC or the OHL.	
Forestry and Woodland	Ancient Woodland (AWI) Native Woodland (NWSS) Forestry (NFI)	The UGC is located close to an area of AWI adjacent to Argrennan Cottages but unlikely to directly affect it.	The OHL will pass directly adjacent to an area of NFI conifer plantation (to the south-east of Upper Balannan), within 150m of an area of NWSS broadleaved woodland (at Big Wood adjacent to Barncross), within approximately 500m (to the west of Barstibly) and AWI (adjacent to Argrennan Cottages), however only a small section of NFI will require felling.
Environmental Summary	<p>The OHL is slightly longer than the UGC.</p> <p>The UGC would likely have significant visual and very localised effects on the LCT as a result of the need for a sealing end compound and terminal tower to facilitate the transition between OHL and UGC. However, it is likely the OHL would have a greater impact on landscape character and residential visual amenity as a whole, extending to a localised area similar to that of the existing OHL Route (R route). It is not anticipated that significant effects will result on either recreational or residential receptors for the UGC or OHL.</p> <p>Neither the UGC nor OHL cross any tourist and recreational routes, however it is considered likely that the OHL will be visible from those in the surrounding area.</p> <p>Neither the UGC nor OHL are likely to result in any significant impacts on surrounding cultural heritage features.</p> <p>The UGC is unlikely to require any felling, while the OHL will require only very minimal felling.</p> <p><b>On balance, the environmental preference for the crossing of the A75 is the UGC option. Comparatively the UGC results in reduced effects on landscape and visual receptors, and residential amenity. However, very localised significant landscape and visual effects will arise from the introduction of sealing end compounds and terminal towers to facilitate the transition between OHL and UGC.</b></p>		
Technical Appraisal	<p>In order to provide the same capability as the OHL system, that is a summer rating of 735Amps and a winter rating of 865Amps for each 132kV circuit, each UGC circuit will need to consist of a single cables per phase and in a three-phase system this means 3 cables in total for each circuit. Hence to establish the same required capacity as the OHL system a total of 6 cables are needed.</p> <p>The UGC5 cable route starts from tower GT97 and heads south across arable/pastoral land towards the A75. Having crossed the A75 the cable route continues south across arable/pastoral land terminating at tower GT104.</p> <p>A ducted cable installation of 2.20 km in arable/pastoral land would be required. Adjacent to tower GT97 the ground was noted to comprise regions of steep incline that would require cable anchoring systems to avoid unwanted cable movement in service. Haul roads would be required (2.20km estimated) with access from the A75. Cable crossings which would require particular attention include the road crossing beneath A75 due to length and unknown ground conditions. There is a risk that the presence of rock beneath a thin soil covering will slow installation progress and increase costs. Some localised cable re-routing may be required near rock outcrops. Cables would terminate onto cable sealing end platforms mounted on suitable OHL tower designs located at GT25 and GT78.</p> <p>A cable system also has different characteristics from an OHL system and long cable routes tend to increase system voltage especially when the network is lightly loaded. High system voltage has an impact on system security and quality of supplies and potentially could damage equipment. SPEN has a license obligation to maintain system voltage within defined limits and often with long cable routes additional equipment is required (normally termed as reactive compensation) to maintain system voltage within the standard limits. However, for this option studies have shown this is not required.</p>		<p>The proposed overhead line will consist of 2.78km of new L4 towers carrying two 132kV circuits, a circuit on each side of the tower. A circuit consists of three phases with each phase strung with a single conductor. Hence in total the tower will carry three conductor on each side (total of 6 wires) and an earth wire between tower peaks strung with single phase conductors (6 wires) and an equivalent optical phase ground wire (OPGW) earth conductor between tower peaks. The route will consist of 11 towers with an average span length between towers of 280m with the average tower height being 30 meters.</p> <p>This solution will provide a summer rating of 735Amps and a winter rating of 865Amps for each circuit. This is based on a single SYCAMORE conductor (1x250mm<sup>2</sup>) per phase operating at 65°C.</p> <p>This solution will provide a rating of Pre-Fault Continuous - Summer: 141MVA / Spring/Autumn: 157MVA / Winter: 166MVA &amp; OHL Ratings Post-Fault Continuous - Summer: 168MVA / Spring/Autumn: 186MVA / Winter: 198MVA</p> <p>This section will run from tower GT97 &amp; GT104 over the A75 crossing.</p> <p>The proposed overhead line route traverses mainly through the forest estate. The line crosses over various forestry roads/ track, roads, rivers and distribution overhead lines. During the wiring works conductors required to over-sail obstacles would require specific mitigation such as temporary lane closures, traffic management &amp; potential distribution outages (further detail on the technical factors surrounding the OHL can be found in chapter 5 of the EIA report further detail on this can be found in chapter 5 of the EIA report).</p>

<sup>13</sup> It should be noted that the appraisal criteria for the underground cable differed from that used for the overhead line as for the cable only Scheduled Monuments within 250m were identified as there will be limited effect on setting as the result of a buried cable, with direct effects being the key potential issue of concern. In the case of the overhead line, a 2km buffer was used.

Criterion	Sub-Criteria	UGC5A <sup>12</sup>	OHL Option
<b>Economic Appraisal</b>		Underground cabling double circuit, one cable per phase, route length of 2.20km gives an estimated total installed costs of £10.79 M with a per kilometre cost of £4.90 M/km.	A new L4 double circuit tower line, single wires per phase, route length of 2.78km gives an estimated total installed cost of £2.17 M with a per kilometre cost of £0.78 M/km.
<b>Conclusions</b>		<p>The appraisal found that the overall environmental benefits that would be experienced from an underground cable, in comparison with an overhead line, would be a reduction on effects on landscape and visual receptors and residential amenity. However, long-term significant visual effects on views and visual amenity will still arise from the installation of cable sealing towers.</p> <p>The appraisal also found that the UGC 5 would be technically feasible although specific difficulties might be encountered in relation to shallow bedrock. Traffic management and lane closures on the A75 and would also be required.</p> <p>The economic appraisal outlined above shows that the costs of an underground cable in this section would be 4.98 times greater than the proposed overhead line route with the projected cable cost being £10.79M and overhead line cost of £2.17 M. This represents an overall projected difference in cost of <b>£8.62M</b>.</p> <p><b>In consideration of the above, SPEN's preference, by virtue of the economic impact, is to progress with an overhead line option across the A75. Nevertheless, UGC5A does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.</b></p> <p><b>Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project<sup>14</sup> which is:</b></p> <p><i><b>"To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it."</b></i></p> <p><b>SPEN believe that proceeding with an overhead line solution across the A75 is a conclusion which remains consistent with the overall KTR routeing objective.</b></p>	

<sup>14</sup> Refer to SPEN's Routeing and Consultation documents at [www.spendgsr.co.uk](http://www.spendgsr.co.uk)

Table 6: UGC and OHL Comparison – Glenlee to Tongland

Criterion	Sub-Criteria	UGC6E	OHL Option
Section Description	N/A	<p>CCI Cable Route following the east side of Loch Ken.</p> <p>Reactive compensation equipment would be required at Kendoon, Glenlee, Newton Stewart, Glenluce and Tongland:</p> <ul style="list-style-type: none"> <li>At Kendoon, the compound would be located directly adjacent to the existing Kendoon substation to the north-west. The compound would be 35m x 20m and would require 40m of 3.5m wide Type 1 access road and 10m of 5m wide asphalt access road.</li> <li>At Glenlee, the compound would be located directly adjacent to the proposed extension to Glenlee substation to the south-west. The compound would be 17m x 13m and would require 40m of 3.5m wide Type 1 access road.</li> <li>At Newton Stewart, the compound would be located directly adjacent to the existing Newton Stewart substation to the south. The compound would be 40m x 30m and would require 120m of 5m wide Type 1 access road.</li> <li>At Glenluce, the compound would be located directly adjacent to the existing Glenluce substation to the north. The compound would be 40m x 30m and would require 70m of 5m wide Type 1 access road.</li> <li>At Tongland, the compound would be located directly adjacent to the existing Tongland substation to the south-west. The compound would be 40m x 30m and would require 40m of 5m wide Type 1 access road.</li> </ul>	Glenlee to Tongland OHL Option
KTR Tower Numbers	N/A	Glenlee substation – Tongland substation	Glenlee substation – Tongland substation
Approximate Length of Route (km)	N/A	37.59 km	33.7 km (note, for the purposes of this study, this includes 32.4 of new L4 towers and 1.3km of existing BG route towers, repurposed to facilitate the new Glenlee to Tongland connection)
Biodiversity and Geological Conservation	Special Protection Areas (SPA)	<p>The route will pass immediately to the east of the Loch Ken and River Dee Marshes SPA and Ramsar site. Qualifying features of the SPA include populations of the Annex I listed Greenland White-fronted Goose <i>Anser albifrons flavirostris</i> as well as migratory Greylag Goose <i>Anser anser</i>.</p> <p>As these routes would be in the carriageway of the A762/A713, it is assumed infrastructure within the SPA itself can be avoided.</p> <p>The reactive compensation compounds are not proposed at locations within or close to any SPAs.</p>	The OHL will pass within 2km of the Loch Ken and River Dee Marshes SPA. Qualifying features of the SPA include populations of the Annex I listed Greenland White-fronted Goose <i>Anser albifrons flavirostris</i> as well as migratory Greylag Goose <i>Anser anser</i> .
	SSSI Sites	<p>To the south of the Glenlee substation the route runs immediately adjacent to the Water of Ken Woods SSSI designated for upland oak woodland and lichen assemblages.</p> <p>At the northern reaches of Loch Ken, the route runs adjacent to Kenmure Holmes SSSI, part of the Loch Ken and River Dee Marshes SPA and Ramsar site.</p> <p>To the southern extents of Loch Ken the routes runs broadly adjacent to the River Dee (Parton to Crossmichael) SSSI, part of the Loch Ken and River Dee Marshes SPA and Ramsar site.</p> <p>Where the cable is proposed in proximity to the designations above, this is all within the public highway therefore it is assumed that works directly within the designated areas can be avoided.</p>	<p>The OHL will pass within 1km of the Laughenghie and Airie Hills SSSI and may include breeding and foraging areas used by the qualifying species. This cannot be avoided during route alignment.</p> <p>To the north the OHL also will pass within 500m of the Water of Ken Woods SSSI designated for upland oak woodland and lichen assemblages. Further to the south the route also will pass within 750m of the Woodhall Loch SSSI designated for beetles, Caddisfly, Fen Meadow and Oligotrophic loch freshwater habitat.</p>

Criterion	Sub-Criteria	UGC6E	OHL Option
		The reactive compensation compounds are not proposed at locations within or close to any SSSIs.	
	<b>SNH Priority Peatland Habitats (Class 1 and 2)</b>	N/A	The OHL will pass through Class 1 habitat at two locations (west of Mossdale Flow and immediately adjacent to the A762 at Beoch Moor). Opportunities exist to avoid/span the class 1 peatland habitats during the alignment stage
<b>Landscape and Visual Amenity</b>	<b>Regional Scenic Areas (RSA)</b>	<p>The UGC route is located predominantly within the Galloway Hills RSA between Glenlee substation and the southern extent of Loch Ken. The very southern extent of the UGC route is located within the Solway Coast RSA where the UGC terminates at Tongland substation. Beyond the localised landscape and visual effects which will arise during construction, the long-term presence of the UGC will not compromise the integrity of these locally designated landscapes or undermine the rationale for their designation.</p> <p>The reactive compensation compounds at Kendoon, Glenlee and Tongland are located within the Galloway Hills RSA. The compounds at Newton Stewart and Glenluce are not located within any designated landscape areas.</p>	<p>The OHL route is located predominantly within the Galloway Hills RSA between Glenlee substation and Slogarie Forest. Localised significant landscape and visual effects are anticipated to arise during construction and operation of the OHL. However, whilst the OHL will appear in some views experienced by receptors from within and outside the RSA, including towards the core area of the Galloway Hills from unforested or elevated areas of the Galloway Forest Park, these effects will not compromise the integrity of the locally designated landscape as a whole or undermine the rationale for its designation.</p> <p>The very southern extent of the OHL route is located within the Solway Coast RSA where the OHL terminates at Tongland substation and will replace the existing infrastructure of R route within this very localised area of the RSA. Effects will not compromise the integrity of these locally designated or undermine the rationale for their designation.</p>
	<b>Landscape Character / Landscape Features</b>	<p>The UGC route follows the A762 south from Glenlee substation before crossing the Water of Ken at Meikle Isle in the foot of the valley before reaching the A713 on the east side of the river valley.</p> <p>The route then follows the road carriageway of the A713 within the Upper Dale (165) and Flooded Valley (164) LCTs. South of Crossmichael, the route heads through the and Drumlin Pasture (169) LCT.</p> <p>The route then will pass through an area of woodland at Barnboard Wood near Balmaghie Bridge, which will create a permanent linear feature in the landscape.</p> <p>Further south the route will pass through enclosed pasture/grazing fields before crossing the A75 near Upper Balannan Farm. At Park of Tongland the UGC route deviates south-west towards Barr Hill where it descends towards the A762 east of woodland on Castle Hill before approaching Tongland substation from the west passing through the Drumlin Pasture (169) LCT.</p> <p>Key characteristics of the LCTs will not be adversely affected.</p> <p>Permanent loss of landscape features will be largely avoidable; however temporary disturbance and reinstatement to stone dykes and hedgerows along the UGC route will occur.</p> <p>No significant effects on the LCTs will occur during operation following restoration of any construction related disturbance which arises.</p> <p>The reactive compensation compound at Kendoon would result in the loss of mature mixed woodland which forms a key landscape feature along the Water of Ken. None of the other reactive compensation compounds would result in the loss of any landscape features. At Glenlee, Newton Stewart and Tongland the compounds extend into existing farmland.</p>	<p>The OHL route will pass through the Rugged Granite Uplands with Forest LCT (Medium capacity); and Foothills with Forest LCT (Higher capacity). Heading south, the OHL follows higher ground to the west of the Water of Ken, utilising routeing opportunities within the shallow valley west of Shiel Hill and Fintloch Hill to minimise skylining of the OHL in views from the east. Further south as the OHL will pass through Laurieston Forest passing through the Drumlin Pastures LCT (Medium capacity) and Foothills with Forest LCT (Higher capacity). The presence of local topography to the east of the route option, and coniferous woodland along a large proportion of the OHL forming the Galloway Forest Park and Laurieston Forest will minimise the visibility of the OHL as it continues southwards and offers opportunities for screening and backclothing the OHL.</p> <p>The route will cross the shallow valley north of Culcrae and will pass over slightly elevated ground to the east and south, utilising opportunities for backclothing or screening of the OHL by the small wooded hill west of the minor road between Upper Balannan and Dunlop, before it deviates southwards along the alignment of the existing 132kV OHL. The simple landcover of pasture farmland with linear field boundaries offers opportunities to tie into the existing landscape pattern, whilst utilising the presence of woodland for screening and backclothing as the OHL approaches the A75.</p> <p>South of the A75, the route ascends the gentle slopes, where a small number of towers will appear skylined as the OHL follows the alignment of the existing R Route onto the elevated plateau to the south. Broadly following the alignment of this existing 132kV OHL, which locally increases the capacity of the landscape to accommodate OHL development. The OHL will cross sparsely populated and relatively high ground between the valleys of the River Tarff to the west and the River Dee to the east, crossing through enclosed pasture farmland and through a stand of coniferous woodland creating a wider wayleave west of the existing OHL.</p>

Criterion	Sub-Criteria	UGC6E	OHL Option
			<p>Approaching Tongland to the south, the OHL continues to closely follow the alignment of the existing R Route, crossing enclosed pasture farmland before passing adjacent to the extensive area of mineral extraction to the north of Tongland. The proposed OHL will result in visibility of towers across the skyline from the River of Dee Valley to the east, extending across the Dundrennan LCU to the south-east, however, the OHL will appear in the context of the existing mineral extraction site.</p> <p>Significant effects on LCTs will occur, extending to localised areas of the host LCTs, and similar in extent to that of the existing R Route at the southern extents of the proposed OHL route. However, significant effects on the host LCTs as whole will not arise.</p>
	<p><b>Visual Amenity / Tourism and Recreation</b> (e.g. Sustrans routes, Core Paths, long distance trails, tourist attractions and recreational areas such as golf courses)</p>	<p>The UGC route runs parallel with the Galloway Tourist Route/A713, east of Loch Ken. The route will then cross the Dalry to new Galloway Core Path twice, first immediately to the south of Boat Knowe and then at Garplefoot. Further south the route will pass to the east of the Galloway Activity Centre situated on Loch Ken.</p> <p>At the southern reaches of Loch Ken, the route will cross the Cruichie and Glengunnoch Wood Core Paths. Further to the south the route will pass Crossmichael before deviating south-west, at this point, where it will cross both the Galloway Tourist Route and Robert the Bruce Trail.</p> <p>Beyond short-term effects on visual amenity arising during construction, long-term visual effects on views and visual amenity of recreational and tourist receptors using these routes will not occur.</p>	<p>The OHL route will be perceptible from sections of the Southern Upland Way as it crosses higher ground on the eastern and western side of the Glenkens Valley.</p> <p>Outward views of the OHL are limited from the Galloway Tourist Route (A713) on the east side of the Glenkens Valley due to intervening landform and the presence of coniferous woodland west of the A762. Sections of the Galloway Kite Trail within the Glenkens Valley (following the A713) will experience distant and partially screened views of this section of the OHL.</p> <p>The OHL route will run parallel with the New Galloway West (516) Core Path to the north of the Queen's Way/A712, from where significant visual effects will be experienced by recreational users of this short walking route.</p> <p>The route will cross the Robert the Bruce Trail and a section of the Galloway Kite Trail (between New Galloway and Clatteringshaws Loch) which follow the A712 between New Galloway and Newton Stewart, before entering dense coniferous woodland south of the A712.</p> <p>Views of the OHL from New Galloway Golf Course are not considered likely, due to the presence of intervening landform and coniferous woodland.</p> <p>Significant visual effects are anticipated for recreational users of the New Galloway West and Raiders Road Kenmuir Link Core Paths, while there will only be intervening glimpses of the OHL from Robert the Bruce Trail and a section of the Galloway Kite Trail which follow the A712/Queen's Way when travelling east and west along a short section of the A712 with minimal opportunity for extended sequential views.</p> <p>The route passes through Bennan Forest south of the A712 in close proximity to the Raiders Road Kenmuir Link Core Path (142), before crossing the Raiders Road Forest Drive/Raiders Road to Mossdale Core Path (143) east of Ross Hill.</p> <p>The OHL will be visible in views from Stroan Loch and Stroan Viaduct, however key views west across the loch from the eastern shore and adjacent picnic area will be unaffected.</p> <p>Further south the OHL then largely follows the existing OHL which is perceptible in views from Barstobrick Hill and Neilson's Monument. The OHL does not cross the Barstobrick Core Path to the south-west; however views of the OHL will be possible from sections of this route in views to the north and east. Visibility of the route from the Barstobrick Visitor Centre will be possible in distant views to the east.</p> <p>Following the alignment of the existing 132kV (R Route) closely is likely to result in similar views of the OHL from the Tongland to Cumstoun Bridge</p>

Criterion	Sub-Criteria	UGC6E	OHL Option
			<p>Core Path which follows the A762 to the south-west and the Dee Walk and Boreland Core Path to the south-east. Similar views of the OHL to that of the existing 132kV OHL are likely where it will pass within 250m of the Tongland Family Golf Centre/Course. The proposed OHL route will position towers slightly further west of the existing R Route, often partially screened by intervening topography to the west of the golf course. Distant views of the OHL from the Burns Heritage Trail and Robert the Bruce Trail are likely to be very limited, appearing in a similar context to the exiting 132kV OHL at a distance of over 1.5km.</p> <p>Significant localised visual effects are anticipated to occur along the southern section of the route, however these will largely be within the extents of the effects arising in relation to the existing OHL (R Route).</p> <p>The OHL route generally crosses walking and cycling routes perpendicular, reducing opportunities for extended sequential views from these routes, which predominantly pass through coniferous woodland where more distant views of the OHL will be limited.</p>
	<p><b>Residential Visual Amenity</b></p>	<p>No effects on residential visual amenity will occur following completion of construction and restoration works.</p> <p>At Kendoon, the reactive compensation compound introduces substation infrastructure on either side of the public access road to residential properties at Kendoon. At Glenlee and Tongland the reactive compensation compound will be largely imperceptible from nearby properties. At Newton Stewart, the presence of additional infrastructure will be visible in views from nearby residential properties and cemetery. At Glenluce, the reactive compensation compound introduces substation infrastructure west of North Street and extends the presence of infrastructure in close proximity to neighbouring residential property and cemetery</p>	<p>The first section of the OHL is located within 150m of the residential properties south of Glenlee substation, including the property of Glenlee Kennels adjacent to Bucks Linn Bridge. Between Bucks Linn Bridge and the A712 the OHL will pass close to a small number of scattered properties and farmsteads on the west side of the Glenkens Valley, including Glenlee Kennels and Airie Cottage, however the principal views of these properties are east, south-eastwards towards the valley or are contained by woodland screening.</p> <p>South of the A712 the OHL will pass through generally uninhabited coniferous woodland, however, the OHL will pass to the east of the property of Darsalloch, north-west of Peal Hill, but will avoid the principal north, north-east facing views from the property. Significant localised visual effects on views are not anticipated to occur from this property. Following establishment of existing intervening woodland to the east of the property (south of Knocknairling Burn) and the replanting of areas identified for windthrow felling south-east of the property residual visual effects on views from this property will further reduce.</p> <p>More distant views of the OHL from properties within the settlement of New Galloway are unlikely to occur due to the presence of intervening landform and woodland where the route will pass west of Peal Hill.</p> <p>The OHL will pass through generally uninhabited coniferous woodland passing through a sparsely populated area of the Galloway Forest Park.</p> <p>From residential properties at Mossdale, there will be distant views of the OHL to the west, from where the perceptibility of towers will be limited by the orientation of properties (generally south, south-east) and the presence of intervening landform and coniferous woodland.</p> <p>A small number of properties are located within the vicinity of Slogarie and Laurieston Forests, the nearest of which are located within or accessed via the grounds of Slogarie NIDL, including Slogarie House, Coach House, Keepers Cottage and Rose Cottage. Principal views from these properties will be unaffected, and views west towards the route are generally contained by intervening landform and the presence of coniferous and broadleaf woodland. South of Slogarie, the OHL will pass through commercial forestry largely absent of habitation.</p>

Criterion	Sub-Criteria	UGC6E	OHL Option
			<p>The OHL will be visible in views north from the properties of Edgarton Cothouse and Edgarton Cottage, however effects on views from these properties will not be significant due to distance and the presence of intervening landform and woodland. Views of the OHL from the nearby properties of Dinnance and Gatehouse to the north will be screened by intervening blocks of forestry west of the A762. Views of the OHL from the properties at Barstobrick will be screened by the presence of dense deciduous woodland and coniferous forestry north of this cluster of properties. The proposed OHL closely follows the alignment of the existing 132kV OHL avoiding the principal view south, south-west from the property of Culcrae east of Barstobrick Hill, before deviating south, south-eastwards whilst avoiding the principal views south, south-west from the property of Upper Balannan. The OHL will be located within 150m this property, but views will be limited to those available north, north-east from the property and its curtilage.</p> <p>South of the A75 the OHL will pass through farmland with a dispersed pattern of scattered farmsteads and properties with various viewing orientations and outlooks informed by local topography and vegetation. The OHL passes between residential properties at Argrennan Cottages and Argrennan Mains, from which the principal views are orientated south. The OHL runs closely parallel to the west of the alignment of the existing 132kV OHL (R Route), within 150m of these residential properties, however the existing OHL which is located within approximately 75m of Argrennan Mains will subsequently be removed.</p> <p>To the west of the alignment of the existing R Route will be located further from residential properties at High Clachan. At its southern extent, following closely the alignment of the existing R Route, the proposed route will require the positioning of towers within 150m of residential properties on the approach to Tongland substation, near Langbarns.</p>
<p><b>Cultural Heritage</b></p>	<p><b>Scheduled Monuments<sup>15</sup></b></p>	<p>Crofts Mott, fort (9SM1065) and Castle earthworks, enclosure 500m SSW Mains of Greenlaw (SM6110), and Kirkland Mote, Motte (SM1124), and Glenlochar, Roman Fort, annexe, camps and barrows 50m E of Montford (SM12792) are within 100m of the UGC. However, no effects on the Scheduled Monuments are anticipated.</p> <p>There are no Scheduled Monuments close to any of the reactive compensation compounds.</p>	<p>From north to south there are 10 Scheduled Monuments within 2 km of the OHL. These include: Dalry Motte (SM1117); Ducharie Fort (SM1077); Kenmure Castle (SM7743), which is also a Category B Listed Building; Edgarton Mote, fort (SM1119); Bargatton Farm cairn (SM1002); Park stone circle (SM1039); Kirkcormarck motte (SM1122); Carse Mote fort (SM1058); Brockcleugh Cottage cup and ring marked rocks (SM1005); and Cumstoun Castle (SM8263).</p> <p>Dalry Motte is a promoted heritage site and has been raised as a sensitive asset by D&amp;G Council in relation to the potential effect on its setting. The built-up areas of St John's Town of Dalry, to the south/south-west of the motte, would principally screen views in the direction of the proposed OHL and its effect on the motte would be minimal.</p> <p>Both Edgarton Mote, fort and Bargatton Farm cairn have been raised as sensitive assets by HES in relation to the potential effect on their setting. Edgarton Mote fort is located in an area of open moorland just west of Edgarton farm. Views are afforded from the motte to the surrounding landscape, principally to the south. The OHL would pass the fort in these views and may potentially adversely affect its setting. Bargatton Farm cairn stands in open moorland with views to the surrounding landscape, principally to the south/south, south-east overlooking Bargatton Loch. The OHL would be a new element in the surrounding landscape of the cairn,</p>

<sup>15</sup> It should be noted that the appraisal criteria for the underground cable differed from that used for the overhead line as for the cable only Scheduled Monuments within 250m were identified as there will be limited effect on setting as the result of a buried cable, with direct effects being the key potential issue of concern. In the case of the overhead line, a 2km buffer was used.

Criterion	Sub-Criteria	UGC6E	OHL Option
			visible in the principal views, c. 0.5km away, however the OHL would not result in a significant adverse effect on its setting.
	<b>Listed Buildings Category A, B and C</b>	There are 110 Listed Buildings within 2km of both the UGC, including: 14 Category A Listed Buildings, 78 Category B Listed Buildings and 18 Category C Listed Buildings. No long-term significant adverse effects on Listed Buildings are anticipated as a result of the UGC.  Kendoon Power Station and Kendoon Valve House, Glenlee Power Station and Bridge (Category B Listed) and Tongland Power Station (Category A Listed) are all located within approximately 100m north of the proposed locations of the reactive compensation compounds. There are no cultural heritage features located close to the proposed location of the compounds at Newton Stewart or Glenluce.	There are 67 Listed Buildings within 2km of both the UGC, including: 5 Category A Listed Buildings, 45 Category B Listed Buildings and 17 Category C Listed Buildings. No long-term significant adverse effects on Listed Buildings are anticipated as a result of the OHL.
	<b>Conservation Areas</b>	One Conservation Area, New Galloway, lies within 2km of both the UGC and OHL.	No adverse significant effects are anticipated.
	<b>Archaeologically Sensitive Areas (ASA)</b>	N/A	One ASA, Grobdale, lies within 2km of the OHL. The OHL will pass to the north of the ASA on the opposite side of the valley and passing through an area of commercial forestry at the closest being approximately 800m from the northern edge of the ASA. The OHL then turns south around Stroan loch where it will cross the eastern extent of Grobdale ASA (at Stroan Hill). Within the ASA, where the route will cross Stroan Hill, are the ruins of a post medieval farmstead and field system and remains of an earlier (medieval) township (MDG8225 & MDG8226) along with elements of earlier land-use, such as small groups of clearance cairns and a prehistoric burnt mound.  The remains form a well-preserved archaeological landscape that has considerable time-depth and are recorded as being of national importance in the D&G Council HER. Although the OHL would cross the ASA it would be on the edge of the ASA and away from the nationally important cultural heritage remains in a less sensitive part of the ASA, removing any potential direct effect on the upstanding archaeological remains. The presence of the OHL crossing the ASA would likely result in a significant effect on the setting of both the ASA and the nationally important settlement remains.  There is one additional ASA, Loch Mannoich, within 2km of the OHL Here the OHL would be present to the north/east of the ASA partially passing through an area of commercial forestry. The proposed route would be principally screened from the ASA by intervening topography and would therefore not adversely affect the setting of the ASA.
	<b>Garden and Designed Landscapes and Non-Inventory Designated Landscapes</b>	The UGC will pass within 2 km of 14 NIDLs, including Garroch, Glenlee Park, Holme, Kenmure Castle, Hensol House, Airds (of Parton), Parton House, Barwhillanty, Danevale Park, Culgruff, Greenlaw, Balmaghie House, Argrennan House and Cumstoun House.  The UGC will pass through Balmaghie House NIDL, however the UGC is within the public highway at this location and would not affect the asset.	Within 2 km of the OHL there are nine NIDLs. These include, Garroch, Glenlee Park, Kenmure Castle, Slogarie, Laurieston Hall, Hensol House, Dildawn, Argrennan House and Cumstoun House.  Seven of these NIDLs, Kenmure Castle, Garroch and Glenlee Park, Slogarie, Hensol House, Laurieston Hall and Argrennan House have been raised as sensitive assets by the D&G Council in relation to the potential effect on their settings. It is considered that the setting of the NIDLs would not be adversely affected by the proposals.
<b>Forestry and Woodland</b>	<b>Ancient Woodland (AWI) Native Woodland (NWSS) Forestry (NFI)</b>	The route follows a small section of the A762 before following the line of the A713 south along the eastern banks for Loch Ken. To the south of Loch Ken the route will pass through a small section of NWSS and NFI at Barony Isle. As the route turns south west, it runs along the farm access track, thus avoiding an area of AWI and NFI at Balmaghie Bridge.	The northerly section of UGC will pass through substantial forestry comprising the eastern extents of the Galloway Forest Park made up of predominantly commercial forestry but will also intersect areas of AWI, NWSS and NFI particularly to the west of Cairn Edward Hill. Significant felling of areas of both NWSS and NFI would be required, while areas of AWI to the north of Stroan Loch are avoided.



Criterion	Sub-Criteria	UGC6E	OHL Option
		<p>At its southern extent the route skirts an area of AWI adjacent to Argrennan Cottages.</p> <p>The reactive compensation compound at Kendoon is proposed in an area of ancient woodland. None of the other locations of the reactive compensation compounds are located in woodland or forestry.</p>	<p>To the south of Stroan Loch the OHL will pass through Laurieston Forest, again, a substantial area of forestry made up of predominantly commercial forestry but will also intersect areas of AWI, NWSS and NFI. The OHL will cross areas of both NWSS and AWI to the east of Lochenbreck Loch on the southern flanks of Kenick Hill.</p> <p>South of the Laurieston Frost the OHL intersects several smaller areas of woodland, including the northern flanks of Whirstone Hill, avoiding areas of both NWSS and AWI in these areas.</p> <p>An additional area of woodland felling is required either side of the OHL wayleave on the north-western flanks of Peal Hill identified as being at risk of wind throw. Additionally areas of woodland felling are required either side of the OHL wayleave within Galloway Forest park including the east of Hind Craig Hill, to the east of Cairn Edward Hill and to the east of Stroan loch. Substantial additional felling for windthrow is also required east of Slogarie Hill. Further to the south two areas of windthrow felling is required to the south of Bargatton loch. Areas of forestry lost due to windthrow will be restocked in line with the exercise of powers in the Forestry and Land Management (Scotland) Act 2018 and associated regulations.</p>
<b>Flood Risk</b>	<b>Flood Zones and Waterbodies</b>	<p>The route will cross four areas within the 1/200yr and 1/1000yr flood risk zones (two to the immediate south east of Glenlee substation (Coom Burn and the Water of Ken); and two to the north of Longwood (Black Bridge Burn).</p> <p>The reactive compensation compounds at Kendoon and Glenlee are located within the 1/200yr and 1/1000yr flood risk zones.</p> <p>The reactive compensation compounds at Newton Stewart, Glenluce and Tongland are not proposed in locations at risk of flooding.</p>	<p>The OHL will cross three areas within the 1/200yr and 1/1000yr flood risk zones, one to the immediate south-west of Glenlee substation (Coom Burn), one to the south of Glenlee (an unnamed burn which meets Coom Burn) and one to the north of Peal Hill (Knocknairling Burn). These flood risk zones cannot be avoided during routeing; however none of these are wider than the average span length of 250m and so can be easily spanned.</p> <p>The OHL will cross two areas within the 1/200yr flood risk zone (one to the south-west of Mossdale – the River Dee, and one within the Laurieston Forest, the Kenich Burn). These flood risk zones cannot be avoided during routeing; however they are not wider than the average span length of 250m and so can be easily spanned.</p>
<b>Environmental Summary</b>	<p>The UGC is approximately 5.1 km longer than the UGC as it follows the route of the existing A713 to the east of Loch Ken for much of its length.</p> <p>The OHL will cross two areas of Class 1 SNH Priority Peatland Habitat. The UGC is not located within peatland habitat.</p> <p>No significant effects on the LCTs will occur during operation of the UGC following restoration of any construction related disturbance which arise. The OHL will result in significant effects on LCTs, extending to localised areas of the host LCTs, and similar in extent to that of the existing OHL route (R Route) at the southern extents of the proposed OHL route. However, significant effects on the host LCTs as whole will not arise.</p> <p>No long term significant visual effects are anticipated during operation of the UGC. Significant localised visual effects are anticipated to occur along the southern section of the OHL, however these will largely be within the extents of the effects arising in relation to the existing R Route. No effects on residential visual amenity will occur during operation of the UGC following the completion of construction and restoration works. Although in close proximity to a number of residential receptors, in particular at its southern extent, significant effects are not likely to occur as a result of the OHL which closely follows the alignment of the existing R Route.</p> <p>Both the UGC and OHL will cross multiple tourist and recreational routes. For the OHL there is the potential to span Core Paths and recreational routes at these locations.</p> <p>No archaeological or cultural heritage features would be directly affected by the cable UGC. The OHL will cross the eastern extent of Grobdale ASA (at Stroan Hill) resulting in a minor impact on the setting of both the ASA and the nationally important settlement remains. The OHL will result in a minor adverse effect on the setting of Bargatton Farm cairn Scheduled Monument.</p> <p>The UGC will require forest felling, however this can be reduced through utilising existing wayleaves and forest breaks, in particular those formed by the A713 to the east of Loch Ken. Significant felling will be required for the OHL, in particular where the OHL is routed through the Galloway Forest Park and Lauriston forest, impacting areas of both NWSS and AWI.</p> <p>The UGC will cross fewer area within the 1/200yr and 1/1000yr flood risk zones.</p>		

Criterion	Sub-Criteria	UGC6E	OHL Option
	<p><b>On balance the environmental preference between Glenlee and Tongland is the UGC option. As well as reducing effects on landscape, visual and residential amenity the UGC would have a lesser impact on surrounding cultural heritage features, including the setting of surrounding Scheduled Monuments and ASA. Furthermore, substantially less felling will be required for the UGC than the OHL.</b></p>		
<b>Technical Appraisal</b>	<p>In order to provide the same capability as the OHL system, that is a summer rating of 735Amps and a winter rating of 865Amps for each 132kV circuit, each UGC circuit will need to consist of a single cables per phase and in a three-phase system this means 3 cables in total for each circuit. Hence to establish the same required capacity as the OHL system a total of 6 cables are needed.</p> <p>The UGC6 cable route starts at Glenlee substation heading south along the A762, before turning east and crossing the Water of Ken at Meikle Isle, then continues south following the A713 down the east side of Loch Ken. The cable route follows the A713 south to Crossmichael and once through the town it turns west, passing around the Mains of Greenlaw, to cross the River Dee at Barony Isle. The cable route continues heading southwest following several country lanes south of Glenlochar, before following the existing overhead line route over the A75. Once south of the A75 the cable route continues along the line of the existing OHL route before sweeping west towards Castle Hill to take a more gradual incline into Tongland substation from the south west, thus avoiding the steeper incline into Tongland substation to the north.</p> <p>A ducted cable installation of 21.19km in carriageway, and 16.40 km in arable/pastoral land would be required. The installation of cables in carriageway and verge would require temporary lane closures and traffic management. Regions of steep incline would require cable anchoring systems to avoid unwanted cable movement in service. Where cables are off-road and/or existing tracks may not be used then haul/access roads would be required (15.70km estimated). The cable route will pass through the settlements of Glenlee, Crossmichael and Townhead of Greenlaw and would be likely to cause some disruption due to road narrowing, loss of parking, traffic management, noise, construction hazard mitigations and risk to existing services during carriageway works. Engineering difficulties which would require attention include the water crossings beneath the Water of Ken at Meikle Isle and a second crossing at Barony Isle. It has been observed that high pressure gas pipelines are installed in the southern area of the route and that some route realignment may be necessary to avoid unnecessary repeat crossings of the pipelines once their full detailed routeing has been confirmed by the pipeline owner/operator. The cable installation would pass through a number of flood zone risk (1 in 200 year) areas from the Water of Ken and other burns; some seasonal working may be necessary. There is a risk of rock beneath a thin soil covering resulting in slow installation progress at increased cost. Cables would terminate onto cable sealing ends located within the substation compounds at either end of the route.</p> <p>A cable system also has different characteristics from an OHL system and long cable routes tend to increase system voltage especially when the network is lightly loaded. High system voltage has an impact on system security and quality of supplies and potentially could damage equipment. SPEN has a license obligation to maintain system voltage within defined limits and often with long cable routes additional equipment is required (normally termed as reactive compensation) to maintain system voltage within the standard limits. In this option reactive compensation will be required at our substations in Glenlee, Newton Stewart, Glenluce and Tongland. All substations will need to be extended to accommodate the additional equipment.</p>		<p>The proposed overhead line will consist of new L4m towers strung with 1x250mm<sup>2</sup> AAAC "Sycamore" phase conductors (conductor operating temperature 65°C) and 1x160mm<sup>2</sup> Keziah equivalent OPGW earth conductors.</p> <p>The proposed overhead line will consist of 32.4km of new build L4 towers and 1.3km of the existing BG overhead line route which will be repurposed to carry both circuits before joining on to the new L4 overhead line west of Glenlee. The overhead line will carry two 132kV circuits, a circuit on each side of the tower. A circuit consists of three phases with each phase strung with a single conductor. Hence in total the tower will carry three conductor on each side (total of 6 wires) and an earth wire between tower peaks strung with single phase conductors (6 wires) and an equivalent optical phase ground wire (OPGW) earth conductor between tower peaks. The route will consist of 121 towers with an average span length between towers of 280m with the average tower height being 30 meters.</p> <p>This solution will provide a summer rating of 735Amps and a winter rating of 865Amps for each circuit. This is based on a single SYCAMORE conductor (1x250mm<sup>2</sup>) per phase operating at 65°C.</p> <p>This solution will provide a rating of Pre-Fault Continuous - Summer: 141MVA / Spring/Autumn: 157MVA / Winter: 166MVA &amp; OHL Ratings Post-Fault Continuous - Summer: 168MVA / Spring/Autumn: 186MVA / Winter: 198MVA</p> <p>This section will run from towers GT001 to GT120 between Glenlee &amp; Tongland.</p> <p>The proposed overhead line route traverses mainly through the forest estate. The line crosses over various forestry roads/ track, roads, rivers and distribution overhead lines. During the wiring works conductors required to over-sail obstacles would require specific mitigation such as temporary lane closures, traffic management &amp; potential distribution outages (further detail on the technical factors surrounding the OHL can be found in chapter 5 of the EIA report further detail on this can be found in chapter 5 of the EIA report).</p>
<b>Economic Appraisal</b>	<p>Underground cabling double circuit, one cable per phase, route length of 37.59km gives an estimated total installed costs of £126.97 M with a per kilometre cost of £3.38 M/km.</p>		<p>A new L4 double circuit tower line (including 1.3km of repurposed BG route), single wires per phase, route length of 33.7km gives an estimated total installed cost of £31.01 M with a per kilometre cost of £0.92 M/km.</p>
<b>Conclusions</b>	<p>The appraisal found that the overall environmental benefits that would be experienced from an underground cable, in comparison with an overhead line, would be a reduction on effects on landscape, visual and residential amenity the UGC would have a lesser impact on surrounding cultural heritage features. Furthermore, substantially less felling will be required for the UGC than the OHL.</p> <p>The appraisal also found that the UGC 6 would be technically feasible although specific difficulties might be encountered in relation to water course crossings, crossing of existing high pressure gas pipelines (in the vicinity of the A75) and shallow bedrock. Traffic management and lane closures on the public road network would also be required and works through the settlements of Glenlee, Crossmichael and Townhead of Greenlaw would also cause significant disruption due to road narrowing, loss of parking and construction noise.</p> <p>The economic appraisal outlined above shows that the costs of an underground cable in this section would be 4.09 times greater than the proposed overhead line route with the projected cable cost being £126.97M and overhead line cost of £31.01M. This represents an overall projected difference in cost of <b>£95.96M</b>.</p> <p><b>In consideration of the above, SPEN's preference, by virtue of the economic impact, is to progress with an overhead line option between Glenlee and Tongland substations. Nevertheless, UGC6E does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less</b></p>		

Criterion	Sub-Criteria	UGC6E	OHL Option
			<p>efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.</p> <p>Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project<sup>16</sup> which is:</p> <p><i>"To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it."</i></p> <p>SPEN believe that proceeding with an overhead line solution between Glenlee and Tongland substations is a conclusion which remains consistent with the overall KTR routeing objective.</p>

<sup>16</sup> Refer to SPEN's Routeing and Consultation documents at [www.spendgsr.co.uk](http://www.spendgsr.co.uk)