

The Kendoon to Tongland 132kV Reinforcement Project

Underground cable study summary report

Appendix 1

July 2020

Appendix 1: Kendoon - Tongland 132kV Preliminary Investigative Cable Route Study

CCI Cable Con PO Box 1, Sevenoaks TN. United Kingdom	<i>sulting International Ltd</i> 14 7EN Engineering Study ER1003 C 14 th April 2020
TITLE:	Kendoon – Tongland 132kV Preliminary Investigative Cable Route Study
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Summary

This study sets out preliminary investigative cable routes and provides CCI's cable route preference for each part of the Kendoon – Tongland 132kV reinforcement cable study.

The cable sections covered include:

- UGC1 Polquhanity Kendoon Substation (Tower No.'s N230 PK10)
- UGC2 Kendoon Substation Glenlee Substation (PK10 PK33)
- UGC3 Queen's Way Crossing (Tower No.'s GT08 GT21)
- UGC4 Bennan, Slogarie and Laurieston Forests (Tower No.'s GT25 GT78)
- UGC5 A75 Crossing (Tower No.'s GT97 GT104)
- UGC6 Glenlee substation Tongland Substation (Tower No.'s GT001 GT120)

This optioneering assessment of the cable routes combines site survey work conducted between 11th - 15th November 2018 with desktop analyses.

For each of the six underground cable studies, schematic route options are presented along with a brief overview of the key routing decisions, points of engineering difficulty and environmental sensitivity along the route, approximate route length comparisons, a route key plan to enable identification of the routing options and CCI's cable route preference.

SPEN required that, based on the findings and recommendations made by CCI and LUC (its environmental consultants), preferred cable routes for each of the 6 cable study areas (UGC1 to UGC6) be agreed between SPEN, LUC and CCI, with conclusions summarising these recommendations given. This report provides CCI's preferred cable

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route options, taking into account SPEN's technical criteria (subsequently expanded by CCI) and environmental feedback from LUC.

Document Revision Record

Document Revision	Date of Issue	Revision Description				
1 st Draft	06.12.2018	First draft issued for LUC and SPEN comment				
Rev A	20.03.2019	Revision incorporating findings from LUC				
		cable route assessment dated February 2019.				
Rev B	02.07.2019	Final revision including additional UGC2 and				
		UGC4 cable routes and incorporating LUC				
		cable route assessment and conclusions on				
		agreed UGC routes dated June 2019.				
Rev C	14.04.2020	Addition of a confidential appendix in				
		accordance with European Protected Species				
		(EPS) requirements.				

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1 Introduction

This study sets out preliminary investigative cable routes and provides CCI's cable route preference for each part of the Kendoon – Tongland 132kV reinforcement cable study. The recommendations provided by CCI take into account SPEN's technical criteria (subsequently expanded by CCI) and environmental feedback from LUC. A summary explanation of key decisions made in selecting the preliminary cable routes is given along with route schematics, provisional points of engineering difficulty, environmental sensitivity, and CCI's cable routes of preference.

The sections of the overhead line route considered for undergrounding included within this cable study were prescribed by SPEN in the Kendoon to Tongland Reinforcement (KTR) Cable Study briefing document dated 8th November 2018. SPEN requested on 12th April 2019 that CCI also look at the connection between Kendoon substation and Glenlee substation.

This study describes CCI's preliminary investigative assessment and CCI's cable route preference for each part of the Kendoon – Tongland 132kV reinforcement scheme, utilising site survey work and desktop analyses performed.

A site survey was undertaken between 11th - 15th November 2018 and served to both familiarise CCI with the routes and inform SPEN / Land Use Consultants (LUC) of the preliminary underground cable route options considered by CCI. As the site survey work was conducted shortly after contract award to take advantage of the weather conditions, access to some parts of the cable routes was not available, consequently the survey focused mainly on cable routing options that were accessible by public roads and those where access had been obtained from landowners.

The desktop analysis enabled those parts of the cable routes which were not accessible during the site survey to be reviewed using mapping and other software tools. Desktop investigation also assisted with routing analysis made during the onsite survey, by allowing routing options to be compared with environmental and other geological considerations available within maps provided by SPEN and available within the software. Consideration of UGC2, UGC4C and the undergrounding of sections within the overhead line (OHL) wayleave is primarily based on desktop analysis.

2 Cable Route Nomenclature

To effectively manage the number of cable routing options under consideration, CCI has developed a cable route nomenclature system.

Each section of the proposed overhead line route being considered for undergrounding and cable routes being investigated have been given unique identification numbers. Three key plans have been developed, one for the cable route options between Polquhanity and Kendoon substation. One for the cable route options between Kendoon substation and Glenlee substation, and one for the cable route options between Glenlee and Tongland substations. Refer to Figure 1, Figure 2 and Figure 3 respectively.

Figure 1 – Key plan between tower N230 at Polquhanity and Kendoon substation



Each section of either the OHL route and identified cable route has been given its own unique reference number and letter, with the letter reference defined as follows:

- Number Prefix P defines a way point of route option divergence
- Number Suffix C defines an underground cable section along a cable wayleave
- Number Suffix U defines an underground cable section along an OHL wayleave
- Number Suffix A defines an aerial OHL section

From Figure 1, three potential cable route options have been identified between Polquhanity and Kendoon substation and these are given in Table 1.

UGC	Study	Route	Section Description	Tower
Number	Number	Section ID		Numbers
	UGC1A	1C+4C	Cable route	N230 - S/S
Ç1	UGC1B	1C+3C+6A	Cable route with OHL into	N230 – PK10
D D			Kendoon substation	
-	UGC1C	2U+5U	Undergrounding proposed	N230 - S/S
			OHL route within its wayleave	

Table 1 - Cable rou	ites and their asso	ociated identification	number for UGC1
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From Figure 2, three potential cable route options between Kendoon substation and Glenlee substation have been identified and are given in Table 2.



Glenlee S/S

Figure 2 – Key plan between Kendoon substation and Glenlee substation

Table 2 - Cable routes and their associated identi	ification number for UGC2
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UGC	Study	Route Section ID	Route Description	Tower
Number	Number			Numbers
	UGC2A	40C+42C+45C	Cable route	S/S -S/S
	UGC2B	6A+38C+42C+43C+46A	Cable route with OHL into	PK10 –
2			Kendoon and Glenlee	PK33
U U U U U			substations	
D	UGC2C	5U+41U+44U	Undergrounding of	S/S -S/S
			proposed OHL route within	
			its wayleave	

The undergrounding of a single circuit between Polquhanity and Glenlee substation requires a section of cable to be installed connecting section 1C and 42C. For Section 39C refer to Section 4.1.2 of this study.



Figure 3 – Key plan between Glenlee and Tongland substations

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From Figure 3, potential cable route options between Glenlee and Tongland have been identified and are given in Table 3.

UGC	Study	Route	Route Description	Tower
Number	Number	Section ID	_	Numbers
33	UGC3A	11C+14C	Queen's Way Crossing – Cable route	
nga	UGC3B	10U	Queen's Way Crossing – cabling	GT08-GT21
	UGC4A	19C	Bennan, Slogarie and Laurieston	
			Forests – Cable route option.	
UGC4	UGC4B	18U	Bennan, Slogarie and Laurieston Forests – cabling within OHL wayleave.	GT25 – GT74
	UGC4C	36C	Bennan, Slogarie and Laurieston Forests – cabling within A762.	GT25 – GT78
35	UGC5A	26C+28C	A75 Crossing – Cable route option.	
UGC	UGC5B	27U+29U	A75 Crossing – cabling within OHL wayleave.	GT97 – GT104
	UGC6A	9C+12C+16 C+22C+30C +33C	Following the access road from Glenlee substation, down the west side of Loch Ken on the A762*, all the way south and into Tongland substation.	S/S -S/S
92	UGC6B	8C+11C+13 C+16C+22C +30C+33C	Following the existing overhead line route from Glenlee substation, over the Queen's way crossing before joining the A762 at Burnfoot bridge and continuing down the west side of Loch Ken, following the A762 all the way into Tongland substation.	S/S -S/S
NGC	UGC6C	9C+12C+16 C+22C+25C +28C+31C+ 32C+33C	Following the access road from Glenlee substation, down the west side of Loch Ken on the A762*, before diverting east at Ringford, following the existing overhead line route over the A75, before following A762 into Tongland substation.	S/S -S/S
	UGC6D	9C+17C+23 C+26C+28C +31C+34C	Following the access road from Glenlee substation, down the east side of Loch Ken on the A713, following the existing overhead line route over the A75 and into Tongland substation.	S/S -S/S

Table 3 - Cable routes and their associated identification number for UGC3 to UGC6

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UGC	Study	Route	Route Description	Tower
Number	Number	Section ID		Numbers
	UGC6E	9C+17C+23	Following the access road from	S/S -S/S
		C+26C+28C	Glenlee substation, down the east side	
		+31C+32C+	of Loch Ken on the A713, following	
		33C	the existing overhead line route over	
			the A75, before following A762 into	
			Tongland substation.	

3 Identification and Evaluation of Underground Cable Route Options

In November 2018, SPEN published a document confirming its intention to undertake an appraisal of underground cable options. The document is included in Appendix 1 of this study. The document sets out a range of criteria which may be included in identifying cable routes. The criteria were as detailed in number 1-11 below :

- 1. Safety and reliability
- 2. Constructability
- 3. Suitable locations for transition between OHL and cable
- 4. Ease of access for construction and future circuit maintenance
- 5. Impact on local environment during construction and ability to mitigate this
- 6. Ground conditions, including risk of contamination and ground stability
- 7. Need to cross wet areas and/or habitats that are difficult to reinstate.
- 8. Flood risk, proximity to water supplies and ability to cross watercourses at their narrowest point.
- 9. Long term visibility of cable routes post construction, including the length that will be seen and distances at which cable routes will be visible.
- 10. Long term loss of landscape features such as hedges or trees
- 11. Long term impact on known and unknown archaeology

The following are typical additional criteria that CCI consider when selecting a cable route:

- 12. Topographical and geological features
- 13. Access for both the construction phase and future maintenance of a project
- 14. Crossing positions at watercourses, access, ground suitability and elevational alignment

LUC provided the following information:

- 15. GIS mapping, including areas of highest environmental value and high level constraints information, was made available to CCI Ltd by LUC to assist with the identification of underground cable routes³.
- 16. Landscape and visual considerations were also taken into account, informed by the work undertaken by LUC as part of the OHL routeing and consultation process (refer to Appendix 2).

SPEN provided additional criteria to be considered as per the following:

- 17. Reference should be made to the potential requirement for cable sealing end compounds (effectively fenced substation areas) being required on the UGC1 route OHL/cable transitions at L7 towers N230 and PK10. This is due to the requirement for 2 cables per phase being required to accommodate the OHL circuit rating.
- 18. It is also noted that Glenlee to Tongland route options (UGC2, 3, 4 and 5) can accommodate sealing ends on the L4 towers themselves.
- 19. Consideration should be given to the requirement for future vehicular access (suitable for a works van e.g. Road going 'Transit Van' light goods vehicle) to the 132kV cable joint and fibre cable joint locations.
- 20. Where transmission cables are intended to be run away from the public highway on or adjacent to forestry tracks, there is a requirement to ensure that the track will continue to be maintained for the life of the asset (40 years) to confirm that access to joint locations will always be available.
- 21. There is also a requirement to ensure that the cable installation route (within / adjacent to a forestry track) is not subject to risk of water washout and forestry ploughing/drainage machinery.

3.1 Limitations to this Preliminary Investigation

The following caveats are given to provide clarity of the limitations of this preliminary cable route investigation:

- HDD: Detailed engineering design relating to the precise drill location, launch and reception pit positions, drill profile, drill length, site compound locations and any specific wayleave requirements is not covered within this study.
- Utility Search: A detailed utility search has not been completed for inclusion within this study. Cable route optioneering within carriageways and other locations where potential existing utilities may be encountered has been based on previous cable installation experience, and where a site walkover has been completed, on any visible surface mounted infrastructure related to buried utilities.
- Forest track maintenance: For several of the cable route options identified within this study, there may be a requirement for permanent access tracks to allow maintenance access to the cable route. Sections of these access tracks utilise existing forest tracks that are currently used for management of commercial forest areas. The installation of cables within forestry roads (which are temporary in their nature) may not be appropriate due to the requirements of future maintenance and access requirements.
- Changes in elevation on cable routes: Where a cable route option follows a change in elevation, it is anticipated that significant additional design and installation work would be required to anchor the cable and prevent uncontrolled migration of the cable down a slope. The space requirement and other detailed engineering design work to allow for these elevational changes is not contained within this study.

• The assessment of the percentage of ground containing rock are based on a limited quantity of bore hole data extracted from a geotechnical report² provided by SPEN.

4 Underground Cable Route Options

For each of the underground cable studies listed in Table 1, Table 2 and Table 3, schematic route options are presented along with an overview of the key routing decisions, points of engineering difficulty along the route and approximate route length comparisons.

Each route has been assessed according to the criteria specified in Section 3 of this study and a route preference identified after consideration of all these criteria.

4.1 UGC1 Polquhanity – Kendoon Substation Cable Route Options

SPEN advised CCI that they had been asked to consider undergrounding as an alternative where this has been identified through pre-application consultation. As follows:

Between Polquhanity and Kendoon substation, the key issue which has been raised during consultation is to mitigate impacts on commercial forestry and on setting of cultural heritage features within Polmaddy forest.

Consistent with SPEN's transmission licence duties and environmental obligations under Schedule 9 of the Electricity Act 1989¹, cable routes will have to establish a balance between engineering requirements, economic viability, land use and the environment. SPEN's objective for cable routeing between Polquhanity and Kendoon substation is to "identify a technically feasible and economically viable cable route, between Polquhanity and Kendoon substation, which causes, on balance, the least disturbance to people and the environment".

As listed in Table 1, the following 3 cable route options were identified between Polquhanity and Kendoon substation:

- UGC1A Cable route
- UGC1B Cable route with a section of OHL into Kendoon substation
- UGC1C Undergrounding of the proposed OHL route within its wayleave

A further route was reviewed running north into Kendoon substation cutting through the Carse of Dundeugh. However, as this route passed through an area marked with several red squirrel exclusion zones, dissected an extensive area of native woodland and would require an additional crossing of the River of Ken, it was deemed unsuitable and has not been considered further in this study.

Table 4 contains the approximate route length comparisons for the three route options. It can be seen that the underground cable route options are within 10% of each other.

Cable Route	Route Description	Route Length (km)
UGC1A	Cable route	3.2
UGC1B	Cable route with OHL into Kendoon S/S	2.9 (UGC =
		2.37km and
		OHL = 0.53 km)
UGC1C	Undergrounding proposed OHL route	2.9
N230 – Kendoon S/S	Straight line distance	2.3

Table 4 – Approximate route length comparisons for Polquhanity – Kendoon

4.1.1 UGC1 Polquhanity – Kendoon Substation Current Rating and Circuit Details

The cable routing options considered under UGC1 require a continuous current rating of 2010A to be transmitted through each of the two cable circuits, with one connecting tower N230 to Kendoon substation and the second connecting N230 to Glenlee substation. Refer to Figure 4 which shows a simplified schematic of the electrical connection arrangement as issued by SPEN.

To deliver this magnitude of current, it is calculated that at least two cables per phase will be required for each circuit. The total number of cables required would therefore be 12 (6 per circuit). Consideration must also be given to the number of cable sealing ends required at terminal positions. To accommodate the 12 terminations required a cable sealing end compound will be necessary at the Polquhanity end of the route where the two circuits terminate.

It has been assumed for the purposes of this study that both circuits would be installed in the same manner, either by underground cabling or OHL. Sections that cover routing the cables into Kendoon substation (sections 4C, 5U and 6A) will be for consideration of two circuits, that is 12 cables and 12 termination positions.



Figure 4 – Electrical schematic for Tower N230 at Polquhanity, Kendoon substation and Glenlee substation



4.1.2 Section 39C

The single circuit between Polquhanity and Glenlee substation has not been considered as an individual cable study, as the individual sections of this route are covered within either UGC1 and/or UGC2 studies.

The only exception to this is section 39C. A short single circuit section, approximately 450m long, that runs along the A713, between way points P1 and P18. Refer to Figure 5. Figure 6 shows section 39C marked as a black line on a map. Installation costs associated with section 39C will need to be included within the bill of quantities for UGC1 and UGC2 for completeness.



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Figure 5 – Key plan with red line showing section 39C





4.1.3 UGC1 Polquhanity – Kendoon Substation Geotechnical Review

From a review of a geotechnical report² provided by SPEN, the underlying rock formation for UGC1 is Wacke. The superficial geology varies along the route from clay, sand and silt, sand and gravel, and peat habitats up to 1.1m deep. The geological description of Wacke within UGC1 describes sandstone with bed thickness from 0.3m to more than 5m with occasional out crops.

Superficial geology refers to geological deposits typically of the Quaternary age which extends back about 2.6 million years. These deposits rest on the underlying rock, often referred to as bedrock.

Considering the OHL wayleave for UGC1, it can be calculated that some superficial geology will be present for approximately 80% of the route, with the remaining 20% containing none. Where the superficial geology layer is shallow or non-existent, a different approach for cable installation may be required. For example, where shallow rock is not able to be broken up and dug out using a bucket on a backhoe excavator.

4.1.4 Polquhanity – Kendoon Substation Route Option UGC1A

Figure 7 shows the key plan for Polquhanity – Kendoon substation, with cable route option UGC1A (1C+4C) shown in red.

Figure 7 – Key plan with red line showing cable route UGC1A



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Cable route UGC1A in Figure 9, shown as a black line, runs from north to south, from the Polquhanity area where OHL tower N230 is located, south to Kendoon substation which sits alongside Kendoon Power Station. The A713 carriageway offered a routing option between Polquhanity and Kendoon substation. This is due to the areas of peat, dense forest and undulating topography either side of the roadway.

The closing section into Kendoon substation presents challenges with the route selected to avoid existing hydroelectric infrastructure associated with the Power Station, and residential housing. Kendoon substation is positioned at the confluence of the Water of Ken and the Water of Deugh and is not directly accessible by an underground cable route from either the north, or the west, due to lack of space and rock formations. Refer to Figure 8, a photograph showing the rock riverbanks of the Water of Deugh, north of Kendoon Substation.



Figure 8 – Photograph showing the Water of Deugh north of Kendoon substation

An additional implication of undergrounding along 4C would in practice require the undergrounding of the cable section into Kendoon of UGC2 along either 40C or section 5U, refer to report section 4.2.3 and 4.2.5 respectively.

Where the cable is laid in the road, it is envisaged that the cable route would be installed in one carriageway at a time with the other carriageway kept open for traffic. Joint bays would be positioned in the verge or in laybys wherever reasonably practicable. The existing services within the road are largely unknown.

A review of the cable route option UGC1A was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the cable route were proposed by LUC with regards to environmental features, sensitivities or impacts.

Table 5 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on the cable schematic in Figure 9. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Peat	Adjacent to terminal tower N230 the ground was noted to
		contain peat. Peat ground preparation work may be required.
		This may also impact on cable conductor material and size.
2	HV cable crossing	The UGC1A cable circuit will be required to cross an
	_	existing HV cable circuit located within the A713.
3	Cabling within	Cables to be installed within A713, appropriate traffic
	A713	management plan would need to be developed and adopted.
		With joints and link equipment located in the verge where
		practicable.
4	Polmaddy river	River crossing at Polmaddy, HDD, cable bridge or within
	crossing	the existing road bridge bed. Directly adjacent to the
	C	Polmaddy bridge is a medium flood risk zone (1 in 200
		years).
5	Peat	Peat habitats between A713 and the Water of Ken river
		crossing. Peat ground preparation work may be required.
		This may also impact on cable conductor material and size.
6	Water of Ken	Water of Ken crossing adjacent to Kendoon substation,
	crossing	HDD across the river positioned in peat ground would be
	-	required. Directly adjacent to the Water of Ken is a medium
		flood risk zone (1 in 200 years).

Table 5 – Key points of engineering difficulty and environmental sensitivity for UGC1A

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Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
7	Entry to Kendoon	Peat habitats, native woodland areas, the existing
	Substation	hydroelectrical scheme and multiple residential properties
		restricting cable route options. There is also a steep
		elevational change and shallow rock associated with the
		banks of the Water of Ken into Kendoon substation. Space
		and access is so restricted that such entry is unlikely to be
		possible for 12 cables (including UGC2). Relocation of the
		substation may be required for this option. Significant
		relocation of existing infrastructure such as substation
		compounds is not considered viable.





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4.1.5 Polquhanity – Kendoon Substation Route Option UGC1B

This route follows the same as that covered in Section 4.1.4, with the exception that it diverts from the A713 to terminate at the proposed new tower PK10, with the closing section into Kendoon substation being OHL. Figure 10 shows the key plan for Polquhanity – Kendoon substation with cable route option UGC1B (1C+3C+6A) shown in red.





It should be noted that route undergrounding option UGC1B does not fully underground the entire route, as the closing section into Kendoon substation is still installed as an OHL.

The use of section 6A as an OHL from PK10 into Kendoon substation would in practice mean the use of section 6A for UGC2. Refer to Section 4.2.4.

Advantages of this route option is that it negates the points of engineering difficulty associated with crossing the Water of Ken and entry into Kendoon substation, as outlined in section 4.1.4 in Table 5 and Figure 7.

However, a cable termination position comprising a cable sealing end compound would be required at the PK10 tower position, the approximate dimensions of which are 24.3m x 15m per circuit. A cable termination position constructed at PK10 is likely to be on a

banked position visible from the A713 and would therefore necessitate civil works to construct. Access to a potential termination position would likely be reasonable with the A713 close by. Any loss of visual amenity associated with this tower position has been assessed by LUC, refer to Appendix 2.

Where the cable is laid in the road, it is envisaged that the cable route would be installed in one carriageway at a time with the other carriageway kept open for traffic. Joint bays would be positioned in the verge or in laybys wherever reasonably practicable. The existing services within the road are largely unknown.

A review of the cable route option UGC1B was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the cable route were proposed by LUC with regards to environmental features, sensitivities or impacts.

Table 6 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on the cable schematic in Figure 11.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Peat	Adjacent to terminal tower N230 the ground was noted to contain peat. Peat ground preparation work may be required. This may also impact on cable conductor material and size.
2	HV cable	The UGC1B cable circuit will be required to cross an
	crossing	existing HV cable circuit located within the A713.
3	Cabling within	Cable to be installed within A713, appropriate traffic
	A713	management plan would need to be developed and adopted.
		With joints and link equipment located in the verge where
1	Dolmoddy river	Diver crossing at Dolmoddy, HDD, ashla bridge or within
4	ronnaddy niver	the existing read bridge had Directly adjacent to the
	crossing	Polmaddy bridge is a madium flood risk zone (1 in 200
		years).
5	Terminal tower	Civil engineering difficulties associated with the construction of a cable termination position at PK10 and any loss of visual amenity as assessed by LUC, refer to
		Appendix 2.

Table 6 – Key points of engineering difficulty and environmental sensitivity for UGC1B



Figure 11 – Black line showing cable route UGC1B

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4.1.6 Polquhanity – Kendoon Substation Route Option UGC1C

For this cable route, the proposed OHL route from Polquhanity to Kendoon substation was followed. Figure 12 shows the key plan for Polquhanity – Kendoon substation with cable route option UGC1C (2U+5U) shown in red.





Cable route UGC1C in Figure 13, shown as a black line, runs north to south, from Polquhanity where OHL tower N230 is located to Kendoon substation. The cable route follows the proposed OHL wayleave south from tower N230, along a corridor of peat set in forest south to Sloan's Cairn, before crossing Polmaddy River west of the A713. From here the route continues with dense forest before turning east, crossing the Water of Ken and entering Kendoon substation.

This proposed cable route contains more points of engineering difficulty than the other route options investigated within this study for UGC1. There would be a requirement for a permanent access road to allow construction and maintenance access to the cable route along its entire length. A-road access points for the maintenance and haul road would also be required. The installation of cables within forestry roads (which are temporary in their nature) may not be appropriate due to the requirements of future maintenance and access requirements.

A review of the cable route option UGC1C was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts by LUC.

Table 7 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on the cable schematic in Figure 13. Confidential data on the locations of European protected species is provided in confidential ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Table 7 – Key points of engineering difficulty and environmental sensitivity for UGC1C

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Peat	Adjacent to terminal tower N230 the ground was noted to
		contain peat. Peat ground preparation work may be
		and size.
2	Burn Crossing	HDD or dam and pump over crossing of burns and any
	6	associated tributaries adjacent to Barlae hill would be
		required.
3	Dense woodland	Tree and stump clearing works associated with installing
		cable through dense woodland would be required; access
		roads would need to be constructed during the installation
		and for future maintenance.
4	Peat	A corridor of peat has been running parallel to the proposed
		OHL route adjacent to Sloan's Cairn. Peat ground
		preparation work may be required. This may also impact
5	Dolmoddy miyon	Diver eressing at Palmoddy, UDD or solla bridge solution
3	Polmaddy river	kiver crossing at Polmaddy, HDD or cable bridge solution would be required. Directly adjacent to the Polmaddy river
	crossing	is a medium flood risk zone (1 in 200 years) Due
		consideration of the close proximity to the otter exclusion
		zone noted to the west of the route.
6	Dense woodland	Tree and stump clearing works would be required when
		cabling through dense woodland, temporary access roads
		would need to be constructed during the installation and for
		future maintenance.
7	Peat	Peat habitats within land west of the water of Ken. Peat
		ground preparation work may be required. This may also
		impact on cable conductor material and size.
8	Water of Ken	Water of Ken crossing adjacent to Kendoon substation, an
	crossing	HDD across the river positioned in peat ground would be

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Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		required. With location of the launch and reception pits and
		access for the drilling rigs to be developed. Directly
		adjacent to the Water of Ken is a medium flood risk zone
		(1 in 200 years).
9	Entry to Kendoon	Peat habitats, native woodland areas, the existing
	Substation	hydroelectrical scheme and multiple residential properties
		restricting cable route options. There is also a steep
		elevational change and shallow rock associated with the
		banks of the Water of Ken into Kendoon substation. Space
		and access is so restricted that such entry is unlikely to be
		possible for 12 cables (including UGC2). Relocation of the
		substation may be required for this option, but this has not
		been considered as it is beyond the scope of this study.
		However, significant relocation of existing infrastructure
		such as substation compounds would be expected to cause
		significant local disruption and incur substantial cost.





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4.1.7 UGC1 Polquhanity – Kendoon Substation Route Appraisal Summary

Three cable route options have been studied for undergrounding between tower N230 at Polquhanity and Kendoon substation. The cable route studies have been based on the 21 criteria defined within section 3 of this study.

Installation of a cable route within the A713 carriageway provides a solid and reliable installation base when compared to installing cable within forest and peat habitats and offers the best solution from a constructability perspective. Working in the carriageway does introduce a risk to the workforce associated with moving traffic, but this risk can be managed with an effective traffic management system.

LUC maps³ provided to CCI show environmental features located on the proposed OHL wayleave. The A713 passes in close proximity to several dwellings and through 1 in 200 year flood risk zones. As the cable installation work is temporary and the carriageway construct contains an integrated drainage system these risks were more manageable.

From a review of a geotechnical report² provided by SPEN, the underlying rock formation for UGC1 is Wacke. The superficial geology varies along the route from clay, sand and silt, sand and gravel, and peat habitats up to 1.1m deep. Considering the OHL wayleave for UGC1, it can be calculated that some superficial geology will be present for approximately 80% of the route, with the remaining 20% containing none.

Installing up to 12 HV cables is likely to prove challenging within the A713 carriageway and diverting to utilise space that could be provided within the carriageway verge would need to be considered if buried services were encountered.

Cabling into Kendoon substation provides multiple points of engineering difficulty including peat habitats, river crossings, shallow rock and elevational changes. Therefore, a solution that avoids cabling into Kendoon substation would be beneficial. Due to the limitations on space within the existing Kendoon substation site and within the potential access corridors suitable for underground cable installation, a wider engineering study may need to be considered. This wider study could consider relocation of Kendoon substation to a more accessible location and/or the construction of a forced ventilated underground tunnel and associated access shafts. Significant relocation of existing infrastructure such as substation compounds is not considered as it is beyond the scope of this study. However, such a proposal would be likely to cause significant local disruption and be at significant cost.

Cabling along the OHL wayleave (cable option UGC1C) poses many additional installation and environmental risks in comparison to the other cable route options presented and is therefore not the preferred cabling solution.

LUC indicated an overal environmental preference for route UGC1B as substantially less tree felling would be required than for UGC1C. Additionally, in comparison to UGC1A, UGC1B can span the Water of Ken and potentially the areas of peatland habitat and flood risk zone in the vicinity of Kendoon substation. 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. Refer to Appendix 2.

CCI recommends cable route option UGC1B from the three route options investigated for the proposed OHL section between Polquhanity and Kendoon substation. This cable route option presents the most practicable option for cable installation and is of a similar length to the OHL route option. The inclusion of an overhead line section into Kendoon substation negates the many points of engineering difficulty associated with accessing the Kendoon substation site, even though construction of an OHL cable sealing end compound at PK10 would require the placement of additional above ground structures within sight of the A713. This option would also require the use of this OHL option on UGC2 into Kendoon substation from PK10.

The selection of the preferred cable route will result in changes to wayleave requirements. Cable routes installed within existing carriageways would not require wayleaves for this section of the route. Other alternative cable routes will require changes to the proposed wayleaves, with wayleaves associated with the existing OHL routes being removed if they are not required.

4.1.8 UGC1 Polquhanity – Kendoon Substation Cable Route Appraisal Conclusion

Following a joint review between CCI, LUC and SPEN, agreement was reached to adopt CCI's route preference UGC1B as the preferred cable route option between Polquhanity and Kendoon substation. This conclusion was predicated on cable route UGC1B being the preference for both the technical and environmental considerations.

Furthermore, it was agreed that the selection of cable route UGC1B wholly met the objective for the UGC1 cable study which was to identify a route that mitigates impacts on commercial forestry and on setting of cultural heritage features within Polmaddy forest.

4.2 UGC2 Kendoon Substation – Glenlee Substation Cable Route Options

SPEN advised CCI that they had been asked to consider undergrounding as an alternative where this has been identified through pre-application consultation. As follows:

Between Kendoon substation and Glenlee substation, the key issue which has been raised during consultation is to mitigate potential landscape and visual impacts of the proposed overhead line on the Water of Ken valley.

Consistent with SPEN's transmission licence duties and environmental obligations under Schedule 9 of the Electricity Act 1989¹, cable routes will have to establish a balance between engineering requirements, economic viability, land use and the environment. SPEN's objective for cable routeing between Kendoon substation and Glenlee substation is to "identify a technically feasible and economically viable cable route, between Kendoon substation and Glenlee substation, which causes, on balance, the least disturbance to people and the environment".

As listed in Table 2, the following 3 cable route options were identified between Kendoon substation and Glenlee substation:

- UGC2A Cable route
- UGC2B Cable route with OHL into Kendoon and Glenlee substations
- UGC2C Undergrounding of the proposed OHL route within its wayleave

Table 8 contains the approximate route length comparisons for the three route options. It can be seen that the underground cable route options are within approximately 16.5% of each other.

Cable Route	Route Description	Route Length (km)
UGC2A	Cable route	8.97
UGC2B	Cable route with sections of OHL into	8.43 (UGC =
	Kendoon and Glenlee substation	7.3km and
		OHL = 1.13 km)
UGC2C	Undergrounding of the proposed OHL	7.7
	route within its wayleave	
Kendoon S/S –	Straight line distance	7.2
Glenlee S/S		

Table 8 – Approximate route length comparisons for Kendoon S/S to Glenlee S/S
4.2.1 UGC2 Kendoon Substation – Glenlee Substation Current Rating and Circuit Details

The cable routing options considered under UGC2 require a continuous current rating of 2010A to be transmitted through each of the two cable circuits, with one connecting Kendoon substation to Glenlee substation and the second connecting tower N230 at Polquhanity to Glenlee substation. Refer to Figure 14 which shows a schematic of the electrical connection arrangement as issued by SPEN.

To deliver this magnitude of current it is calculated that at least two cables per phase will be required for each circuit. The total number of cables required would therefore be 12 (6 per circuit). Consideration must also be given to the number of cable sealing ends required at terminal position. To accommodate the 12 terminations required a cable sealing end compound will be necessary at the Glenlee substation end of the route where the two circuits terminate.

It has been assumed for the purposes of this study that both circuits would be installed in the same manner, either by underground cabling or OHL. Sections that cover routing the cables into Kendoon substation (sections 40C, 5U and 6A) will be for consideration of two circuits, that is 12 cables and 12 termination positions.

Figure 14 – Electrical schematic for Tower N230 at Polquhanity, Kendoon S/S and Glenlee S/S



4.2.2 UGC2 Kendoon Substation - Glenlee Substation Geotechnical Review

From a review of a geotechnical report² provided by SPEN, the underlying rock formation for UGC2 is Wacke with a band of siltstone between towers PK25 to PK27. Outcrops were noted at several locations on the route most notable PK11 to PK17 and PK24 to PK33. This is the only information available and applies to the OHL wayleave route. The superficial geology varies along the route from clay, sand and silt, sand and gravel. There were also long sections of the route where no superficial layer is recorded.

Superficial geology refers to geological deposits typically of the Quaternary age which extends back about 2.6 million years. These deposits rest on the underlying rock, often referred to as bedrock.

Considering the OHL wayleave for UGC2, it can be calculated that some superficial geology will be present for approximately 37% of the route, with the remaining 63% containing none. Where the superficial geology layer is shallow or non-existent, a different approach for cable installation may be required. For example, shallow rock is not able to be broken up and dug out using a bucket on a backhoe excavator.

4.2.3 Kendoon Substation – Glenlee Substation Route Option UGC2A

Figure 15 shows the key plan for Kendoon – Glenlee substation, with cable route option UGC2A (40C+42C+45C) shown in red.



Figure 15 – Key plan with red line showing cable route UGC2A

Cable route UGC2A in Figure 16 and Figure 17, shown as a black line, runs from north to south, from Kendoon substation, south to Glenlee substation, passing west of Carsfad Loch and Earlstoun Loch. The A713 and A762 carriageways offered a practical cable routing option between Kendoon substation and Glenlee substation. This is due to the areas of peat, archaeological sensitive areas, non-inventory designed landscapes, native woodlands, flood zones and undulating topography either side of the roadway. The exception to this was adjacent to Earlstoun Power Station, where the cable route crossed the Water of Ken to avoid infrastructure associated with the hydroelectrical Power Station operation.

The closing section into Kendoon substation presents challenges with the route selected to avoid existing hydroelectric infrastructure and associated Power Station and housing. Kendoon substation is positioned at the confluence of the Water of Ken and the Water of Deugh and is not directly accessible by an underground cable route from either the north, or the west, due to lack of space and rock formations. The cable route 40C, would also require the use of 4C in UGC1. The installation of 12 cables into Kendoon substation is unlikely to be practicable due to existing infrastructure.

Likewise, the closing section into Glenlee substation presents several challenges that include; two crossings of Coom Burn, flood zones, peat habitat, non-inventory designed landscapes, multiple residential properties and native woodlands, in addition to installing up to 12 cables within the substation access road.

Where the cable is laid in the road, it is envisaged that the cable route would be installed in one carriageway at a time with the other carriageway kept open for traffic. Joint bays would be positioned in the verge or in laybys wherever reasonably practicable. The existing services within the road are largely unknown.

A review of the cable route option UGC2A was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts by LUC.

Table 9 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on the cable schematic in Figure 16 and Figure 17. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-01 which has been provided to SNH, DGC and the Scottish Government ECU.

Table 9 – Key points of engineering difficulty and environmental sensitivity for UGC2A

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Entry to	Peat habitats, native woodland areas, the existing
	Kendoon	hydroelectrical scheme and multiple residential properties
	Substation	restricting cable route options. There is also a steep
		elevational change and shallow rock associated with the banks
		of the Water of Ken into Kendoon substation. Space and
		access is so restricted that such an entry is unlikely to be
		possible for 12 cables (including UGC1). Relocation of the
		substation may be required for this option. Significant
		relocation of existing infrastructure such as substation
		compounds is not within the scope of this study. However,
		such changes would be expected to be disruptive and
2	Watar of Van	Significantly increase costs.
2	crossing	across the river positioned in peat ground would be required
	crossing	Directly adjacent to the Water of Ken is a medium flood risk
		zone (1 in 200 years)
3	Peat	Peat habitats between A713 and the Water of Ken river
-		crossing. Peat ground preparation work would be required.
		This may also impact on cable conductor material and size.
4	Cabling within	Cables to be installed within A713, appropriate traffic
	A713	management plan would need to be developed and adopted.
		With joints and link equipment located in the verge where
	· _ · · ·	practicable.
5	Burn crossings	HDD or dam and pump over crossing of burns adjacent to
	adjacent to	tower PK11 would be required.
(tower PK11	\mathbf{D}_{1}
0	Peat	real nabilats next to the A/15 adjacent to tower PK12. Peat
		ground preparation work may be required. This may also
7	Residential	Residential property and peat habitats adjacent to the A713
,	property and	and the cable route at Stroangassel Peat ground preparation
	Peat at	work may be required. This may also impact on cable
	Stroangassel	conductor material and size.
8	Archaeological	West of the A713 and alongside the cable route. an
	sensitive area	archaeological sensitive area is located at Owlet Knowe,
		adjacent to Carsfad loch.
9	Native	A native woodland is situated between the A713 and Carsfad
	woodlands at	Loch to the east alongside the cable route.
	Carsfad Loch	

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
10	Flood zone	The A713 and the cable route passes through a medium
		likelihood (1 in 200 years) flood zone at the southern end of
		Carsfad Loch.
11	Carsfad dam and	Carsfad dam and hydroelectric Power Station is located either
	Power Station	side of the A713 alongside the cable route. Infrastructure
		relating to this could be located within the carriageway.
		Residential properties are also noted at this location alongside
		the cable route.
12	Peat, non-	Peat habitats west of the A713 south of Carsfad Loch
	inventory	alongside the cable route. Peat ground preparation work may
	designed	be required. This may also impact on cable conductor material
	landscapes	and size. Non-inventory designed landscapes are located west
	ancient and	of the A/13 along with ancient woodlands at Knocknalling
	native	Wood. Native woodlands were also noted to the east of the
	woodlands	A/13. These features are also located alongside the cable
12	Flood zono	The A712 and the apple route page through a medium
15	riood zolle	likelihood (1 in 200 years) flood zone at the south of Carsfad
		Loch associated with the Water of Ken
1/	Polharrow hurn	HDD or use of the road bridge deck at the crossing of
17	crossing	Polharrow burn would be required Scaring on the
	crossing	carriageway surface was noted at Polharrow hurn suggestive
		of buried services.
15	Peat, native	Peat habitats west of the A713 at Polharrow bridge. Peat
	woodlands at	ground preparation work may be required. This may also
	Polharrow	impact on cable conductor material and size. Native
	bridge	woodlands were noted to the west of the A713 alongside the
	- C	cable route.
16	Listed Building	A category B listed building is located east of the A713 and
	south of	the cable route, south of Polharrow bridge.
	Polharrow	
	bridge	
17	Ancient and	The A713 and the cable route dissects an area of ancient
	native	woodlands to the west and ancient and native woodlands to
	woodlands at	the east at White Hill. The area of ancient and native
	White Hill	woodlands continues south to Fairy Knowe and the Earlstoun
1.0		dam.
18	Earlstoun dam	Earlstoun dam is crossed by the A713 and the cable route. An
	crossing	HDD, standalone cable bridge, or use of the road bridge deck
		would be required. Additional infrastructure relating to the
		dam could be located within the carriageway.

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Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
19	Native	The cable route crosses areas of native woodlands south of
	woodlands	Earlstoun Dam that extend south to Allangibbon Bridge.
20	HDD crossing	HDD under the Water of Ken from west to east, and under the
	of the Water of	junction of the A713 and A762. Disruption associated with
	Ken and	cabling close to an A-road intersection. An appropriate traffic
	Junction of	management plan may need to be developed and adopted.
	A713 and A762	Residential properties are located alongside the A713 at this
		location. This HDD crossing is to avoid Earlstoun Power
		Station outflow on the A762 and any infrastructure relating to
		the dam and Power Station that may be located within the
		carriageway. This HDD also helps minimise impacts on two
		category B listed buildings which are located on the A/62
		adjacent to the Power Station and several residential
21		The set is a set of Earlstown dam.
21	Cabling within a	rick zone on the cast hank of the Water of Ver
22	Notivo	Tisk zone on the east bank of the water of Ken.
	woodlands	of Kon alongside the cable route, with the HDD extending to
	wooulallus	avoid them Peat habitats are located west of the A762 which
		were avoided by routing the cable on the eastern banks of the
		Water of Ken Crossing peat ground may impact on cable
		conductor material and size
23	HDD crossing	HDD crossing the Water of Ken from east to west with both
23	of the Water of	the launch and reception positions for the HDD located within
	Ken	medium (1 in 200 year) flood risk zones. The HDD passes
		under an area of native woodland.
24	Flood risk zones	The A762 and the cable route pass close to a medium (1 in
		200 year) and low (1 in 1000 year) flood risk zone at
		Covenanters' Grave.
25	Private water	The A762 and the cable route pass close to a private water
	supply zone of	supply zone of interest at Knockensee. The A762 and the
	interest and	cable route pass through a medium (1 in 200 year) flood risk
	flood risk zone	zone at Knockensee associated with Coom Burn.
26	Coom Burn	The A713 and the cable route cross Coom Burn at two
	crossing and	locations where an HDD or use of the road bridge deck would
	listed building	be required. The land adjacent to the Coom burn at this
		location is within a medium (1 in 200 year) flood risk zone.
		The bridge is noted to be a category C listed building.
27	Entry to Glenlee	Entry for the cable route into Glenlee substation is via the
	Substation	access lane. The lane falls within a medium (1 in 200 year)
		flood risk zone. Non-inventory designed landscapes are

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Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		located south of the access lane. Native woodlands and peat
		habitats are situated to the north of the access road. Multiple
		residential properties are situated along the access lane. By
		utilising the access lane, the impact of these features on the
		cable route is hoped to be reduced.



Figure 16 – Black line showing cable route UGC2A 40C+42C(part)

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Figure 17 – Black line showing cable route UGC2A 42C(part)+45C

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4.2.4 Kendoon Substation – Glenlee Substation Route Option UGC2B

This route follows the same as that covered in Section 4.2.3, with the following two exceptions; at the northern end of the route it diverts from the A713 to terminate at the proposed new tower PK10, with the closing section into Kendoon substation being OHL. Figure 18 shows the key plan for Kendoon substation – Glenlee substation with cable route option UGC2B (6A+38C+42C+43C+46A) shown in red.





It should be noted that route undergrounding option UGC2B does not fully underground the entire route, as the closing sections into Kendoon substation and Glenlee substations are still installed as OHL's. Advantages of this route option is that it negates the points of engineering difficulty associated with access into Kendoon and Glenlee substation including the crossing of the Water of Ken and Coom Burn as outlined in section 4.2.3 in Table 9, Figure 16 and Figure 17.

However, cable termination positions comprising a cable sealing end compound would be required at both PK10 and PK33 tower positions, the approximate dimensions of which are 24.3m x 15m per circuit. Cable termination positions constructed at PK10 and PK33 are likely to be on banked positions visible from the A713 and A762 respectively.

This would necessitate civil works to construct, in the presence of peat habitats adjacent to both tower locations.

Access to the potential termination positions would require construction of haul roads with this expected to be more challenging at PK33, where the tower is approximately 600m from the A762. Any loss of visual amenity associated with the tower positions have been assessed by LUC, refer to Appendix 2. An additional implication of the use of section 6A into Kendoon substation, will practicably mean the use of this OHL route into Kendoon substation for UGC1 also.

Where the cable is laid in the road, it is envisaged that the cable route would be installed in one carriageway at a time with the other carriageway kept open for traffic. Joint bays would be positioned in the verge or in laybys wherever reasonably practicable.

A review of the cable route option UGC2B was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts by LUC.

Table 10 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on the cable schematic in

Figure 19 and Figure 20. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Table 10 – Key po	oints of engineering	difficulty and	environmental	sensitivity for
UGC2B				

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Terminal tower at	Civil engineering difficulties associated with the
	PK10	construction of a cable termination position at PK10 and
		any adverse visual impact as assessed by LUC, refer to
		Appendix 2.
2	Peat	Peat habitats between PK10 and the A713. Peat ground
		preparation work may be required. This may also impact on
		cable conductor material and size.
3	Cabling within	Cables to be installed within A713, appropriate traffic
	A713	management plan would need to be developed and adopted.
		With joints and link equipment located in the verge where
		practicable.
4	Burn crossings	HDD or dam and pump over crossing of burns adjacent to
	adjacent to tower	tower PK11 would be required.
_	PK11	
5	Peat	Peat habitats next to the A/13, alongside the cable route,
		adjacent to tower PK12. Peat ground preparation work may
		be required. This may also impact on cable conductor
(material and size. $1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 $
6	Residential	Residential property and peat habitats adjacent to the A/13
	property and Peat	and the cable route, at Stroangassel. Peat ground
	at Stroangasser	preparation work may be required. This may also impact on
7	Archagological	Wast of the A713 and alongside the cable route an
/	Alchaeological	archaeological sensitive area is located at Owlet Knowe
	sclisitive area	adjacent to Carsfad loch
8	Native woodlands	Δ native woodland is situated between the Δ 713 and
0	at Carsfad Loch	Carsfad Loch to the east alongside the cable route
9	Flood zone	The A713 and the cable route pass through a medium
	11000 20110	likelihood (1 in 200 years) flood zone at the southern end of
		Carsfad Loch.
10	Carsfad dam and	Carsfad dam and hydroelectric Power Station is located
	Power Station	either side of the A713, alongside the cable route.
		Infrastructure relating to this could be located within the
		carriageway. Residential properties are also noted at this
		location.

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Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
11	Peat, non-	Peat habitats west of the A713 south of Carsfad Loch,
	inventory designed	alongside the cable route. Peat ground preparation work
	landscapes ancient	may be required. This may also impact on cable conductor
	and native	material and size. Non-inventory designed landscapes are
	woodlands	located west of the A713 along with ancient woodlands at
		Knocknalling Wood. Native woodlands were also noted to
		the east of the $A/13$. These features are all located
10	F1 1	alongside the cable route. $1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 $
12	Flood zone	The A/13 passes through a medium likelihood (1 in 200
		years) flood zone at the south of Carsiad Loch, associated
12	Dolharrow hurn	HDD or use of the read bridge deak at the crossing of
15	crossing	Polharrow burn would be required Scaring on the
	crossing	carriageway surface was noted at Polharrow hurn
		suggestive of buried services.
14	Peat, native	Peat habitats west of the A713 at Polharrow bridge. Peat
	woodlands at	ground preparation work may be required. This may also
	Polharrow bridge	impact on cable conductor material and size. Native
	C C	woodlands were noted to the west of the A713.
15	Listed Building	Th cable route passes close to a category B listed building
	south of Polharrow	located east of the A713, south of Polharrow bridge.
	bridge	
16	Ancient and native	The A713 and the cable route dissects an area of ancient
	woodlands at	woodlands to the west and ancient and native woodlands to
	White Hill	the east at White Hill. The area of ancient and native
		woodlands continue south to Fairy Knowe and the
17		Earlstoun dam.
17	Earlstoun dam	Earlstoun dam is crossed by the A/13. An HDD, standalone
	crossing	cable bridge, or use of the road bridge deck would be
		required. Additional infrastructure relating to the dam could
18	Nativa woodlanda	The cable route grosses gross of notive woodlands south of
10	Native woodiands	Farlstoun Dam that extend south to Allangibbon Bridge
19	HDD crossing of	HDD under the Water of Ken from west to east and under
17	the Water of Ken	the junction of the A713 and A762 Disruption associated
	and Junction of	with cabling close to an A-road intersection. An appropriate
	A713 and A762	traffic management plan may need to be developed and
	11,10 and 11,02	adopted. Residential properties are located alongside the
		A713 at this location. This HDD crossing is to avoid
		Earlstoun Power Station outflow on the A762 and any
		infrastructure relating to the dam and Power Station that

T.		
Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
	•	may be located within the carriageway. This HDD also
		helps minimise impacts on two category B listed buildings
		which are located on the A762 adjacent to the Power Station
		and several residential properties close to Earlstoun dam.
20	Cabling within a	The cable route passes through a medium (1 in 200 year)
	flood zone	flood risk zone on the east bank of the Water of Ken.
21	Native woodlands	Native woodlands are located on the eastern bank of the
		Water of Ken, alongside the cable route, with the HDD
		extending to avoid them. Peat habitats are located west of
		the A762, which were avoided by routing the cable on the
		eastern banks of the Water of Ken. Crossing peat ground
		may impact on cable conductor material and size.
22	HDD crossing of	HDD crossing the Water of Ken from east to west, with both
	the Water of Ken	the launch and reception positions for the HDD located
		within medium (1 in 200 year) flood risk zones. The HDD
		passes under an area of native woodland
23	Flood risk zones	The A762 and cable routes pass close to a medium (1 in 200
23	1 1000 HISK ZOHOS	vear) and low (1 in 1000 year) flood risk zone at
		Covenanters' Grave
24	Driveto vyetor	The solid route pages through a private water supply zone.
24		a finterest et teurer DV22
	supply zone of	of interest at tower PK33.
2.5	interest	
25	Overhead services	The cable route passes under several existing OHL routes
		feeding into Glenlee substation
26	Peat	Peat habitats adjacent to PK33. Peat ground preparation
		work may be required. This may also impact on cable
		conductor material and size.
27	Terminal tower at	Civil engineering difficulties associated with the
	PK33	construction of a cable termination position at PK33 and
		any adverse visual impact as assessed by LUC. refer to
		Annendix 2
1		



Figure 19 – Black line showing cable route UGC2B 6A+38C+42C(part)

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Figure 20 – Black line showing cable route UGC2B 42C(part)+43C+46A

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4.2.5 Kendoon Substation – Glenlee Substation Route Option UGC2C

For this cable route, the proposed OHL route from Kendoon substation to Glenlee substation was followed. Figure 21 shows the key plan for Kendoon – Glenlee substation with cable route option UGC2C (5U+41U+44U) shown in red.



Figure 21 – Key plan with red line showing cable route UGC2C

Cable route UGC2C in Figure 22 and Figure 23, shown as a black line, runs north to south, from Kendoon substation to Glenlee substation. The cable route follows the proposed OHL wayleave exiting Kendoon substation to the west, before turning due south and continuing parallel to the A713, passing through an archaeological sensitive area west of Carsfad Loch.

The OHL wayleave continues south within the medium flood zone (1 in 200 year) associated with the Water of Ken, staying parallel with the A713 west of Earlstoun Loch. From here the route continues south now parallel with the A762 before turning south west, crossing the Coom Burn and entering Glenlee substation.

This proposed cable route contains more points of engineering difficulty than the other route options investigated within this study for UGC2. There would be a requirement for a permanent access road to allow construction and maintenance access to the cable route

along its entire length. A-road access points for the maintenance and haul road would also be required.

A review of the cable route option UGC2C was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts by LUC.

Table 11 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on the cable schematic in Figure 22 and Figure 23. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Table 11– Key points of engineering difficulty and environmental sensitivity for UGC2C

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Entry to	Peat habitats, native woodland areas, the existing
	Kendoon	hydroelectrical scheme and multiple residential properties
	Substation	restricting cable route options. There is also a steep
		elevational change and shallow rock associated with the banks
		of the Water of Ken into Kendoon substation. Space and
		access is so restricted that such entry is unlikely to be possible
		for 12 cables (including UGC1). Relocation of the substation
		may be required for this option and is beyond the scope of this
		study. However, relocation of existing infrastructure such as
		substation compounds would be disruptive and increase costs.
2	Water of Ken	Water of Ken crossing adjacent to Kendoon substation, HDD
	crossing	across the river positioned in peat ground would be required.
		Directly adjacent to the Water of Ken is a medium flood risk
		zone (1 in 200 years).
3	Peat	Peat habitats between A713 and the Water of Ken river
		crossing. Peat ground preparation work may be required. This
		may also impact on cable conductor material and size.
4	Peat	Peat habitats between PK10 and the A713. Peat ground
		preparation work may be required. This may also impact on
		cable conductor material and size.
5	Changes in	Undulations within the topography heading south from tower
	elevation	PK11 that may require cable anchoring systems to be
		designed and installed to minimise migration of the cable
		down a slope over the long term.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
6	Burn crossings	HDD or dam and pump over crossing of burns adjacent to
	adjacent to	tower PK11 would be required.
	tower PK11	
7	Peat	Cable route passes through peat habitats next to tower PK13.
		Peat ground preparation work may be required. This may also
		impact on cable conductor material and size.
8	Archaeological	Cable route enters an archaeological sensitive area, west of
	sensitive area	Carsfad Loch, from tower PK14 to PK18 at Carsfad.
9	Burn crossings	HDD or dam and pump over crossing of burns near Owlet
	and peat at	Knowe would be required. Intermittent peat habitats are also
	Owlet Knowe	noted in this area. Peat ground preparation work may be
		required. This may also impact on cable conductor material
		and size.
10	Native	A native woodland is situated between the A713 and Carsfad
	woodlands at	Loch to the east, the cable route passes alongside it.
	Carsfad Loch	
11	Flood zone	A medium likelihood (1 in 200 years) flood zone is located to
		the east at the southern end of Carsfad Loch. The cable route
		avoids this area by remaining within the archaeological
		sensitive area to the west.
12	Carsfad dam and	Utility avoidance of any supplies to Carsfad dam and
	Power Station	hydroelectric Power Station which is located either side of the
	and private	A713. The cable route passes through a private water supply
	water supply	zone of influence that is located at the Power Station.
		Residential properties are also noted at this location.
13	Peat, non-	The cable route passes through intermittent peat habitats
	inventory	adjacent to tower PK18 south of Carsfad Loch. Peat ground
	designed	preparation work may be required. This may also impact on
	landscapes	cable conductor material and size. Non-inventory designed
	ancient and	landscapes are located west of the cable route along with
	native	ancient woodlands at Knocknalling Wood. Native woodlands
	woodlands	were also noted to the east of the A713, alongside the cable
		route.
14	Flood zone	The cable route passes through a medium likelihood (1 in 200
		years) flood zone at the south of Carsfad Loch, associated
		with the Water of Ken.
15	Polharrow burn	HDD or use of the road bridge deck at the crossing of
	crossing	Polharrow burn would be required. Scaring on the
		carriageway surface was noted at Polharrow burn suggestive
		of buried services.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
16	Peat, native	Peat habitats within the cable route south of Polharrow bridge.
	woodlands at	Peat ground preparation work may be required. This may also
	Polharrow	impact on cable conductor material and size. Native
	bridge	woodlands were noted to the west of the A713, alongside the
		cable route.
17	Lane crossing	Lane crossing required south of Polharrow bridge, with either
	_	HDD or duct block solution sought.
18	Listed Building	The cable route passes close to a category B listed building
	south of	that is located east of the A713, south of Polharrow bridge.
	Polharrow	
	bridge	
19	Peat and ancient	Peat habitats within the cable route at Barchock Wood. Peat
	woodlands	ground preparation work may be required. This may also
		impact on cable conductor material and size. Ancient
		woodlands are located west of the route at Barchock Wood.
20	Burn Crossing	HDD or dam and pump over crossing of burns at Glen Strand
		would be required.
21	Ancient and	An area of ancient and native woodlands is located to the east
	native	of the cable route at White Hill. The area ancient and native
	woodlands at	woodlands continue south to Fairy Knowe and the Earlstoun
	White Hill	dam.
22	Peat and private	The cable route passes through intermittent peat habitats and
	water supply	a private water supply zone of influence west of White Hill.
	zone of	Peat ground preparation work may be required. This may also
	influence	impact on cable conductor material and size.
23	Burn Crossing	HDD or dam and pump over crossing of burns south of
	_	Barskeoch Mains would be required.
24	Peat	Peat habitats present on the cable route at Fairy Knowe. Peat
		ground preparation work may be required. This may also
		impact on cable conductor material and size.
25	Changes in	Undulations within the topography that may require cable
	elevation	anchoring systems to be designed and installed to minimise
		migration of the cable down a slope over the long term.
26	Earlstoun dam	Earlstoun dam is located to the east of the cable route.
	crossing	Infrastructure relating to the dam could be located within the
	U U	area. Ancient woodlands are also noted at this location,
		extending south towards Allangibbon Bridge. The cable route
		avoids these obstacles by remaining in the OHL wavleave to
		the west.
27	Listed buildings.	Two category B listed buildings are located on the A762
	flood zone and	adjacent to the Power Station associated with Earlstoun dam.

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Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
	outflow crossing	Infrastructure relating to the dam and Power Station could be
	at Earlstoun	located within the carriageway. A medium (1 in 200 year)
	Power Station	flood risk zone is located east of the cable route at Earlstoun
		Power Station. Residential properties are located adjacent to
		the A762 at this location. The cable route avoids these
		obstacles by remaining in the OHL wayleave to the west.
28	Peat	Peat habitats present on the cable route at Craiggubble Wood.
		Peat ground preparation work may be required. This may also
		impact on cable conductor material and size.
29	Native	Native woodlands are located to the west of the cable route at
	woodlands	Craiggubble Wood.
30	Flood risk zones	The cable route passes close to a medium (1 in 200 year) and
		low (1 in 1000 year) flood risk zone at Covenanters' Grave.
31	Private water	The route passes through a private water supply zone of
	supply zone of	interest at tower PK33. A residential property is located
	interest	directly east of the cable route.
32	Peat	Peat habitats adjacent to PK33. Peat ground preparation work
		may be required. This may also impact on the cable conductor
		material and size.
33	Native	The cable route crosses an area of native woodlands at Hag
	woodland	Wood close to PK34.
34	Peat	Peat habitats south of Hag Wood. Peat ground preparation
		work may be required. This may also impact on cable
		conductor material and size.
35	Flood risk zone	The cable route passes through a medium (1 in 200 year) flood
		risk zone at Knockensee associated with Coom Burn.
36	Coom Burn	The cable route crosses Coom Burn at two locations where an
	crossing and	HDD would be required. The land adjacent to the Coom burn
	listed building	at this location is within a medium (1 in 200 year) flood risk
		zone. The nearby road bridge is noted to be a category C listed
		building.
37	Entry to Glenlee	Entry into Glenlee substation via land that falls within a
	Substation	medium (1 in 200 year) flood risk zone. Native woodlands
		and peat habitats are situated within the cable route adjacent
		to the substation boundary. Non-inventory designed
		landscapes are located south of the substation site. Multiple
		residential properties are situated along the access lane.



Figure 22 – Black line showing cable route UGC2C sections 5U+41U(part)

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Figure 23 – Black line showing cable route UGC2C sections 41U(part)+44U

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4.2.6 UGC2 Kendoon Substation – Glenlee Substation Route Appraisal Summary

Three cable route options have been studied for undergrounding between Kendoon substation and Glenlee substation. The cable route studies have been based on the 21 criteria and other information detailed within section 3 of this study.

Installation of a cable route within the A713 and A762 carriageways are expected to provide a solid and reliable installation base when compared to installing cable within peat habitats and undulating woodland and offers the best solution from a constructability perspective. Working in the carriageway does introduce a risk to the workforce associated with moving traffic, but this risk can be managed with an effective traffic management system.

LUC maps³ provided to CCI show environmental features located on the proposed OHL wayleave. The cable route following the A713 and A762 pass through several medium likelihood (1 in 200 year) flood risk zones, cross several burns and pass two hydroelectrical Power Stations. In addition, the A713 and A762 pass in close proximity to ancient and native woodlands, peat habitats, archaeological sensitive areas, non-inventory designed landscapes, multiple residential dwellings and listed buildings. Although the list of environmental features is considerable it is substantially fewer than those encountered when following a cable route along the OHL wayleave.

From a review of a geotechnical report² provided by SPEN, the underlying rock formation for UGC2 is Wacke with a band of siltstone between towers PK25 to PK27. Outcrops were noted at several locations on the route most notable PK11 to PK17 and PK24 to PK33. The superficial geology varies along the route from clay, sand and silt, sand and gravel. There were also long sections of the route where no superficial layer is recorded. Considering the OHL wayleave for UGC2, it can be calculated that some superficial geology will be present for approximately 37% of the route, with the remaining 63% containing none.

Installing up to 12 HV cables is likely to prove challenging within the A713 and A762 carriageways and diverting to utilise space that could be provided within the carriageway verge would need to be considered if buried services were encountered.

Cabling into Kendoon and Glenlee substations provide multiple points of engineering difficulty including peat habitats, river and burn crossings, shallow Wacke formations, flood zones, elevational changes and native woodlands. Therefore, a solution that avoids cabling into both Kendoon and Glenlee substations would be beneficial.

Cabling along the OHL wayleave (cable option UGC2C) poses many additional installation and environmental risks in comparison to the other cable route options presented and is therefore not the preferred cabling solution.

LUC indicated an overal environmental preference for route UGC2C as it is the shortest cable route and requires the least tree felling and will result in substantially fewer visual

effects on residential receptors in comparison to UGC2B while crossing fewer flood risk zones than UGC2A and UGC2B, refer to Appendix 2.

CCI recommends cable route option UGC2B from the three route options investigated for the proposed OHL section between Kendoon and Glenlee substation. Although 1.13km would not be undergrounded, this cable route option presents the most practicable option for undergrounding. CCI deems installation of the cable system within a flood plain (1 in 200 years) to present less buildability risk than following a cable route, the majority of which is away from the carriageway crossing undulating rocky terrain.

The inclusion of an overhead line section into Kendoon and Glenlee substations negate many of the points of engineering difficulty associated with accessing the Kendoon and Glenlee substation sites, even though construction of OHL cable sealing end compounds at PK10 and PK33 would require the placement of additional above ground structures within sight of the A713 and A762 respectively.

The selection of the preferred cable route will result in changes to wayleave requirements. Cable routes installed within existing carriageways would not require wayleaves for this section of the route. Other alternative cable routes will require changes to the proposed wayleaves, with wayleaves associated with the existing OHL routes being removed if they are not required.

4.2.7 UGC2 Kendoon Substation – Glenlee Substation Cable Route Appraisal Conclusion

Following a joint review between CCI, LUC and SPEN, LUC stated a preferred route option UGC2C, in preference to CCI's preferred route option UGC2B. Option UGC2C being the environmental preference as it is the shortest and will result in fewer visual effects on residential receptors.

However, cabling into Kendoon and Glenlee substations provide multiple points of engineering difficulty including peat habitats, river and burn crossings, shallow Wacke formations, flood zones, elevational changes and native woodlands. Therefore, a solution that avoids cabling into both Kendoon and Glenlee substations would be beneficial.

The selection of UGC2B as CCI's preferred cable route for this study is predicated on this cable route being buildable, which on balance was felt to have precedence over the specific environmental considerations in this instance.

Furthermore, it was agreed that the selection of cable route UGC2B partially met the objective (as the UGC will still have an impact on the Water of Ken valley, particularly during construction) for the UGC2 cable study which was to identify a route that mitigates potential landscape and a loss of visual amenity of the proposed overhead line on the Water of Ken valley.

4.3 UGC3 Queen's Way Crossing Cable Route Options

SPEN advised CCI that they had been asked to consider undergrounding as an alternative where this has been identified through pre-application consultation. As follows:

At the Queen's Way crossing the key issue which has been raised during consultation is to mitigate potential landscape, visual, tourism and recreation impacts on the Queen's Way crossing tourist route between New Galloway and Newton Stewart, the gateway into the Galloway Forest Park.

Consistent with SPEN's transmission licence duties and environmental obligations under Schedule 9 of the Electricity Act 1989¹, cable routes will have to establish a balance between engineering requirements, economic viability, land use and the environment. SPEN's objective for cable routeing at the Queen's Way crossing is to "identify a technically feasible and economically viable cable route, at the Queen's Way crossing, which causes, on balance, the least disturbance to people and the environment".

As listed in Table 3, the following 2 cable route options were identified for the Queen's Way crossing:

- UGC3A Cable route
- UGC3B Undergrounding of the proposed OHL route within its wayleave

Table 12 contains the approximate route length comparisons, and it can be seen that the proposed cable route is longer than the overhead line equivalent by 16.6%. This addition to UGC3A cable route alternative is due to the topographic limitations associated with Peal hill.

Cable Route	Route Description	Route Length (km)
UGC3A	Cable route	4.2
UGC3B	Undergrounding proposed OHL route	3.6
GT08 – GT21	Straight line distance	3.3

Table 12 – Approximate route length comparisons for the Queen's Way Crossing

4.3.1 UGC3 Queen's Way Crossing Current Rating and Circuit Details

The cable routing options considered under UGC3 require a continuous current rating of 815A to be transmitted through each of the two circuits connecting proposed OHL tower GT08 to GT21.

To deliver this magnitude of current it is expected that one cable per phase will be required for each circuit. The total number of cables required would therefore be 6 (3 per circuit).

Consideration must also be given to the number of cable sealing ends required at terminal positions. To accommodate the 6 terminations required, towers containing elevated cable sealing end platforms (sealing end platforms attached to the tower body) will be necessary at either end of the route.

4.3.2 UGC3 Queen's Way Crossing Geotechnical Review

From a review of a geotechnical report² provided by SPEN, the underlying rock formation is noted to be Wacke formation for the section of the route between towers GT08 and GT17 and then granite from GT17 to GT21. The superficial geology varies from clay/silt with gravel and boulders, sand and gravel and peat habitats up to 2.2m deep. Rocky outcrops of siltstone bedrock were also noted.

Superficial geology refers to geological deposits typically of the Quaternary age which extends back about 2.6 million years. These deposits rest on the underlying rock, often referred to as bedrock.

Considering the OHL wayleave for UGC3, it can be calculated that some superficial geology will be present for approximately 38.5% of the route, with the remaining 61.5% containing none. Where the superficial geology layer is shallow or non-existent, a different approach for cable installation may be required. For example, where shallow rock is not able to be broken up and dug out using a bucket on a backhoe excavator.

4.3.3 Queen's Way Crossing Route Option UGC3A

Figure 24 is a magnified extract of the Glenlee – Tongland key plan, with cable route option UGC3A (11C+14C) shown in red.





The UGC3A cable route in Figure 25, shown as a black line, runs from north to south, from the proposed new OHL towers GT08 to GT21 and includes the Queen's Way crossing.

Towers with an elevated sealing end platform (sealing end platform attached to the tower body) would be required at both ends of this route at tower position GT08 and GT21. Tower position GT08 is noted to be situated in a peat habitat, within a private water supplies zone of influence, which would likely necessitate civil works to make the ground suitable for construction. In addition, both tower positions would likely require some levelling work and temporary haul road access to be constructed. Any adverse visual impacts associated with these tower positions have been assessed by LUC, refer to Appendix 2.

A preliminary route for UGC3A was selected which aimed to avoid areas containing peat habitats and outcropping rock as it passes down Achie Hill to the Queen's Way crossing. The approximate A712 crossing location aims to offer a position with minimal surface elevational change across a proposed HDD length. The cable has been preliminary routed around the east side of Peal Hill following existing tracks where possible, here the land appeared more open and accessible than the west side. However, as access was restricted in this area additional site survey work may clarify these assumptions.

A review of the cable route option UGC3A was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts by LUC.

Table 13 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on Figure 25.

Table 13 – Key	points of engineer	ing difficulty a	and environmenta	al sensitivity for
UGC3A				

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Peat	Adjacent to tower GT08 the ground was noted to contain
		significant peat. Peat ground preparation work may be
		required. This may also impact on cable conductor material
		and size. Tower GT08 is within a private water supplies
		zone of interest. Any adverse visual impact associated with
		the terminal tower has been assessed by LUC, refer to
		Appendix 2.
2	Shallow rock	The cable route bypasses rocky outcrops on the hill side
		north of the A712.
3	Significant	Steep undulations within the topography from the hill
	changes in	locations either side of the valley containing the A712, that
	elevation	may require cable anchoring systems to be designed and
		installed to minimise migration of the cable down a slope
		over the long term.
4	Crossing of A712	HDD crossing under A712 would be required with
		launch and reception pit identification to be developed.
		This HDD would pass through native woodland areas and
		medium (1 in 200 year) flood risk zones.
5	Knocknairling	HDD or dam and pump over crossing of burns and any
	Burn crossing	associated tributaries adjacent to Peal hill would be
		required. Medium flood risk zone (1 in 200 years) is located
		adjacent to the burn.
6	Dense woodland	Tree and stump clearing works would be required when
		cabling through dense woodland, temporary access roads
		would need to be constructed during the installation and for
		future maintenance.
7	Heavy forestry	Risk to the cable being traversed and damaged by heavy
	machinery	forestry machinery for all forestry shown on the map. The
		cable route passes through a section of native woodland
		southwest of Peal Hill.



Figure 25 – Black line showing cable route UGC3A

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4.3.4 Queen's Way Crossing Route Option UGC3B

Figure 26 is a magnified extract of the Glenlee – Tongland key plan, with cable route option UGC3B (10U) shown in red.





The UGC3B cable route in Figure 27, shown as a black line, runs from north to south, following the proposed OHL wayleave starting from the proposed new OHL tower GT08 through to GT21, and includes the Queen's Way crossing. The OHL wayleave passes through areas of peat habitats, shallow rock formations and dense forest where extensive forestry clearance would be required.

Towers with an elevated sealing end platform (sealing end platform attached to the tower body) would be required at both ends of this route at tower position GT08 and GT21. Both tower positions GT08 and GT21 are situated in peat habitats, within a private water supplies zone of interest, which would likely necessitate civil works to make the ground suitable for construction. In addition, both tower positions would likely require some levelling work and temporary haul road access to be constructed. Any loss of visual amenity associated with these tower positions has been assessed by LUC, refer to Appendix 2.

This proposed cable route contains more points of engineering difficulty than the other route options investigated within this study for UGC3. There would be a requirement for a permanent access road to allow construction and maintenance access to the cable route along its entire length. A-road access points for the maintenance and haul road would also be required. The installation of cables within forestry roads (which are temporary in their nature) may not be appropriate due to the requirements of future maintenance and access requirements.

A review of the cable route option UGC3B was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts by LUC.

Table 14 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on Figure 27.

Table 14 – Key points of engin	neering difficulty	y and environmenta	l sensitivity for
UGC3B			

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Peat	Adjacent to tower GT08 the ground was noted to contain
		significant peat. Peat ground preparation work would be
		required. This may also impact on cable conductor material
		and size. Tower GT08 is within a private water supplies
		zone of interest. Any loss of visual amenity associated with
		the terminal tower has been assessed by LUC, refer to
		Appendix 2.
2	Shallow rock	The cable route bypasses rocky outcrops on the hill side
		north of the A712, this may have implications for cable
		installation methods adopted.
3	Significant	Steep undulations within the topography from the hill
	changes in	locations either side of the valley containing the A712 that
	elevation	may require cable anchoring systems to be designed and
		installed to minimise migration of the cable down a slope
		over the long term.
4	Crossing of A712	HDD crossing under A712, launch and reception pit
		identification required. This HDD would pass through
		native woodland areas and medium (1 in 200 year) flood
-	77 1 11	risk zones.
5	Knocknairling	HDD or dam and pump over crossing of Knocknairling
	Burn crossing	burn south of $A/12$ would be required. Medium flood risk
(D 11 1	Zone (1 in 200 years) is located adjacent to the burn.
6	Dense woodland	I ree and stump clearing works would be required when
		cabling through dense woodland, temporary access roads
		would need to be constructed during the installation and for
7	Deet	Protection in the second secon
/	Peat	Peat nabitats located south of A/12, continuing along the
		route to approximately 0115. Pear ground preparation
		work may be required. This may also impact on cable
	1	conductor material and size.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
8	Burn crossing	HDD or dam and pump over crossing of burns and any associated tributaries would be required adjacent to Peal hill.
9	Pine Martin Exclusion Zone	Pine Martin den box and 30m exclusion zone marked between GT15 and GT16.
10	Dense woodland	Tree and stump clearing works would be required when cabling through dense woodland, temporary access roads would need to be constructed during the installation and for future maintenance.
11	Heavy forestry machinery	Risk to the cable being traversed and damaged by heavy forestry machinery for all forestry shown on the map.
12	Peat	Peat habitats adjacent to the tower GT18. Peat ground preparation work may be required. This may also impact on cable conductor material and size.
13	Dense woodland	Tree and stump clearing works would be required when cabling through dense woodland, temporary access roads would need to be constructed during the installation and for future maintenance.
14	Heavy forestry machinery	Risk to the cable being traversed and damaged by heavy forestry machinery for all forestry shown on the map.
15	Pultarson Burn Crossing	HDD or dam and pump over crossing of Pultarson burn south of GT20 would be required.
16	Peat	Peat habitats adjacent to the tower GT21. Peat ground preparation work may be required. This may also impact on cable conductor material and size. Any loss of visual amenity associated with the terminal tower has been assessed by LUC, refer to Appendix 2.



Figure 27 – Black line showing cable route UGC3B

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4.3.5 UGC3 Queen's Way Crossing Cable Route Appraisal Summary

Two cable route options have been studied for undergrounding between tower GT08 and GT21, the Queen's way crossing. The cable route studies have been based on the 21 criteria and other information detailed within section 3 of this study.

Installation of a cable route that bypasses peat habitats, runs adjacent to existing forest tracks where possible and avoids steep changes in elevation offers the best solution from a constructability perspective.

LUC maps³ provided to CCI show environmental features located on the proposed OHL wayleave. The HDD under the Queen's Way crosses under areas of natural woodland and through a 1 in 200 year flood risk zone. Other environmental features along the OHL route include a pine martin den and peat habitats which may impact on cable conductor material and size .

From a review of a geotechnical report provided by SPEN, the underlying rock formation is noted to be Wacke formation for the section of the route between towers GT08 and GT17 and then granite from GT17 to GT21. The superficial geology varies from clay/silt with gravel and boulders, sand and gravel and peat habitats up to 2.2m deep. Rocky outcrops of siltstone bedrock were also noted. Considering the OHL wayleave for UGC3, it can be calculated that some superficial geology will be present for approximately 38.5% of the route, with the remaining 61.5% containing none.

Cabling along the OHL wayleave (cable option UGC3B) poses many additional installation and environmental risks in comparison to the other cable route options presented and is therefore not the preferred cabling solution.

LUC indicated an overal environmental preference for route UGC3A as less tree felling would be required in comparison to the other route options considered within cable study UGC3, refer to Appendix 2.

CCI recommends cable route option UGC3A from the two route studies for the proposed OHL crossing of the Queen's Way. This option, though longer than the OHL route is more practicable for cabling installation as it follows established forest tracks where possible, thus reducing the requirement for felling and forest clearance. In addition, access to the cable route for future maintenance and repair operations could be more easily achieved and the replacement track maintained.

Access to the UGC3 routes was limited during the site survey, accordingly this preliminary route investigation is based largely on a desktop assessment, particularly to the southern side of the Queen's Way.

The selection of the preferred cable route will result in changes to wayleave requirements. Cable routes installed within existing carriageways would not require wayleaves for this section of the route. Other alternative cable routes will require changes to the proposed wayleaves, with wayleaves associated with the existing OHL routes being removed if they are not required.

4.3.6 UGC3 Queen's Way Crossing Cable Route Appraisal Conclusion

Following a joint review between CCI, LUC and SPEN, agreement was reached to adopt CCI's route preference UGC3A as the preferred cable route option for the Queen's Way crossing. This conclusion was predicated on cable route UGC3A being the preference for both the technical and environmental considerations.

Furthermore, it was agreed that the selection of cable route UGC3A partially met the objective (as the UGC will still have an impact on the Queen's Way crossing, particularly during construction) for the UGC3 cable study which was to mitigate potential landscape, visual, tourism and recreation impacts on the Queen's Way crossing tourist route between New Galloway and Newton Stewart, the gateway into the Galloway Forest Park.

4.4 UGC4 Bennan, Slogarie and Laurieston Forests Route Options

SPEN advised CCI that they had been asked to consider undergrounding as an alternative where this has been identified through pre-application consultation. As follows:

At the Bennan, Slogarie and Laurieston forest the key issue which has been raised during consultation is to mitigate potential landscape, visual, tourism and recreation, forestry, ecology and ornithology impacts on receptors within the Bennan, Slogarie and Laurieston forest areas within the Galloway Forest Park.

Consistent with SPEN's transmission licence duties and environmental obligations under Schedule 9 of the Electricity Act 1989¹ cable routes will have to establish a balance between engineering requirements, economic viability, land use and the environment. SPEN's objective for cable routeing within the Bennan, Slogarie and Laurieston forest areas is to "identify a technically feasible and economically viable cable route, within the Bennan, Slogarie and Laurieston forest areas, which causes, on balance, the least disturbance to people and the environment".

As listed in Table 3, the following 3 cable route options were identified for the crossing the Bennan, Slogarie and Laurieston Forests:

- UGC4A Cable route from GT25 to GT74
- UGC4B Undergrounding proposed OHL route from GT25 to GT74
- UGC4C Cable route following the A762 from GT25 to GT78

Table 15 contains the approximate route length comparisons, and it can be seen that the underground cable routes are longer than the OHL route by up to 23.8%.
Cable Route	Route Description	Route Length (km)
UGC4A	Cable route	14.2
UGC4B	Undergrounding proposed OHL route	13
UGC4C	Cable route following the A762	16.1
GT25 – GT74	Straight line distance	11.9

Table 15 – Approximate route length comparisons for UGC4

4.4.1 UGC4 Bennan, Slogarie and Laurieston Forests Current Rating and Circuit Details

The cable routing options considered under UGC4 require a continuous current rating of 815A to be transmitted through each of the two cable circuits connecting proposed OHL tower GT25 to GT78.

To deliver this magnitude of current it is expected that one cable per phase will be required for each circuit. The total number of cables required would therefore be 6 (3 per circuit). Consideration must also be given to the number of cable sealing ends required at terminal positions. To accommodate the 6 terminations required, towers containing elevated cable sealing end platforms (sealing end platforms attached to the tower body) will be necessary at either end of the route.

4.4.2 UGC4 Bennan, Slogarie and Laurieston Forests Geotechnical Review

From a review of a geotechnical report² provided by SPEN, the underlying rock formation is noted to be granite for the section of the route between towers GT25 and GT44, where outcrops comprising granite were noted, and then Wacke from GT45 to GT78. The superficial geology varies from gravel, sand and silt, clay / silt with gravel and boulders, and peat habitats up to 3.3m deep located at GT48.

Superficial geology refers to geological deposits typically of the Quaternary age which extends back about 2.6 million years. These deposits rest on the underlying rock, often referred to as bedrock.

Considering the OHL wayleave for UGC4, it can be calculated that some superficial geology will be present for approximately 26% of the route, with the remaining 74% containing none. Where the superficial geology layer is shallow or non-existent, a different approach for cable installation may be required. For example, shallow rock is not able to be broken up and dug out using a bucket on a backhoe excavator.

4.4.3 Bennan, Slogarie and Laurieston Forests Route Option UGC4A

Figure 28 is a magnified section of the Glenlee – Tongland key plan, with cable route option UGC4A (19C) shown in red. Figure 29 and Figure 30, shown as a black line, runs from north to south, from OHL tower GT25 to GT74, and includes parts of the Bennan, Slogarie and Laurieston forests.



Figure 28 – Magnified extract of key plan with red line showing cable route UGC4A

A preliminary cable route for UGC4A was selected which follows pre-existing forest tracks where possible, to mitigate environmental and other impacts associated with cabling through dense forest. The crossing position at the River Dee was identified as the area with the most potential to be suitable for an HDD, with the reception position on the southern bank located approximately 200 metres south of the riverbank at a position clear of dense woodland. The preliminary cable route passes east of Slogarie, Bennan and Kenick Hill's to avoid both the extensive peat habitats and the archaeologically sensitive areas identified by LUC.

Access to the UGC4A cable route was limited during the site survey; accordingly, this preliminary route investigation is based largely on a desktop assessment. However, from the observations made during the survey, it was noted that the geological and topographical features combine to make this route far from ideal for HV cable installation. Specific obstructions included densely wooded ground, sloping ground, shallow rock and peat habitats.

Towers with an elevated sealing end platform (sealing end platform attached to the tower body) would be required at both ends of this route at tower position GT25 and GT74. Both tower positions GT25 and GT74 are situated in or close to peat habitats which would likely necessitate civil works to make the ground suitable for construction. In addition, both tower positions would likely require some levelling work and temporary haul road access to be constructed. Possible adverse visual impacts associated with these tower positions are to be assessed by LUC, refer to Appendix 2.

There would be a requirement for a permanent access road to allow maintenance access to the cable route along its entire length. A-road access points for the maintenance and haul road would also be required. The installation of cables within forestry roads (which are temporary in their nature) may not be appropriate due to the requirements of future maintenance and access requirements.

A review of the cable route option UGC4A was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts. Table 16 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on Figure 29 and Figure 30. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Table 16 – Key po	oints of engineering	g difficulty and	environmental	sensitivity	for
UGC4A					

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Peat	Potential for unquantifiable peat located in dense woodland within the forests adjacent to tower. Peat ground preparation work may be required. This may also impact on cable conductor material and size. Any loss of visual amenity associated with the terminal tower has been assessed by LUC, refer to Appendix 2.
2	Significant	Steep undulations within the forest topography associated
	changes in	with Cairn Edward Hill that may require cable anchoring
	elevation	systems to be designed and installed to minimise migration
		of the cable down a slope over the long term.
3	Mid Burn	HDD or dam and pump over crossing of Mid Burn adjacent
	crossing	to Upper Gairloch would be required.
4	Dense woodland	Tree and stump clearing works would be required when cabling through dense woodland adjacent to Forest Drive. The forest areas at this location are noted to be a mix of native and ancient woodlands.
5	Heavy forestry machinery	Risk to the cable being traversed by heavy forestry machinery along Forest Drive.
6	Acre Burn crossing	HDD or dam and pump over crossing for Acre Burn adjacent to Knowle Happle would be required. Low (1 in 1000 year) and medium (1 in 200 year) flood risk zones are located just south of the cable route.
7	Clachrum Burn crossing	HDD or dam and pump over crossing of Clachrum Burn adjacent to Clachrum would be required. Low (1 in 1000 year) and medium (1 in 200 year) flood risk zones are located just south of the cable route. A pine marten den is noted north east of the cable route.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
8	Dismantled	HDD crossing, or open cut trenching would be required at
	railway crossing	the embankment associated with the dismantled railway line
		adjacent to the Stroan viaduct. This would be dependent on
		the crossing position. Native wood lands and pine marten
		dens are located adjacent to the cable route.
9	Dense woodland	Clearing works would be required when cabling through
		dense woodland north of the river Dee crossing.
10	Heavy forestry	Risk to the cable being traversed and damaged by heavy
	machinery	forestry machinery for all forestry shown on the map.
11	River Dee	HDD under river Dee would be required, extending to
	crossing	access track on the southern bank adjacent to Slogarie
		bridge. Launch and reception pit identification and access
12	Danca woodland	Clearing works would be required when ashling through
12	Dense woodiand	dense woodland south of Slogaria Bridge. The forest grass
		at this location are noted to be a mix of native and ancient
		woodlands Medium (1 in 200 year) flood risk zones are
		located just west of the cable route A residential property
		is also sited east of the cable route. Non-inventory designed
		landscape is also situated west of the cable route south of
		Slogarie Bridge.
13	Significant	Steep undulations within the forest topography associated
	changes in	with Bennan Hill that may require cable anchoring systems
	elevation	to be designed and installed to minimise migration of the
		cable down a slope over the long term. The cable route
		passes east of an area of native woodland south of White
		Hill.
14	Unnamed Burn	HDD or dam and pump over crossing of unnamed Burn's
	crossings	south of Little White Hill would be required.
15	Heavy forestry	Risk to the cable being traversed and damaged by heavy
	machinery	forestry machinery south of Slogarie Bridge and adjacent to
16	11 1D	Craig Hill.
16	Unnamed Burn	HDD or dam and pump over crossing of unnamed Burn
17	crossing	south of Craig Hill would be required.
17	Dense woodland	Clearing works would be required when cabling through
10	U 1D	dense woodland east of Kenick Hill.
18	Kenick Burn	HDD crossing of Kenick Burn, west of Barlue Hill would
	crossing	be required. With HDD extended to include an unnamed
		country lane. Medium (1 in 200 year) flood risk zones are
1		located just west of the cable route. The cable route passes

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		south of an area of ancient woodland south of the Kenick
		Burn.
19	Dense woodland	Clearing works would be required when cabling through
		dense woodland east of Crow Whits. The cable passes
		through a private water source protection zone and within
		150m of a residential property sited to the east at Cullenoch.
20	Heavy forestry	Risk to the cable being traversed and damaged by heavy
	machinery	forestry machinery for all forestry shown on the map.
21	Gatehouse Burn	HDD or dam and pump over crossing of Gatehouse Burn,
	crossing	east of Craigelwhan would be required.



Figure 29 – Black line showing cable route UGC4A section 19C(part)

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Figure 30 – Black line showing cable route UGC4A section 19C(part)

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4.4.4 Bennan, Slogarie and Laurieston Forests Route Option UGC4B

Figure 31 is a magnified section of the Glenlee – Tongland key plan, with cable route option UGC4B (18U) shown in red.

Figure 31 – Magnified extract of key plan with red line showing cable route UGC4B



The UGC4B cable route in Figure 32 and Figure 33, shown as a black line, runs from north to south, following the proposed OHL wayleave, from OHL tower GT25 to GT74 and includes parts of the Bennan, Slogarie and Laurieston forests. The OHL wayleave passes through peat habitats, dense forest and an archaeological sensitive area.

Towers with an elevated sealing end platform (sealing end platform attached to the tower body) would be required at both ends of this route at tower position GT25 and GT74. Both tower positions GT25 and GT74 are situated in or close to peat habitats which would likely necessitate civil works to make the ground suitable for construction. In addition, both tower positions would likely require some levelling work. A temporary haul road access would need to be constructed. Any loss of visual amenity associated with these tower positions has been assessed by LUC, refer to Appendix 2. Terminal towers would be a large tension design with basket SEP or terminal compound.

This proposed cable route contains more points of engineering difficulty than the other route options investigated within this study for UGC4. There would be a requirement for a permanent access road to allow maintenance access to the cable route along its entire length. A-road access points for the maintenance and haul road would also be required. The installation of cables within forestry roads (which are temporary in their nature) may not be appropriate due to the requirements of future maintenance and access requirements.

A review of the cable route option was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. LUC noted that the OHL wayleave passes through the Grobdale ASA and recommends that the OHL route is re-routed to avoid this area, which has not been included for the cable route in this study, to maintain position within the OHL wayleave.

Table 17 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on Figure 32 and Figure 33. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Table 17 - Key points of engineering difficulty and environmental sensitivity for UGC4B

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Peat	Potential for unquantifiable peat located in dense woodland within the forests. Peat ground preparation work may be required. This may also impact on cable conductor material and size. Any loss of visual amenity associated with the terminal tower has been assessed by LUC, refer to Appendix 2.
2	Significant changes	Steep undulations within the forest topography associated
	in elevation	with Cairn Edward Hill that may require cable anchoring
		systems to be designed and installed to minimise
		migration of the cable down a slope over the long term.
3	Mid Burn crossing	HDD or dam and pump over crossing of Mid Burn adjacent to Upper Gairloch would be required.
4	Dense woodland	Tree and stump clearing works would be required when cabling through dense woodland adjacent to Sannoch. The forest areas at this location are noted to be a mix of native and ancient woodlands.
5	Heavy forestry machinery	Risk to the cable being traversed by heavy forestry machinery at Sannoch.
6	Peat	Potential for unquantifiable peat located in dense woodland within the forests adjacent to Sannoch. Peat ground preparation work may be required. This may also impact on cable conductor material and size.
7	Significant changes in elevation	Steep undulations within the forest topography associated with Millminnoch that may require cable anchoring systems to be designed and installed to minimise migration of the cable down a slope over the long term. The forest areas at this location are noted to be a mix of native and ancient woodlands.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
8	Acre Burn crossing	HDD or dam and pump over crossing of Acre Burn would
		be required.
9	Peat	Potential for unquantifiable peat located in dense
		woodland within the forests adjacent to Clachrum Rig.
		Peat ground preparation work may be required. This may
		also impact on cable conductor material and size.
10	Native Woodland	Area of native woodland is cut through, east of Craigdoon.
11	Clachrum Burn	HDD or dam and pump over crossing of Clachrum Burn
12	Dum magina	UDD on dom and numer over areasing of Dum couth of
12	Burn crossing	Bennan Moss would be required A pine marten den is
		noted south of the cable route at this location
13	Significant changes	Steen undulations within the forest tonography associated
15	in elevation	with Airds Craig that may require cable anchoring
		systems to be designed and installed to minimise
		migration of the cable down a slope over the long term.
		An area of native woodland is passed through south of
		Airds Craig.
14	Dismantled railway	HDD or open cut trench crossing of the embankment
	crossing	would be required associated with the dismantled railway
		line adjacent to the Stroan viaduct. This would be
		dependent on the crossing position. An area of native
		woodland is passed through south of the dismantled
1.7	D 11 1	railway line.
15	Dense woodland	Clearing works would be required when cabling through
16	Haava faractry	Disk to the cable being traversed and demograd by because
10	machinery	forestry machinery for all forestry shown on the man
17	River Dee crossing	HDD under river Dee would be required with launch and
17	River Dee crossing	reception pit identification and access for drilling rigs to
		be developed. Medium (1 in 200 year) flood risk zones are
		located either side of the River Dee crossing position.
18	Grobdale ASA	Route passes through Grobdale archaeological sensitive
		area. Peat habitats are also noted in this location. Peat
		ground preparation work may be required. This may also
		impact on cable conductor material and size.
19	Significant changes	Steep undulations within the forest topography associated
	in elevation	with Stroan and Bennan Hill that may require cable
		anchoring systems to be designed and installed to
		minimise migration of the cable down a slope over the
		long term.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
20	Peat	Potential for unquantifiable peat located in dense
		woodland within the forests west of Brennan Hill. Peat
		ground preparation work may be required. This may also
		impact on cable conductor material and size.
21	Dense woodland	Clearing works would be required when cabling through
		dense woodland west of Brennan Hill.
22	Unnamed Burn	HDD or dam and pump over crossing of unnamed Burn's
	crossings	east of Slogarie Hill would be required.
23	Significant changes	Steep undulations within the forest topography associated
	in elevation	with Slogarie and Tormollan Hill that may require cable
		anchoring systems to be designed and installed to
		minimise migration of the cable down a slope over the
		long term.
24	Peat	Potential for unquantifiable peat located in dense
		woodland within the forests west of Kenick Hill. Peat
		ground preparation work may be required. This may also
		impact on cable conductor material and size.
25	Heavy forestry	Risk to the cable being traversed and damaged by heavy
	machinery	forestry machinery west of Kenick Hill.
26	Significant changes	Steep undulations within the forest topography associated
	in elevation	with Kenick Hill that may require cable anchoring
		systems to be designed and installed to minimise
		migration of the cable down a slope over the long term.
27	Dense woodland	Clearing works would be required when cabling through
		dense woodland west of Kenick Hill, with areas of native
		woodland sited along the cable route.
28	Ancient and Native	Route crosses through areas of both ancient and native
	woodlands	woodlands adjacent to Kenick Burn.
29	Kenick Burn	HDD crossing of Kenick Burn, south of Kenick Hill
	crossing	would be required. With HDD extended to include an
		unnamed country lane.
30	Peat	Potential for unquantifiable peat located in dense
		woodland within the forests south of Kenick burn. Peat
		ground preparation work may be required. This may also
		impact on cable conductor material and size.
31	Dense woodland	Clearing works would be required when cabling through
		dense woodland south of Kenick burn. The cable passes
		through a private water source protection zone south of
		Kenick Burn.
32	Heavy forestry	Risk to the cable being traversed and damaged by heavy
	machinery	forestry machinery in woodland south of Kenick burn.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
33	Gatehouse Burn	HDD or dam and pump over crossing of Gatehouse Burn,
	crossing	east of Craigelwhan would be required.



Figure 32 – Black line showing cable route UGC4B section 18U(part)

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Figure 33 – Black line showing cable route UGC4B section 18U(part)

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4.4.5 Bennan, Slogarie and Laurieston Forests Route Options UGC4C

Figure 34 is a magnified section of the Glenlee – Tongland key plan, with cable route option UGC4C (36C) shown in red.





The UGC4C cable route in Figure 35 and Figure 36, shown as a black line, runs from north to south, from OHL tower GT25 to GT78, and includes part of Bennan forest before diverting east at the Stroan viaduct along a dismantled railway line to follow the A762, to terminate at tower GT78.

Towers with an elevated sealing end platform (sealing end platform attached to the tower body) would be required at both ends of this route at tower position GT25 and GT78. Both tower positions GT25 and GT78 are situated in or close to peat habitats which would likely necessitate civil works to make the ground suitable for construction. In addition, both tower positions would likely require some levelling work. A temporary haul road access would need to be constructed at GT25 and GT78. Any loss of visual amenity associated with these tower positions has been assessed by LUC, refer to Appendix 2.

There would be a requirement for a permanent access road to allow maintenance access to the northern section of the cable route from tower GT25 to the Stroan viaduct. The installation of cables within forestry roads (which are temporary in their nature) may not be appropriate due to the requirements of future maintenance and access requirements.

The UGC4C cable route was selected to mitigate environmental and other impacts associated with cabling through dense forest, by diverting east out of the forest area, via the dismantled railway line between the Stroan viaduct and Mossdale and onto the A762.

The cable route remains in the carriageway heading south until it dissects the proposed OHL route at tower GT78.

By utilising the A762, UGC4C cable route negates many of the points of engineering difficulty associated with cabling through dense forest areas and peat habitats, although it is the longest of the three cable route options considered under the UGC4 study and there is some concern at the usability of the A762 due to its width. This route reduces the number of burns that require crossing and provides potential to develop alternative methods for crossing the River Dee. As the UGC4C cable route crosses the River Dee at Hensol road bridge in the A762, where the existing road bridge deck, a specially designed cable bridge adjacent to the road bridge or an HDD could be developed to provide a crossing solution.

Where the cable is laid in the road, it is envisaged that the cable route would be installed in one carriageway with the other carriageway kept open for traffic. Joint bays would be positioned in the verge or in laybys wherever reasonably practicable.

Access to the northern section of the UGC4C cable route was limited during the site survey; accordingly, this section of the preliminary route investigation is based largely on a desktop assessment.

A review of the cable route option UGC4C was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts.

Table 18 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on Figure 35 and Figure 36. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Peat	Potential for unquantifiable peat located in dense
		woodland within the forests adjacent to tower. Peat
		ground preparation work may be required. This may also
		impact on cable conductor material and size. Any loss of
		visual amenity associated with the terminal tower has
		been assessed by LUC, refer to Appendix 2.
2	Significant changes	Steep undulations within the forest topography associated
	in elevation	with Cairn Edward Hill that may require cable anchoring

Table 18 - Key points of engineering difficulty and environmental sensitivity for UGC4C

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		systems to be designed and installed to minimise
		migration of the cable down a slope over the long term.
3	Mid Burn crossing	HDD or dam and pump over crossing of Mid Burn
		adjacent to Upper Gairloch would be required.
4	Dense woodland	Tree and stump clearing works would be required when
		cabling through dense woodland adjacent to Forest Drive.
		The forest areas at this location are noted to be a mix of
	-	native and ancient woodlands.
5	Heavy forestry	Risk to the cable being traversed by heavy forestry
	machinery	machinery for all forestry shown on the map.
6	Acre Burn crossing	HDD or dam and pump over crossing for Acre Burn
		adjacent to Knowle Happle would be required. Low (1 in
		1000 year) and medium (1 in 200 year) flood risk zones
		are located just south of the cable route.
7	Clachrum Burn	HDD or dam and pump over crossing of Clachrum Burn
	crossing	adjacent to Clachrum would be required. Low (1 in 1000
		year) and medium (1 in 200 year) flood risk zones are
		located just south of the cable route. A pine marten den is
		noted north east of the cable route, which the cable route
		avoids.
8	Dismantled railway	Native wood lands and pine marten dens are located
	cutting	adjacent to the cable route where it merges with the
		dismantled railway line adjacent to the Stroan viaduct.
		The native woodland extends along the railway line east
		where the railway line is cut into the rock. Due
		consideration is required of the elevational change as the
0	Diamontlad milway	Cable route aligns with the disused ranway line.
9	ombonisment	cabing within an elevated embankment with dense forest and next habitate located on either side. Public access to
	embankment	and peat nationals located on entitle side. Fublic access to
10	Cabling within	Potential disruption associated with cabling through
10	A 762 at Mossdale	Mossdale Traffic management plan would need to be
	11/02 at 110050ate	developed and adopted Cabling in close proximity to
		residential properties within Mossdale.
11	River Dee Crossing	River Dee crossing adjacent to Hensol Bridge requiring
	at Hensol Bridge	either HDD or installation in bridge deck. Low (1 in 1000
		year) and medium (1 in 200 year) flood risk zones are
		located either side of Hensol Bridge.
12	Listed Buildings	A762 and the cable route pass two grade 2 category B
	and Native	listed buildings and through a section of native woodland
	Woodlands	

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		South of Hensol Bridge. The native woodland extends
		south to a third category C listed building at little Duchrae.
13	Cabling within	Potential for several tributary crossings and shallow
	A762	bridge sections within A762 adjacent to Woodhall Loch.
		Low (1 in 1000 year) and medium (1 in 200 year) flood
		risk zones are located east of Woodhall Loch. The A762
		passes through sections of native woodland adjacent to
		Woodhall Loch.
14	Laurieston Hall	Cabling in A762 adjacent to Laurieston Hall a non-
		inventory designed landscape and category B listed
		building.
15	Services within	Both OHL and buried services were noted on A762 north
	A762	of Laurieston.
16	Cabling within	Difficulties associated with cabling within a narrow road
	Laurieston	in a populated area. An appropriate traffic management
		plan would need to be developed and adopted. The cable
		route passes within close proximity to multiple residential
		properties. Unknown quantity of buried existing utilities
1.5	D	within the carriageway.
17	Burn crossing at	Burn crossing adjacent to Mill Lade requiring either HDD
10	Mill Lade	or dam and pump over.
18	Services within	OHL services were noted along the A/62 running the
10	A/62	extent of Laurieston village.
19	Cabling at junction	Evidence of services buried in the carriageway and
	with B795	overhead services noted at the junction of the A/62 and
		B/95. Potential disruption associated with cabling across
		a reasonably busy road junction. I rattic management plan
20		would need to be developed and adopted.
20	Cabling within	Potential for several tributary crossings and shallow
21	A/02	The A762 reasons along to an attempt time wint on 1
21	otter resting point	I ne A / 62 passes close to an otter resting point and private
	and F w S Zone OI	water suppry zone of influence south of Gatenouse bridge.
22	Otton posting point	by cauling within the A/02 these are avoided.
22	otter resting point	The caple route dissects a native woodland north east of
	and native	Cameron orlage. Due consideration was also given to
	woodiand	nee ouer resung points which were noted in close
22	Doot habitat and	Potontial for unquantificable most least of a discont to the
23	etter resting resists	GT78 Doot ground propagation work may be ground
	ouer resung points	This may also impact on cable conductor meterial and
		rins may also impact on cable conductor material and size. Any loss of visual amonity associated with the
	1	j size. Any joss of visual amenity associated with the

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		terminal tower has been assessed by LUC. Reference
		should be made to Appendix 2. Tower position is close to
		two otter resting points.



Figure 35 – Black line showing cable route UGC4C section 36C(part)

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Figure 36 – Black line showing cable route UGC4C section 36C(part)

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4.4.6 UGC4 Bennan, Slogarie and Laurieston Forests Cable Route Appraisal Summary

Three cable route options have been studied for undergrounding between tower GT25 and GT74 a section of the proposed OHL route that crosses the Bennan, Slogarie and Laurieston forests. The cable route studies have been based on the 21 criteria and other information detailed within section 3 of this study.

Installation of a cable route within the A762 carriageway provides a solid and reliable installation base when compared to installing cable within dense forest and peat habitats and offers the best solution from a constructability perspective. Installation in the A762 also reduces the number of burns that require crossing and provides potential to develop alternative methods for crossing the River Dee. However, there is some concern at the usability of the A762 due to its width in places and the carriageway introduces a risk to the workforce associated with moving traffic, but this risk can be managed with an effective traffic management system.

Cabling within an existing carriageway would also offer improved access both during the installation works and after when access for maintenance would be required. This is particularly relevant when considering access to the terminal tower positions at either end of the UGC4 cabling route. Where tower GT78 is located relatively close to the A762 and would require less civil works during the construction phase and would be easier to access for maintenance than GT74.

Where existing forest tracks are used for cable routing, consideration must be given to the risk of future damage to the cable system by heavy forestry plant and machinery that frequently use the tracks. A solution which limits use of forestry tracks for the cable would be of preference. Cabling within the dismantled railway line is anticipated to prove challenging both from an engineering and permissions perspective, with ownership of disused lines often proving complex.

LUC maps³ provided to CCI show environmental features located on the proposed OHL wayleave. The A762 passes in close proximity to multiple dwellings at Mossdale and Laurieston and contains several watercourse crossings including the River Dee. The A762 also passes through sections of native woodlands and through medium (1 in 200 year) flood risk zones. However, as the cable installation work is following the existing carriageway no new clearance of woodlands would be required. With regards flood risk, the carriageway construct contains an integrated drainage system which should assist with protection of the cable system from wash out both during the installation phase and whilst in operation. Overall these risks were deemed manageable, especially when considered in comparison to the impact and associated risks cabling within dense, forest areas that contain peat habitats.

From a review of a geotechnical report² provided by SPEN, the underlying rock formation is noted to be granite for the section of the route between towers GT25 and GT44, where outcrops comprising granite were noted, and then Wacke from GT45 to GT78.

The superficial geology varies along the route from gravel, sand and silt, clay / silt with gravel and boulders. Peat habitats up to 3.3m deep were recorded at GT48. Considering the OHL wayleave for UGC4, it can be calculated that some superficial geology will be present for approximately 26% of the route, with the remaining 74% containing none.

Cabling with the A762 would be expected to create more disturbance for residents during the installation phase when compared to cabling within the forests. However, as the installation phase is temporary and with the possibility that traffic management systems could be designed to maintain traffic flow using a single carriageway, disturbance for residents could be managed and kept to a minimum.

Cabling along the OHL wayleave (cable option UGC3B) poses many additional installation and environmental risks in comparison to the other cable route options presented, including passing through the Grobdale archaeologically sensitive area, and is therefore not the preferred cabling solution. Furthermore, cabling within the OHL route would require a permanent access road to be constructed through the forests, to allow maintenance access to the cable route along its entire length.

LUC indicated an overal environmental preference for route UGC4C as although longer, it requires the least tree felling and will have the least impact on the Raiders Road and other recreational routes through paralleling the A762, refer to Appendix 2.

CCI recommends cable route option UGC4C from the three route options investigated for the proposed OHL crossing of Bennan, Slogarie and Laurieston forests. This cable route option presents the most practicable option for cable installation as it negates many of the points of engineering difficulty associated with cabling through dense forest and peat habitats. In addition, UGC4C offers the best access both during the installation phase and after when access for future maintenance work is required.

Access to the northern section of UGC4C cable route was limited during the site survey, accordingly this section of the cable route investigation is based largely on a desktop assessment.

The selection of the preferred cable route will result in changes to wayleave requirements. Cable routes installed within existing carriageways would not require wayleaves for this section of the route. Other alternative cable routes will require changes to the proposed wayleaves, with wayleaves associated with the existing OHL routes being removed if they are not required.

4.4.7 UGC4 Bennan, Slogarie and Laurieston Forest Cable Route Appraisal Conclusion

Following a joint review between CCI, LUC and SPEN, agreement was reached to adopt CCI's route preference UGC4C as the preferred cable route option for the Bennan, Slogarie and Laurieston forests. This conclusion was predicated on cable route UGC4C being the preference for both the technical and environmental considerations.

Furthermore, it was agreed that the selection of cable route UGC4C partially (as the UGC will still have an impact on the Bennan Forest, particularly during construction) met the objective for the UGC4 cable study which was to mitigate potential landscape, visual, tourism and recreation, forestry, ecology and ornithology impacts on receptors within the Bennan, Slogarie and Laurieston forest areas within the Galloway Forest Park.

4.5 UGC5 A75 Crossing Cable Route

SPEN advised CCI that they had been asked to consider undergrounding as an alternative where this has been identified through pre-application consultation. As follows:

At the A75 crossing the key issue which has been raised during consultation is to mitigate potential landscape and visual impacts of the proposed overhead line crossing of the A75 tourist route between Dumfries and Stranraer.

Consistent with SPEN's transmission licence duties and environmental obligations under Schedule 9 of the Electricity Act 1989¹ cable routes will have to establish a balance between engineering requirements, economic viability, land use and the environment. SPEN's objective for cable routeing at the A75 crossing is to "identify a technically feasible and economically viable cable route, at the A75 crossing, which causes, on balance, the least disturbance to people and the environment".

As listed in Table 3, the following 2 cable route options were identified for the A75 crossing:

- UGC5A Cable route
- UGC5B Undergrounding of the proposed OHL route within its wayleave

Table 19 contains the approximate route length comparisons for the two options. It can be seen that the underground cable route options are within 8% of each other.

Cable Route	Route Description	Route Length (km)
UGC5A	Cable route	2.2
UGC5B	Undergrounding proposed OHL route	2.03
GT97 – GT104	Straight line distance	2.0

Table 19 – Approximate route length comparisons for the UGC 5 A75 Crossing

4.5.1 UGC5 A75 Crossing Current Rating and Circuit Details

The cable routing options considered under UGC5 require a continuous current rating of 815A to be transmitted through each of the two cable circuits connecting proposed OHL GT97 to GT104.

To deliver this magnitude of current it is expected that at one cable per phase will be required for each circuit. The total number of cables required would therefore be 6 (3 per circuit).

Consideration must also be given to the number of cable sealing ends required at terminal positions. To accommodate the 6 terminations required, towers containing elevated cable sealing end platforms (sealing end platforms attached to the tower body) will be necessary at either end of the route.

4.5.2 UGC5 A75 Crossing Geotechnical Review

From a review of a geotechnical report² provided by SPEN, the underlying rock formation is noted to be Wacke formation for the section of the route between towers GT97 and GT104, comprising parallel-sided thin to medium bedded turbidite rock. The superficial geology varies from clay/silt with gravel and boulders, with a majority of the route having no superficial geology recorded.

Superficial geology refers to geological deposits typically of the Quaternary age which extends back about 2.6 million years. These deposits rest on the underlying rock, often referred to as bedrock.

Considering the OHL wayleave for UGC5, it can be calculated that some superficial geology will be present for approximately 12.5% of the route, with the remaining 87.5% containing none. Where the superficial geology layer is shallow or non-existent, a different approach for cable installation may be required. For example, where shallow rock is not able to be broken up and dug out using a bucket on a backhoe excavator.

4.5.3 A75 Crossing Route UGC5A

Figure 37 is a magnified section of the Glenlee – Tongland key plan, with cable route option UGC5A (26C+28C) shown in red.



Figure 37 – Magnified extract of key plan with red line showing cable route UGC5A

The UGC5A cable route in Figure 38, shown as a black line, runs from north to south, from OHL tower GT97 to GT104 and includes the crossing of A75. LUC reset the tower position to GT97 and GT104 to achieve a required level of visual amenity.

A preliminary cable route for UGC5A was selected which largely follows the proposed overhead line route. This is reflected in the cable route length being similar to that of the overhead line route length. With deviations from the overhead line route being associated with avoidance of rocky outcrops, peat habitats, residential properties and steep changes in elevation.

Towers with an elevated sealing end platform (sealing end platform attached to the tower body) would be required at both ends of this route at tower position GT97 and GT104. GT97 has good access available from a lane which joins the A75. At GT104, access is more restricted with temporary haul roads being required to link the tower position to lanes that lead onto the A711. Any loss of visual amenity associated with these tower positions has been assessed by LUC, refer to Appendix 2.

A review of the cable route option UGC5A was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts.

Table 20 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circle on Figure 38. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Table 20 – Key points of engineering difficulty and environmental sensitivity for UGC5A $\,$

Item	Points of	Comment	
No.	Engineering		
	Difficulty and		
	Environmental		
	Sensitivity		
1	Peat	Adjacent to tower GT97 the ground was noted to contain significant peat. Peat ground preparation work may be required. This may also impact on cable conductor material and size. Any loss of visual amenity associated with the terminal tower has been assessed by LUC, refer to Appendix 2.	
2	Residential	Several residential properties are located on the lane west	
	Properties	of the cable route at White Hill.	
3	A75 crossing	HDD under A75 would be required, launch and reception	
		pit identification and access for drilling rigs is likely to be	
		good.	
4	Native	Native woodland is located east of the cable route adjacent	
	woodlands and	to Ardgrennan Cottages but is unlikely to be directly	
	Peat	affected. Intermittent peat habitats . Several residential	
		properties are also situated east of the cable route at	
		Barstibly.	
5	Significant	Steep undulations within the topography heading south	
	changes in	from the A75 towards proposed tower GT103 that may	
	elevation	require cable anchoring systems to be designed and	
		installed to minimise migration of the cable down a slope	
		over the long term	
6	Shallow rock	Rocky outcrops are bypassed by the cable route on the hill	
		side south of the A75 close to proposed tower location	
		GT103 and GT104.	



Figure 38 – Black line showing cable route UGC5A

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4.5.4 A75 Crossing Route UGC5B

Figure 39 is a magnified section of the Glenlee – Tongland key plan, with cable route option UGC5B (27U-29U) shown in red.





The UGC5B cable route in Figure 40, shown as a black line, runs from north to south following the proposed OHL wayleave, from OHL tower GT97 to GT104 and includes the crossing of A75. The OHL wayleave passes through areas of peat habitats, shallow rock formations and undulating topography.

Towers with an elevated sealing end platform (sealing end platform attached to the tower body) would be required at both ends of this route at tower position GT97 and GT104. GT97 has good access available from a lane which joins the A75. At GT104, access is more restricted with temporary haul roads being required to link the tower position to lanes that lead onto the A711. Construction may also be hampered by an adjacent area of native woodland. Any loss of visual amenity associated with these tower positions has been assessed by LUC, refer to Appendix 2.

This proposed cable route contains more points of engineering difficulty than the other route options investigated within this study for UGC5. There would be a requirement for a permanent access road to allow construction and maintenance access to the cable route

along its entire length. A-road access points for the maintenance and haul road would also be required.

A review of the cable route option UGC5B was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts.

Table 21 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circle on Figure 40. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Table 21 – Key points of engineering difficulty and environmental sensitivity for UGC5B

Item	Points of	Comment		
No.	Engineering			
	Difficulty and			
	Environmental			
	Sensitivity			
1	Peat	Adjacent to tower GT97 the ground was noted to contain significant peat. Peat ground preparation work may be		
		required. This may also impact on cable conductor material		
		and size. Any loss of visual amenity associated with the		
		terminal tower has been assessed by LUC, refer to		
		Appendix 2.		
2	Residential	Several residential properties are located on the lane west		
	Properties	of the cable route at White Hill.		
3	A75 crossing	HDD under A75 would be required, launch and reception		
		pit identification and access for drilling rigs is likely to be		
		good.		
4	Native	Native woodland is located east of the cable route adjacent		
	woodlands and	to Ardgrennan cottages but is unlikely to be directly		
	Peat	affaceted. Intermittent peat habitats. Several residential		
		properties are also situated east of the cable route at		
		Barstibly.		
5	Significant	Steep undulations within the topography heading south		
	changes in	from the A75 towards proposed tower GT103 that may		
	elevation	require cable anchoring systems to be designed and		
		installed to minimise migration of the cable down a slope		
		over the long term.		
6	Shallow rock	Rocky outcrops are crossed by the cable route on the hill		
		side south of the A75 close to proposed tower location		
		GT103 and GT104.		



Figure 40 – Black line showing cable route UGC5B

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4.5.5 UGC5 A75 Crossing Cable Route Appraisal Summary

Two cable route options have been studied for undergrounding between tower GT97 and GT104, the A75 crossing. The cable route studies have been based on the 21 criteria and other information detailed within section 3 of this study.

Installation of a cable route that bypasses peat habitats, avoids steep changes in elevation and rocky outcrops offers the best solution from a constructability perspective. LUC maps³ provided to CCI show environmental features located on the proposed OHL wayleave. Environmental features along the OHL route include native woodlands and peat habitats which may impact on cable conductor material and size.

From a review of a geotechnical report² provided by SPEN, the underlying rock formation is noted to be Wacke formation for the section of the route between towers

GT97 and GT104, comprising parallel-sided thin to medium bedded turbidite rock. The superficial geology is formed of clay/silt with gravel and boulders, with a majority of the route having no superficial geology recorded. Considering the OHL wayleave for UGC5, it can be calculated that some superficial geology will be present for approximately 12.5% of the route, with the remaining 87.5% containing none.

Cabling along the OHL wayleave (cable option UGC5B) poses some additional installation risks associated with rocky outcrops and changes in elevation in comparison to the other cable route options presented and is therefore not the preferred cabling solution.

LUC provided no overall environmental preference between the cable route options considered within cable study UGC5, due to the presence of few environmental constraints within this UGC, and with both routes following the alignment of the existing OHL wayleave. Refer to Appendix 2.

CCI recommends cable route option UGC5A from the two route options investigated for the proposed OHL crossing of the A75. This option, though slightly longer than the OHL route is more practicable for cabling installation as it avoids steep changes in elevation and rocky outcrops. Access to the UGC5 routes was limited during the site survey, accordingly this preliminary route investigation is based on a desktop assessment, particularly to the southern side of the A75.

The selection of the preferred cable route will result in changes to wayleave requirements. Cable routes installed within existing carriageways would not require wayleaves for this section of the route. Other alternative cable routes will require changes to the proposed wayleaves, with wayleaves associated with the existing OHL routes being removed if they are not required.

4.5.6 UGC5 A75 Crossing Route Appraisal Conclusion

Following a joint review between CCI, LUC and SPEN, agreement was reached to adopt CCI's route preference UGC5A as the preferred cable route option for the A75 crossing. This conclusion was predicated on cable route UGC5A being the preference for the technical considerations, as in this instance no environmental preference was given owing to presence of few environmental constraints within the UGC5 study extents.

Furthermore, it was agreed that the selection of cable route UGC5A wholly met the objective for the UGC5 cable study which was to mitigate potential landscape and visual impacts of the proposed overhead line crossing of the A75 tourist route between Dumfries and Stranraer.

4.6 UGC6 Glenlee Substation – Tongland Substation Route Options

SPEN advised CCI that they had been asked to consider undergrounding as an alternative where this has been identified through pre-application consultation. As follows:

Between Glenlee substation and Tongland substation, the key issue which has been raised during consultation is to ensure consistency with the approach to routeing of overhead line i.e. a 'blank sheet' approach to identifying potential cable route options both east and west of Loch Ken.

Consistent with SPEN's transmission licence duties and environmental obligations under Schedule 9 of the Electricity Act 1989¹, cable routes will have to establish a balance between engineering requirements, economic viability, land use and the environment. SPEN's objective for cable routeing between Glenlee substation and Tongland substation is to "identify a technically feasible and economically viable cable route, between Glenlee substation and Tongland substation, which causes, on balance, the least disturbance to people and the environment".

As listed in Table 3, the following 5 cable route options were identified between Glenlee substation and Tongland substation:

- UGC6A
- UGC6B
- UGC6C
- UGC6D
- UGC6E

Figure 41 provides a key plan that shows each section of cable and OHL route under consideration between Glenlee substation and Tongland substation.



Figure 41 – Key plan for Glenlee Substation – Tongland Substation

Table 22 contains the approximate route lengths for the five route options, compared to the proposed OHL wayleave and the straight-line alternative.

The underground cable route options vary markedly in length, with cable route alternatives that follow the west side of the Loch Ken, routes UGC6A and UGC6B generally being shorter than the proposed OHL route. In comparison, the two cable route options UGC6D and UGC6E that follow the east side of Loch Ken are up to approximately 17.8% longer than the proposed OHL route option.

Cable Route	Route Description	Route Length (km)
UGC6A	Cable route alternative following	31.24
	the west side of Loch Ken.	
UGC6B	Cable route alternative following	31.34
	the proposed OHL wayleave to the	
	Queen's Way crossing before	
	following the west side of Loch	
	Ken.	
UGC6C	Cable route alternative following	33.15
	west side of Loch Ken and crossing	
	the A75 close to the proposed OHL	
	wayleave.	
UGC6D	Cable route alternative following	37.79
	the east side of Loch Ken.	
UGC6E	Cable route alternative following	38.31
	the east side of Loch Ken and then	
	diverting to follow the A762 into	
	Tongland substation.	
Proposed OHL Route	OHL route.	32.5
Glenlee S/S – Tongland S/S	Straight line distance.	28.2

Table 22 – Approximate route length comparisons for Glenlee S/S – Tongland S/S

4.6.1 UGC6 Glenlee Substation – Tongland Substation Installation in Loch Ken

Further to the five options covered within this study, CCI also considered the option of installing the cable within Loch Ken. CCI have experience of this installation method both from extensive work on subsea cable projects and having worked to review a similar solution for a transmission project elsewhere within Scotland.

SPEN within the summary of feedback from the second round of consultation⁴ provided the following key factors for consideration of installing cable within Loch Ken:

- A further environmental assessment for placing cable sealing end compounds on either side of Loch Ken;
- Potential additional costs associated with the technical design of underwater cable in terms of manufacturing and rating requirements;
- Costs associated with securing spare underwater cable to facilitate fault repairs;

- Installation method for placing cable in the water is likely to be via a specialised boat or a barge. These vessels are limited in availability which would add cost;
- Access and transport considerations wold require a detailed transport plan to deliver the installation equipment to the Loch which could cause disruption to the local community during transportation; and
- Future maintenance and reliability. Any fault which occurs during the lifetime of the underwater cable would require the same installation equipment to be brought back to the Loch to facilitate repair. A double circuit fault would have an extended repair time to restore supplies on the transmission network which could affect the supplies to around 13,000 customers in Tongland, Castle Douglas, Gatehouse and Dalbeattie

Based on CCI's installation experience, the following additional key points have been considered:

- The logistics to lay cable in Loch Ken would be complex and expensive, with both financial and environmental implications needing consideration, when compared to more traditional land installation techniques.
- Extensive geophysical, environmental and bathymetry surveys would be required to understand the depth of Loch Ken and loch bed features.
- A detailed technical installation design would be required to ensure the cables performance over its service lifetime.
- A reliability study would be required to understand and contrast the service reliability of a land cable with an embedded submersible cable section, compared to a land cable connection end to end.
- A special vessel or barge would be required for installing cable within Loch Ken, including an anchoring system for laying the cable. This barge would have to be delivered in sections by road and then assembled at the loch side.
- An extensive operations area including cranage, delivery space and storage both permeant and temporary would be required at either the northern or southern loch shore.
- The operations area would also need to provide access for submersible cable installation equipment e.g. transpooling of the submersible cable from drums to the installation vessel
- The operations area would be likely to become a permeant feature for assembly of the barge, carrying out maintenance, and for spare submersible cable necessary for future maintenance and / or fault repair.
- The cable installation process is expected to disturb the loch bed and could impact on wildlife and / or water quality, with the potential for dredging and boulder clearance of the cable route pre-installation and rock dumping or concrete mattress laying post installation.
- Where the cable enters and exits the loch, transition joints and joint bays would be required on the loch shore, with a permeant right of access required for future maintenance.
- The cable installation works and the visual impact of having construction areas positioned on the loch shore could potentially damage local business who rely on use of Loch Ken for tourism.
- The loch covers only the middle section of the route between Glenlee substation and Tongland substation, approximate maximum of 15km, which leaves approximately 53% of the route that would still require underground cable or OHL routing.

Based on these factors, CCI has not developed cable installation within Loch Ken further within this study.

4.6.2 UGC6 Glenlee Substation - Tongland Substation Current Rating and Circuit Details

The cable routing options considered under UGC6 require a continuous current rating of 815A to be transmitted through each of the two cable circuits connecting Glenlee substation to Tongland substation. Refer to Figure 42 which shows a schematic of the electrical connection arrangement as issued by SPEN.

To deliver this magnitude of current it is expected that one cable per phase will be required for each circuit. The total number of cables required would therefore be 6 (3 per circuit). Consideration must also be given to the number of cable sealing ends required at terminal positions. To accommodate the 6 terminations required, towers containing elevated cable sealing end platforms (sealing end platforms attached to the tower body) or a sealing end compound within the substation boundary will be necessary at either end of the route.

Figure 42 – Electrical schematic for Glenlee substation to Tongland substation



4.6.3 UGC6 Glenlee Substation - Tongland Substation Geotechnical Review

From a review of a geotechnical report² provided by SPEN, the underlying rock formation for UGC6 is as follows:

- GT01 GT16 Wacke
- GT17 GT44 Granite
- GT45 GT108 Wacke
- GT109 Microdiorite (medium grained intrusive igneous rock)
- GT110 GT112 Wacke
- GT113 Mircodiorite (medium grained intrusive igneous rock)
- GT114 GT117 Wacke

Rocky outcrops were noted at several locations on the route most notable GT100 to GT117, and sporadically from GT1 to GT10 and GT17 to GT44. The superficial geology varies along the route from clay, clay/silt with gravel and boulders, sand and silt, sand and gravel and peat. The peat was noted to be at depths up to 5m deep at GT86. There were also long sections of the route where no superficial layer is recorded.

Superficial geology refers to geological deposits typically of the Quaternary age which extends back about 2.6 million years. These deposits rest on the underlying rock, often referred to as bedrock.

Considering the OHL wayleave for UGC6, it can be calculated that some superficial geology will be present for approximately 27% of the route, with the remaining 73% containing none. Where the superficial geology layer is shallow or non-existent, a different approach for cable installation may be required. For example, where shallow rock is not able to be broken up and dug out using a bucket on a backhoe excavator.

4.6.4 Glenlee Substation - Tongland Substation Route Option UGC6A

Figure 43 is the Glenlee – Tongland key plan, with cable route option UGC6A (9C+12C+16C+22C+30C+33C) shown in red.





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The UGC6A cable route in Figure 44, Figure 45, Figure 46 and Figure 47, shown as a black line, runs from north to south, from Glenlee to Tongland substation and includes OHL tower GT001 to GT120. This underground cable route option was selected to follow roadways from Glenlee to Tongland substation around the western side of Loch Ken on the A762, with the exception of cross-country routing around Ringford.

This preliminary cable route has the advantage of being shorter than cable routes following the eastern side of Loch Ken and the proposed overhead line route. Refer to Table 22 . However, the A762 road is noted to be narrow, winding, undulating and with many water crossings making cable installation within it likely to pose many engineering difficulties. In addition, the sections of cross-country cabling around Ringford are also likely to be problematic owing to the steep undulating topography, peat habitats, densely forested areas and multiple watercourses.

Where the cable is laid in the road, it is envisaged that the cable route would be installed in one carriageway with the other carriageway kept open for traffic. Joint bays would be positioned in the verge or in laybys wherever reasonably practicable.

A review of the cable route option UGC6A was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. Two alterations to an initial route plot were proposed, at Kenmure Castle and Laurieston Hall, both areas are categorised as non-inventory designed landscapes. These sensitive landscapes were avoided by rerouting the cable along the A762. These route changes combined to increase the total route length by approxiamtely 140m and this change is included in this study.

Table 23 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on Figure 44, Figure 45, Figure 46 and Figure 47. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Glenlee Substation	Approaching the substation in the road, requiring appropriate traffic management plan to be developed and adopted. The road dissects native woodlands to the north and a non-inventory design landscape, five category B listed buildings. The road is located within a medium likelihood (1-200 year) flood zone associated with the adjacent Water of Ken.

Table 23 - Key points of engineering difficulty and environmental sensitivity for UGC6A

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
2	Burn crossing at	Burn crossing adjacent to Coom Bridge requiring either
	Coom Bridge	HDD or installation in bridge deck. Several residential
		dwellings are located to the south. The road is located
		within a medium likelihood (1-200 year) flood zone
		associated with the adjacent Water of Ken.
3	Burn crossing at	Burn crossing at Finlay's Burn requiring either HDD or
	Finlay's Burn	installation in bridge deck. Several residential dwellings
		are located to the south.
4	Cabling within A762	Cabling in A762 roadway, requiring appropriate traffic
		management plan to be developed and adopted. With
		joints and link equipment located in the verge where
		practicable.
5	Services within	Evidence was noted of services within A762
	A762	approaching New Galloway from Glenlee, limiting
		space for cable route. Several residential dwellings are
		situated along the road including three category B listed
		properties. The road passes through a small section of
		native woodland. The dwellings and woodland are
		bypassed by the cable route as it is positioned within the
		carriageway.
6	Junction A762 and	Disruption associated with cabling across a reasonably
	A/12	busy A-road intersection. An appropriate traffic
		management plan would need to be developed and
7	Mill Drum and agin a	adopted.
/	Will Burn crossing	HDD or installation in bridge deak
0	Cabling within Now	Difficulties associated with colling within a normous
0	Callowey	Difficulties associated with cabling within a hallow
	Ganoway	residential properties including estagery P and C listed
		huilding An appropriate traffic management plan
		would need to be developed and adopted
9	Services within	Both OHL and an unknown quantity of buried services
9	$\Delta 762$	were noted on A762 south of New Galloway. The road
	11/02	nasses through areas of native woodland south of New
		Galloway
10	Kenmure Castle	Cabling in A762 adjacent to Kenmure Castle which is a
10		category B listed building and its associated non-
		inventory designed landscapes
11	Burn crossing at	Burn crossing adjacent to Burnfoot Bridge requiring
	Burnfoot Bridge	either HDD or dam and pump over. The road is located
		within a medium likelihood (1-200 year) flood zone

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		associated with the adjacent Water of Ken. Several
		residential properties are located along the road.
12	Cabling within A762	Cabling in A762 roadway, requiring appropriate traffic management plan would need to be developed and adopted. With joints and link equipment located in the verge where practicable. The road cuts through sections of both native and ancient woodlands adjacent to Loch Ken.
13	Cabling within A762	Potential for several tributary crossings and shallow bridge sections within A762 adjacent to Loch Ken. Pine marten dens are noted within the woodlands west of the road within Bennan forest. The carriageway width may prove problematic adjacent to Loch Ken.
14	Cabling within A762	Potential disruption associated with cabling through
	at Mossdale	Mossdale. Traffic management plan would need to be
		developed and adopted. Cabling in close proximity to
1.5		residential properties within Mossdale.
15	at Hensol Bridge	River Dee crossing adjacent to Hensol Bridge requiring either HDD or installation in bridge deck. Low (1 in 1000 year) and medium (1 in 200 year) flood risk zones are located either side of Hensol Bridge. A762 passes two grade 2 category B listed buildings and through a section of native woodland south of Hensol Bridge. The native woodland extends south to a third category C listed building at little Duchrae.
16	Cabling within A762	Potential for several tributary crossings and shallow bridge sections within A762 adjacent to Woodhall Loch. Low (1 in 1000 year) and medium (1 in 200 year) flood risk zones are located east of Woodhall Loch. The A762 passes through sections of native woodland adjacent to Woodhall Loch. The carriageway width may prove problematic adjacent to Woodhall Loch.
17	Laurieston Hall	Cabling in A762 adjacent to Laurieston Hall a non-
		inventory designed landscape and category B listed building.
18	Services within A762	Both OHL and buried services were noted on A762 north of Laurieston.
19	Cabling within	Difficulties associated with cabling within a narrow
	Laurieston	road in a populated area. An appropriate traffic
		management plan would need to be developed and

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		adopted. The cable route passes within close proximity
		to multiple residential properties.
20	Burn crossing at Mill	Burn crossing adjacent to Mill Lade requiring either
	Lade	HDD or dam and pump over.
21	Services within	OHL services were noted along the A762 running the
	A762	extent of Laurieston village.
22	Cabling at junction	Evidence of services buried in the carriageway and
	with B795	overhead services noted at the junction of the A762 and
		B795. Potential disruption associated with cabling
		across a reasonably busy road junction. Traffic
		management plan would need to be developed and
		adopted.
23	Cabling within A762	Cabling in A762 roadway, requiring appropriate traffic
		management plan would need to be developed and
		adopted.
24	Otter resting point	The A762 and cable route pass close to an otter resting
	and PWS zone of	point and private water supply zone of influence south
	influence	of Gatehouse bridge.
25	Otter resting point	The A762 and cable route pass close to three otter
	and native woodland	resting points and dissects a native woodland adjacent
		to Camelon bridge.
26	PWS zone of	Potential for unquantifiable peat located adjacent to the
	influence and peat	A762. Peat ground preparation work may be required.
	habitat	This may also impact on cable conductor material and
		size. Road passes through a private water supply zone
		of influence south of Camelon bridge
27	Flood zone and	The A762 passes through a medium likelihood (1 in 200
	Native woodlands	year) flood zone adjacent to Back Fell. The road also
		passes through sections of native woodland.
28	Lane crossing	Lane crossing required west of Ringford, with either
		HDD or duct block solution sought.
29	Tarff Water crossing	2 x HDD's under Tarff Water west of Ringford would
		be required, with launch and reception pit identification
		and access for drilling rigs to be developed.
30	A75 crossing	HDD under A75 would be required, with launch and
		reception pit identification and access for the drilling
		rigs to be developed.
31	Shallow rock	The cable route bypasses rocky outcrops on the hill
		sides in land south of the A75 adjacent to the A762.
32	Significant changes	Steep undulations within the topography in land south
	in elevation	of the A75 adjacent to the A762 that may require cable

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		anchoring systems to be designed and installed to minimise migration of the cable down a slope over the long term.
33	High pressure gas pipeline crossing	Cable circuits cross a high-pressure gas pipeline at Chapel. Early correspondence with the pipeline operators is advised to understand constraints including spacing requirements, protection, supervised digging arrangements etc.
34	Cabling within A762	Cabling in A762 roadway for a short section adjacent to Castle Hill, requiring appropriate traffic management plan to be developed and adopted. With joints and link equipment located in the verge where practicable.
35	Shallow rock	The cable route bypasses rocky outcrops on the hill sides in the western approach to Tongland substation.
36	Watercourse and residential properties	Several residential properties are located to the east of the cable route as it heads towards Tongland substation. A watercourse is marked directly north of the cable route.



Figure 44 – Black line showing cable route UGC6A sections 9C+12C+16C(Part)

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Figure 45 – Black line showing cable route UGC6A sections 16C(Part)

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Figure 46 – Black line showing cable route UGC6A sections 16C(part)+22C(part)

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Figure 47 – Black line showing cable route UGC6A sections 22C(part)+30C+33C

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4.6.5 Glenlee Substation - Tongland Substation Route Option UGC6B

Figure 48 is the Glenlee – Tongland key plan, with cable route option UGC6B (8C+11C+13C+16C+22C+30C+33C) shown in red.





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Cable route UGC6B follows the route covered in section 4.6.1 of this study, except for routing into Glenlee substation which is shown as a black line in Figure 49.

Here the proposed overhead line route was followed, from Glenlee substation to the proposed OHL tower GT09, north of the Queen's Way crossing and although likely to be more engineeringly challenging than following the A762, this deviation would utilise the proposed overhead line wayleaves. From GT09, the route continues south crossing the Queen's Way at the same position as specified in UGC3A, refer to section 5.3.3 of this study. Once south of the Queen's way, the route diverts back to join the A762 carriageway south of New Galloway. From here, the route continues down the west side of Loch Ken on the A762, with the exception of cross-country routing around Ringford. Although route 8C+11C+13C is an alternative route to 9C+12C, it is marginally longer and is likely to be more challenging to install.

Where the cable is laid in the road, it is envisaged that the cable route would be installed in one carriageway with the other carriageway kept open for traffic. Joint bays would be positioned in the verge or in laybys wherever reasonably practicable.

A review of the cable route option UGC6B was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. One alteration to the route was proposed, at Laurieston Hall, as the grounds are categorised as non-inventory designed landscapes. The cable was re-routed to avoid this area by routing the cable along the A762. This route change acted to decrease the total route length by approxiamtely 60m and is included within this revision.

Table 24 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on Figure 49. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Table 24 – Key points of engineering difficulty and environmental sensitivity for UGC6B sections 8C+11C+13C

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Significant	Steep slope on cable route out of Glenlee substation that
	changes in	may require cable anchoring systems to be designed and
	elevation	installed to minimise migration of the cable down a slope
		over the long term. Requirement for HDD or other
		engineering solution would need to be developed. Multiple
		residential dwellings are located adjacent to Glenlee
		substation.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
2	Peat and Native	Potential for peat in ground southwest of Glenlee
	woodlands	This may also impost on apple conductor material and size
		This may also impact on cable conductor material and size. The cable route dissects a section of native woodlands
3	Significant	Steen undulations within the topography in land southwest
5	changes in	of Glenlee substation that may require cable anchoring
	elevation	systems to be designed and installed to minimise migration
		of the cable down a slope over the long term. The cable
		route dissects a private water supply zone of influence.
4	Shallow rock	The cable route bypasses rocky outcrops on the hill sides in
		land southwest of Glenlee substation. The cable route
		bypasses a private water supply zone of influence and peat
5	Tributory	Tributary arousing requiring either on HDD or dom and
3	crossing	nump over solution located within land southwest of
	crossing	Glenlee substation near to Bucks Linn Bridge The cable
		route bypasses a private water supply zone of influence
		and peat habitats to the east.
6	Lane crossing	Lane crossing required south of Glenlee substation, with
		either HDD or duct block solution sought.
7	Shallow rock	The cable route bypasses rocky outcrops in land section
		from west of Shiel hill to A/12 crossing. The cable route
		and next habitats to the cast
8	Peat	Potential for significant neat in land section from west of
0	1 out	Shiel hill to A712 crossing. Peat ground preparation work
		may be required. This may also impact on cable conductor
		material and size. The cable route passes through three
		private water supply zones of influence.
9	Significant	Steep undulations within the topography from the hill
	changes in	locations either side of the valley containing the A712 that
	elevation	may require cable anchoring systems to be designed and
		installed to minimise migration of the cable down a slope
10	Crossing of A712	HDD crossing under A712 would be required with launch
10	Clossing of A/12	and reception nit identification to be developed. This HDD
		would pass through native woodland areas and medium (1
		in 200 year) flood risk zones.
11	Dense woodland	Clearing works would be required when cabling through
		dense woodland south of A712 crossing. Temporary access

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		roads would need to be constructed during the installation
		and for future maintenance.
12	Heavy forestry	Risk to the cable being traversed and damaged by heavy
	machinery	forestry machinery for all forestry shown on the map.
		Several residential properties are bypassed by the cable
		route at this location.
13	Significant	Steep undulations within the topography in land southwest
	changes in	of New Galloway that may require cable anchoring systems
	elevation	to be designed and installed to minimise migration of the
		cable down a slope over the long term.
14	Peat	Potential for peat within land southwest of New Galloway.
		Peat ground preparation work may be required. This may
		also impact on cable conductor material and size.
15	Shallow rock	The cable route bypasses rocky outcrops on the hill sides in
		land southwest of New Galloway. The cable route passes
		in close proximity to an area of non-inventory designed
		landscape to the north associated with Kenmure Castle.
16	Tributary	Potential for several tributary crossings within land
	crossings	southwest of New Galloway. The development of a suitable
		crossing solution would be required. A medium risk (1-200
		years) flood risk zone is located east of the cable route,
		including where the route re-joins the A762 south of New
		Galloway.

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Figure 49 – Black line showing cable route UGC6B sections 8C+11C+13C+16C(part)



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4.6.6 Glenlee Substation - Tongland Substation UGC6C

Figure 50 is the Glenlee – Tongland key plan, with cable route option UGC6C (9C+12C+16C+22C+25C+28C+31C+32C+33C) shown in red.





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Cable route UGC6C follows the route covered in section 4.6.4 of this study, with the exception of the routing at Ringford and into Tongland substation which is shown as a black line in Figure 51.

Here the proposed cable route passes to the east of Ringford, aiming to avoid peat habitats and water crossings associated with the land around Tarff Water. The route then utilises the existing overhead line wayleave to cross the A75 and broadly keeps with the overhead line route until Loch Hill. The cable route then sweeps west towards Castle Hill taking a more gradual incline into Tongland substation from the south west, thus avoiding the steeper incline into Tongland substation to the north.

Where the cable is laid in the road, it is envisaged that the cable route would be installed in one carriageway with the other carriageway kept open for traffic. Joint bays would be positioned in the verge or in laybys wherever reasonably practicable.

A review of the cable route option UGC6C was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. Two alterations to the route were proposed, at Kenmure Castle and Laurieston Hall, both areas are categorised as non-inventory designed landscapes. These sensitive landscapes were avoided by re-routing the cable along the A762. These route changes combined to increase the total route length by approxiamtely 140m and this change is included in this study.

Table 25 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on Figure 51. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Shallow rock	The cable route bypasses rocky outcrops in land north of
		Ringford.
2	Tributary	Tributary crossing at adjacent to Glentarff Bridge requiring
	Crossing	HDD or dam and pump over solution. The cable route
		passes adjacent to several residential dwellings.
3	A75 crossing	HDD under A75 would need be required, with launch and
		reception pit identification and access for drilling rigs to be
		developed.
4	Significant	Steep undulations within the topography in land south of
	changes in	A75 and Tongland substation that may require cable
	elevation	

Table 25 – Key points of engineering difficulty and environmental sensitivity for UGC6C sections 25C+28C+31C+32C+33C

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Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		anchoring systems to be designed and installed to minimise
		migration of the cable down a slope over the long term.
5	High pressure gas	Cable circuits cross a high-pressure gas pipeline at Chapel.
	pipeline crossing	Early correspondence with the pipeline operators is advised
		to understand constraints including spacing requirements,
		protection, supervised digging arrangements etc.
6	Shallow rock	The cable route bypasses rocky outcrops on the hill sides in
		land south of A75 and Tongland substation. The cable route
		passes through a private water supplies zone of influence.
		Several residential properties are located to the east of the
		cable route as it heads towards Tongland substation.
7	Watercourse and	Several residential properties are located to the east of the
	residential	cable route as it heads towards Tongland substation. A
	properties	watercourse is marked directly north of the cable route.

Figure 51 – Black line showing cable route UGC6C sections 22C(part)+25C+28C+31C+32C+33C



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4.6.7 Glenlee Substation - Tongland Substation UGC6D

Figure 52 is the Glenlee – Tongland key plan, with cable route option UGC6D (9C+17C+23C+26C+28C+31C+34C) shown in red.





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The UGC6D cable route in Figure 53, Figure 54, Figure 55, Figure 56 and Figure 57, shown as a black line, runs from north to south, from Glenlee to Tongland substation and includes OHL tower GT001 to GT120. This cable route was selected to follow roadways from Glenlee to Tongland substation around the eastern side of Loch Ken, with the exception of cross-country routing around Crossmichael and Glenlochar, before following the existing overhead line route over the A75 and into Tongland substation.

Though this route is one of the longest, it has the advantage of being positioned in what is likely to be a sufficiently wide roadway with relatively few points of engineering difficulties and good scope for joint bay positions, in comparison to the cable route alternatives on the western side of Loch Ken.

Where the cable is laid in the road, it is envisaged that the cable route would be installed in one carriageway with the other carriageway kept open for traffic. Joint bays would be positioned in the verge or in laybys wherever reasonably practicable.

The HDD positions across Loch Ken, both at the northern and southern end of the Loch, have been selected as they provide relatively narrow crossing positions, offer relatively good locations for launch and reception pits and have minimal elevational changes along the HDD length.

Access to the land around Crossmichael and Glenlochar where the cable route leaves the roadway and cuts across country was limited during the site survey, accordingly these sections of the route are primarily based on a desktop assessment. Here the preliminary cable route aims to avoid excessively steep changes in elevation, rocky outcrops, dwellings, peat habitats and known archaeological sites.

A review of the cable route option UGC6D was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts.

Table 26 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on Figure 53, Figure 54, Figure 55, Figure 56 and Figure 57. Confidential data on the locations of European protected species is provided in confidential appendix ER1003-1 which has been provided to SNH, DGC and the Scottish Government ECU.

Table 26 – Key points of engineering difficulty and environmental sensitivity for UGC6D

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	Glenlee	Approaching the substation in the road, requiring appropriate
	Substation	traffic management plan to be developed and adopted. The

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Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		road and cable route dissects native woodlands to the north
		and a non-inventory design landscape and five category B
		listed buildings to the south. The road is located within a
		medium likelihood (1-200 year) flood zone associated with
		the adjacent Water of Ken.
2	Burn crossing	Burn crossing adjacent to Coom Bridge requiring either HDD
	at Coom	or installation in bridge deck. Several residential dwellings
	Bridge	are located to the south. The road is located within a medium
		likelihood (1-200 year) flood zone associated with the
-		adjacent Water of Ken.
3	Water of Ken	HDD under water of Ken would be required, with launch and
	crossing	reception pit identification and access for drilling rigs to be
		developed. The cable route is located within a medium
		likelihood (1-200 year) flood zone associated with the
1	Califin a swithin	aujacent water of Ken.
4		Cabing in A/15 carriageway requiring appropriate trainic
	A/13	and link equipment located in the verge where practicable
		The road is located within a medium likelihood (1-200 year)
		flood zone associated with the adjacent Water of Ken. Several
		residential properties are situated along the A713 which the
		cable route passes.
5	Burn crossing	Burn crossing at Garple Bridge requiring either HDD or
	at Garple	installation in bridge deck. The road is located within a
	Bridge	medium likelihood (1-200 year) flood zone associated with
		the adjacent Water of Ken. Several residential properties are
		situated along the A713 which the cable route passes
		including a category A listed building to the west.
6	Burn crossing	Burn crossing at Shirmers Bridge requiring either HDD or
	at Shirmers	installation in bridge deck. Several sections of native
	Bridge	woodland are located west of the A713. The road is located
		within a medium likelihood (1-200 year) flood zone
		associated with the adjacent Water of Ken. Several residential
		properties are situated along the A713 alongside the cable
		route.
7	Listed	The road is located within a medium likelihood (1-200 year)
	buildings at	flood zone associated with the adjacent Water of Ken. Several
	Loch Ken	residential properties are situated along the A/13 which the
	Viaduct	cable route passes, including several category b listed
		buildings to the east with associated non-inventory designed
		landscapes.

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Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
8	Listed	Several residential properties are situated along the A713
	buildings at	alongside the cable route, including several category b listed
	Parton	buildings close to the road at Parton. A scheduled monument
		is also noted south of the A713 at Parton. The road is located
		within a medium likelihood (1-200 year) flood zone
		associated with the adjacent Water of Ken.
9	Non-inventory	The A713 and cable route pass south of Parton passing non-
	designed	inventory designed landscapes. The road is located within a
	landscape	medium likelihood (1-200 year) flood zone associated with
	south of Parton	the adjacent Water of Ken.
10	Burn crossing	Burn crossing at Spearford culvert requiring either HDD or
	at Spearford	installation in bridge deck. The road is located within a
	culvert	medium likelihood (1-200 year) flood zone associated with
11	T ·	the adjacent Water of Ken.
	Lane crossing	Three lane crossings required around Crossmichael, with
		either HDD or duct block solution sought. Directly south of
		the cable route are non-inventory designed landscapes and a
10	Ciquificant	Category A listed building.
12	Significant	Steep undulations within the topography in land east of
	elevation	designed and installed to minimise migration of the cable
	cicvation	down a slope over the long term Multiple residential
		properties are bypassed by the cable route to the west at
		Crossmichael
13	Peat	Potential for peat within land east of Crossmichael Peat
10	1 000	ground preparation work may be required. This may also
		impact on cable conductor material and size.
14	Shallow rock	The cable route bypasses rocky outcrops on the hill sides in
		land east of Crossmichael.
15	B795 crossing	B road crossing required east of Glenlochar, with either HDD
-	6	or duct block solution to be developed.
16	A713 crossing	HDD under A713 at Glenlochar would be required, with
		launch and reception pit identification and access for drilling
		rigs to be developed.
17	Mains of	The cable route passes adjacent to the Mains of Greenlaw, a
	Greenlaw	site of cultural heritage. Additional care when installing in this
		area would be required. The cable route is located within a
		medium likelihood (1-200 year) flood zone associated with
		the adjacent Water of Ken.
18	Peat	Potential for peat within land adjacent to River Dee. Peat
		ground preparation work may be required. This may also

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		impact on cable conductor material and size. The cable route
		is located within a medium likelihood (1-200 year) flood zone
		associated with the adjacent Water of Ken.
19	Burn crossing	Burn crossing at Barony Isle requiring either HDD or
	at Barony Isle	installation in bridge deck. The cable route is located within a
		medium likelihood (1-200 year) flood zone associated with
		the adjacent Water of Ken. Scheduled monuments are sited
		directly north and south of the cable route.
20	River Dee	HDD under river Dee would be required, with launch and
	crossing	reception pit identification and access for drilling rigs to be
		developed. The cable route is located within a medium
		likelihood (1-200 year) flood zone associated with the
		adjacent Water of Ken.
21	Peat	Potential for peat within land adjacent to River Dee. Peat
		ground preparation work may be required. This may also
		impact on cable conductor material and size. The cable route
		is located within a medium likelihood (1-200 year) flood zone
		associated with the adjacent Water of Ken.
22	Lane crossing	Five lane crossings required between land south of Glenlochar
		and the A/5 crossing, with either HDD or duct block solution
		sought. The cable route is located within a medium likelihood
		(1-200 year) flood zone associated with the adjacent Water of
		Ken.
23	Significant	Steep undulations within the topography in land south of
	changes in	Glenlochar that may require cable anchoring systems to be
	elevation	designed and installed to minimise migration of the cable
		down a slope over the long term. The cable route is located
		within a medium likelihood (1-200 year) flood zone
		associated with the adjacent water of Ken and passes through
		a low likelihood (1-1000 years) flood zone south of Braeloot.
		designed landscore system ding to the north. Several residential
		designed landscape extending to the north. Several residential
		properties are located in close proximity north of the cable
24	Deat	Dotential for next within land south of Clanlacher Dest
24	real	ground preparation work may be required. This may also
		impact on cable conductor material and size. The cable route
		is located within a medium likelihood (1, 200 year) flood zono
		associated with the adjacent Water of Ken
25	Shallow rock	The cable route bypasses rocky outgrops on the hill sides in
23	Shanow IOCK	land south of Glenlochar. The cable route is located within a

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
		medium likelihood (1-200 year) flood zone associated with
		the adjacent Water of Ken. The cable route passes south of
		native woodlands.
26	A75 crossing	HDD under A75 would be required, with launch and reception
		pit identification and access for drilling rigs to be developed.
		The cable route passes adjacent to several residential
		dwellings to the north of the A75.
27	Significant	Steep undulations within the topography in land south of A75
	changes in	and Tongland substation that may require cable anchoring
	elevation	systems to be designed and installed to minimise migration of
		the cable down a slope over the long term. The cable route
		passes adjacent to several residential dwellings.
28	High pressure	Cable circuits cross a high-pressure gas pipeline at Chapel.
	gas pipeline	Early correspondence with the pipeline operators is advised
	crossing	to understand constraints including spacing requirements,
		protection, supervised digging arrangements etc.
29	Shallow rock	The cable route bypasses rocky outcrops on the hill sides in
		land south of A75 and Tongland substation. The cable route
		passes through a private water supplies zone of influence. The
		cable route passes adjacent to several residential dwellings to
		the east.
30	Significant	Steep undulations within the topography in land directly north
	changes in	of Tongland substation that may require cable anchoring
	elevation	systems to be designed and installed to minimise migration of
		the cable down a slope over the long term. Several residential
		properties are located to the east of the cable route as it heads
		towards Tongland substation.



Figure 53 – Black line showing cable route UGC6D sections 9C+17C(part)

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Figure 54 – Black line showing cable route UGC6D section 17C(part)

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Figure 55 – Black line showing cable route UGC6D section 17C(part)

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Figure 56 – Black line showing cable route UGC6D sections 17C(part)+23C+26C+28C(part)



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Figure 57 – Black line showing cable route UGC6D sections 23C(part)+26C+28C+31C+34C



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4.6.8 Glenlee Substation - Tongland Substation UGC6E

Figure 58 is the key plan for Glenlee – Tongland, with cable route option UGC6E (9C+17C+23C+26C+28C+31C+32C+34C) shown in red.

Figure 58 – Key plan with red line showing cable route UGC6E



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Cable route UGC6E follows the route covered in section 4.6.7 of this study, with the exception of the route into Tongland substation which is shown as a black line in Figure 59.

Here the proposed cable route sweeps west towards Castle Hill taking a more gradual incline into Tongland substation from the south west, thus avoiding the steeper incline into Tongland substation to the north. This additional deviation makes this route the longest of all the options considered.

A review of the cable route option UGC6E was undertaken by LUC in June 2019 and finalised in February 2020, refer to Appendix 2. No alterations to the route were proposed with regards to environmental features, sensitivities or impacts.

Table 27 contains points of engineering difficulty and environmental sensitivity identified along the route, with each item number marked in red circles on Figure 59.

Table 27 – Key points of engineering	difficulty a	and environmental	sensitivity for
cable route UGC6E sections 32C+33C			

Item	Points of	Comment
No.	Engineering	
	Difficulty and	
	Environmental	
	Sensitivity	
1	High pressure gas	Cable circuits cross a high-pressure gas pipeline at Chapel.
	pipeline crossing	Early correspondence with the pipeline operators is advised
		to understand constraints including spacing requirements,
		protection, supervised digging arrangements etc.
2	Significant	Steep undulations within the topography in land south of
	changes in	A75 and Tongland substation that may require cable
	elevation	anchoring systems to be designed and installed to minimise
		migration of the cable down a slope over the long term.
3	Shallow rock	The cable route bypasses rocky outcrops on the hill sides in
		land south of A75 and Tongland substation.
4	Watercourse and	Several residential properties are located to the east of the
	residential	cable route as it heads towards Tongland substation. A
	properties	watercourse is marked directly north of the cable route.

Figure 59 – Black line showing cable route UGC6E sections 28C(part)+31C+32C+33C



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4.6.9 UGC6 Glenlee – Tongland Cable Route Appraisal Summary

Five cable route options have been studied for undergrounding between Glenlee substation and Tongland substation. The cable route studies have been based on the 21 criteria and other information detailed within section 3 of this study .

Installation of a cable route within the carriageway provides a solid and reliable installation base when compared to installing cable within dense forest, over steep changes in elevation and within peat habitats. Of the two carriageway options, the A762 following the west of Loch Ken, or the A713 following the east of Loch Ken, the A713 following the east of Loch Ken offers the best solution from a constructability perspective. Working in the carriageway does introduce a risk to the workforce associated with moving traffic, but this risk can be managed with an effective traffic management system.

The route down the eastern side of Loch Ken requires crossing of watercourses at the northern and southern extremities of the loch which introduces an engineering risk, however the risk associated with these crossings is offset by the advantages of cabling within the A713 carriageway. The A713 is generally, of sufficient width to accommodate the two cable circuits within a single carriageway and has relatively few points of engineering difficulties, in addition to providing good scope for joint bay positions. Cabling within an existing carriageway would also offer improved access both during the installation works and after when access for maintenance would be required.

LUC maps³ provided to CCI show environmental features located on the proposed OHL wayleave. Both the A713 and A762 pass through or are in close proximity to ancient and native woodlands, flood risk zones, peat habitats, archaeological sensitive areas, non-inventory designed landscapes, multiple residential dwellings and listed buildings. However, as the cable installation work is following the existing carriageway no new clearance of woodlands would be required. With regards flood risk, the carriageway construct contains an integrated drainage system which should assist with protection of the cable system from wash out both during the installation phase and whilst in operation. Overall these risks were deemed manageable, when compared to the environmental impact and associated risks of clearing the working swathe required to install cables within dense forest areas that contain peat habitats.

From a review of a geotechnical report² provided by SPEN, the underlying rock formations along the proposed OHL route between Glenlee substation to Tongland substation include Wacke, granite and Microdiorite (medium grained intrusive igneous rock). Rocky outcrops were noted at several locations on the route most notable GT100 to GT117, and sporadically from GT1 to GT10 and GT17 to GT44. The superficial geology varies along the route from clay, clay/silt with gravel and boulders, sand and silt, sand and gravel and peat. The peat was noted to be at depths up to 5m deep at GT86. There were also long sections of the route where no superficial layer is recorded. Considering the OHL wayleave for UGC6, it can be calculated that some superficial geology will be present for approximately 27% of the route, with the remaining 73% containing none.
Cabling within either of the carriageways, the A762 or the A713, would be expected to create more disturbance for residents during the installation phase when compared to cabling within the forests. However, as the installation phase is temporary and with the possibility that traffic management systems could be designed to maintain traffic flow using a single carriageway, disturbance for residents could be managed and kept to a minimum.

Cabling along the OHL wayleave was not considered within UGC6 as five alternative options were investigated. Furthermore, the sections of the OHL wayleave covered within UGC3 and UGC4 posed many additional installation and environmental risks in comparison to the other cable route options presented.

LUC indicated an overal environmental preference for route UGC6D or UGC6E as although longer, these options require the least forestry felling, cross fewer flood risk zones and have the greatest potential to minimise effects on tourism and recreation receptors than route options west of Loch Ken. Refer to Appendix 2.

CCI recommends cable route option UGC6E from the five route options investigated for the route between Glenlee and Tongland substation. This route option, though the longest of the five options investigated, is routed mainly along a sufficiently wide roadway with relatively few points of engineering difficulty in comparison to the alternative route options following the western side of Loch Ken. Access into both substations is via practicable routes for cable installation with reasonable options for joint bay locations and future access to the circuit for maintenance or repair operations presented along the length of the route.

Access to the land around Crossmichael, Glenlochar and south of the A75 where the cable route leaves the roadway and cuts across country, was limited during the site survey, accordingly these sections of the route are primarily based on a desktop assessment.

The selection of the preferred cable route will result in changes to wayleave requirements. Cable routes installed within existing carriageways would not require wayleaves for this section of the route. Other alternative cable routes will require changes to the proposed wayleaves, with wayleaves associated with the existing OHL routes being removed if they are not required.

4.6.10 UGC6 Glenlee Substation – Tongland Substation Cable Route Appraisal Conclusion

Following a joint review between CCI, LUC and SPEN, agreement was reached to adopt CCI's route preference UGC6E as the preferred cable route option between Glenlee and Tongland substation. This conclusion was predicated on cable route UGC6E being the preference for both the technical and environmental considerations.

Furthermore, it was agreed that the selection of cable route UGC6E wholly met the objective for the UGC6 cable study which was to ensure consistency with the approach to routeing of overhead line i.e. a 'blank sheet' approach to identifying potential cable route options both east and west of Loch Ken.

5 Underground Cable Route Length Summary Table

Table 28 provides a summary table of all the underground cable study route lengths covered within this study and includes comparisons to the OHL route length and straight-line lengths.

Document	Cable Route	Straight Line	Overhead Line	Proposed
Section	Study ID	Length (km)	Length (km)	Cable
				Length
				(km)
5.1.4	UGC1A	2.3	2.9	3.2
5.1.5	UGC1B	2.3	2.9	2.9
5.1.6	UGC1C	2.3	2.9	2.9
5.2.3	UGC2A	7.2	7.7	8.9
5.2.4	UGC2B	7.2	7.7	8.43
5.2.5	UGC2C	7.2	7.7	7.7
5.3.3	UGC3A	3.3	3.6	4.2
5.3.4	UGC3B	3.3	3.6	3.6
5.4.3	UGC4A	11.9	13	14.2
5.4.4	UGC4B	11.9	13	13
5.4.5	UGC4C	11.9	13	16.1
5.5.3	UGC5A	2.0	2.03	2.2
5.5.4	UGC5B	2.0	2.03	2.03
5.6.4	UGC6A	28.2	32.5	31.24
5.6.5	UGC6B	28.2	32.5	31.34
5.6.6	UGC6C	28.2	32.5	33.15
5.6.7	UGC6D	28.2	32.5	37.79
5.6.8	UGC6E	28.2	32.5	38.31

 Table 28 – Underground cable route length summary table

6 Summary of Agreed UGC Routes

Following discussion between CCI, LUC and SPEN, agreement was reached on the preferred cable routes for each of the 6 UGC study areas. These agreed cable routes are to be taken forward to a final cable routeing report. A summary of the agreed cable routes is provided below.

6.1 Agreed Cable Route for Polquhanity – Kendoon Substation UGC1

CCI recommends cable route option UGC1B from the three route options investigated for the proposed OHL section between Polquhanity and Kendoon substation. This cable route option presents the most practicable option for cable installation and is of a similar length to the OHL route option. The inclusion of an overhead line section into Kendoon substation negates the many points of engineering difficulty associated with accessing the Kendoon substation site, even though construction of an OHL cable sealing end compound at PK10 would require the placement of additional above ground structures within sight of the A713. This option would also require the use of this OHL option on UGC2 into Kendoon substation from PK10.

LUC indicated an overal environmental preference for route UGC1B as substantially less tree felling would be required than for UGC1C. Additionally, in comparison to UGC1A, UGC1B can span the Water of Ken and potentially the areas of peatland habitat and flood risk zone in the vicinity of Kendoon substation. 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. Refer to Appendix 2.

Following a joint review between CCI, LUC and SPEN, agreement was reached to adopt CCI's route preference UGC1B as the preferred cable route option between Polquhanity and Kendoon substation. This conclusion was predicated on cable route UGC1B being the preference for both the technical and environmental considerations.

Refer to section 4.1 page 16 of this study for additional detail on the selection of this buried cable route preference.

Figure 60 shows the key plan for cable route UGC1B and Figure 61 a map of cable route UGC1B, where the route is marked with a black line. For detail relating to the numbering on the map, refer to section 4.1.5 of this study.



Figure 60 – Key plan with red line showing cable route UGC1B





Figure 61 – Black line showing cable route UGC1B

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6.2 Agreed Cable Route for Kendoon – Glenlee Substation UGC2

CCI recommends cable route option UGC2B from the three route options investigated for the proposed OHL section between Kendoon and Glenlee substation. Although 1.13km would not be undergrounded, this cable route option presents the most practicable option for undergrounding. CCI deems installation of the cable system within a flood plain (1 in 200 years) to present less buildability risk than following a cable route, the majority of which is away from the carriageway crossing undulating rocky terrain.

The inclusion of an overhead line section into Kendoon and Glenlee substations negate many of the points of engineering difficulty associated with accessing the Kendoon and Glenlee substation sites, even though construction of OHL cable sealing end compounds at PK10 and PK33 would require the placement of additional above ground structures within sight of the A713 and A762 respectively.

LUC indicated an overal environmental preference for route UGC2C as it is the shortest cable route and requires the least tree felling and will result in substantially fewer visual effects on residential receptors in comparison to UGC2B while crossing fewer flood risk zones than UGC2A and UGC2B. Refer to Appendix 2.

Following a joint review between CCI, LUC and SPEN, CCI's route preference UGC2B was selected as the preferred cable route option between Kendoon and Glenlee substations. This conclusion was predicated on cable route UGC2B being the preference for the technical considerations, which on balance were given precedence to the specific environmental considerations in this instance.

Refer to section 4.2 on page 34 of this study for additional detail on the selection of this buried cable route preference.

Figure 62 shows the key plan for cable route UGC2B. Figure 63 and Figure 64 shows a map of cable route UGC2B, where the route is marked with a black line. For detail relating to the numbering on the maps, refer to section 4.2.4 of this study.





Figure 62 – Key plan with red line showing cable route UGC2B



Figure 63 – Black line showing cable route UGC2B 6A+38C+42C(part)

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Figure 64 – Black line showing cable route UGC2B 42C(part)+43C+46A

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6.3 Agreed Cable Route for the Queen's Way Crossing UGC3

CCI recommends cable route option UGC3A from the two route studies for the proposed OHL crossing of the Queen's Way. This option, though longer than the OHL route is more practicable for cabling installation as it follows established forest tracks where possible, thus reducing the requirement for felling and forest clearance. In addition, access to the cable route for future maintenance and repair operations could be more easily achieved and the replacement track maintained.

Access to the UGC3 routes was limited during the site survey, accordingly this preliminary route investigation is based largely on a desktop assessment, particularly to the southern side of the Queen's Way.

LUC indicated an overal environmental preference for route UGC3A as less tree felling would be required in comparison to the other route options considered within cable study UGC3. Refer to Appendix 2.

Following a joint review between CCI, LUC and SPEN, agreement was reached to adopt CCI's route preference UGC3A as the preferred cable route option for the Queen's Way crossing. This conclusion was predicated on cable route UGC3A being the preference for both the technical and environmental considerations.

Refer to section 4.3 page 60 of this study for additional detail on the selection of this buried cable route preference.

Figure 65 shows the key plan for cable route UGC3A and Figure 66 a map of cable route UGC3A, where the route is marked with a black line. For detail relating to the numbering on the map, refer to section 4.3.3 of this study.

Figure 65 - Magnified extract of key plan with red line showing cable route UGC3A



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Figure 66 – Black line showing cable route UGC3A

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6.4 Agreed Cable Route for Bennan, Slogarie and Laurieston Forests UGC4

CCI recommends cable route option UGC4C from the three route options investigated for the proposed OHL crossing of Bennan, Slogarie and Laurieston forests. This cable route option presents the most practicable option for cable installation as it negates many of the points of engineering difficulty associated with cabling through dense forest and peat habitats. In addition, UGC4C offers the best access both during the installation phase and after when access for future maintenance work is required.

Access to the northern section of UGC4C cable route was limited during the site survey, accordingly this section of the cable route investigation is based largely on a desktop assessment.

LUC indicated an overal environmental preference for route UGC4C as although longer it requires the least tree felling and will have the least impact on the Raiders Road and other recreational routes through paralleling the A762. Refer to Appendix 2.

Following a joint review between CCI, LUC and SPEN, agreement was reached to adopt CCI's route preference UGC4C as the preferred cable route option for the Bennan, Slogarie and Laurieston forests. This conclusion was predicated on cable route UGC4C being the preference for both the technical and environmental considerations.

Refer to section 4.4 page 70 of this study for additional detail on the selection of this buried cable route preference.

Figure 67 shows the key plan for cable route UGC4C. Figure 68 and Figure 69 show a map of cable route UGC4C, where the route is marked with a black line. For detail relating to the numbering on the map, refer to section 4.4.5 of this study.

Figure 67 – Magnified extract of key plan with red line showing cable route UGC4C



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Figure 68 – Black line showing cable route UGC4C section 36C(part)

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Figure 69 – Black line showing cable route UGC4C section 36C(part)

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6.5 Agreed Cable Route for the A75 Crossing UGC5

CCI recommends cable route option UGC5A from the two route options investigated for the proposed OHL crossing of the A75. This option, though slightly longer than the OHL route is more practicable for cabling installation as it avoids steep changes in elevation and rocky outcrops.

Access to the UGC5 routes was limited during the site survey, accordingly this preliminary route investigation is based on a desktop assessment, particularly to the southern side of the A75.

LUC provided no overall environmental preference between the cable route options considered within cable study UGC5, due to the presence of few environmental constraints within this UGC, and with both routes following the alignment of the existing OHL wayleave. Refer to Appendix 2.

Following a joint review between CCI, LUC and SPEN, agreement was reached to adopt CCI's route preference UGC5A as the preferred cable route option for the A75 crossing. This conclusion was predicated on cable route UGC5A being the preference for the technical considerations, as in this instance no environmental preference was given owing to presence of few environmental constraints within the UGC5 study extents.

Refer to section 4.5 page 94 of this study for additional detail on the selection of this buried cable route preference.

Figure 70 shows the key plan for cable route UGC5A and Figure 71 show a map of cable route UGC5A, where the route is marked with a black line. For detail relating to the numbering on the map, refer to section 4.5.3 of this study.

Figure 70 – Magnified extract of key plan with red line showing cable route UGC5A





Figure 71 – Black line showing cable route UGC5A

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6.6 Agreed Cable Route for Glenlee - Tongland Substation UGC6

CCI recommends cable route option UGC6E from the five route options investigated for the route between Glenlee and Tongland substation. This route option, though the longest of the five options investigated, is routed mainly along a sufficiently wide roadway with relatively few points of engineering difficulty in comparison to the alternative route options following the western side of Loch Ken. Access into both substations is via practicable routes for cable installation with reasonable options for joint bay locations and future access to the circuit for maintenance or repair operations presented along the length of the route.

Access to the land around Crossmichael, Glenlochar and south of the A75 where the cable route leaves the roadway and cuts across country, was limited during the site survey, accordingly these sections of the route are primarily based on a desktop assessment.

LUC indicated an overal environmental preference for route UGC6D or UGC6E as although longer, these options require the least forestry felling, cross fewer flood risk zones and have the greatest potential to minimise effects on tourism and recreation receptors than route options west of Loch Ken. Refer to Appendix 2.

Following a joint review between CCI, LUC and SPEN, agreement was reached to adopt CCI's route preference UGC6E as the preferred cable route option between Glenlee and Tongland substation. This conclusion was predicated on cable route UGC6E being the preference for both the technical and environmental considerations.

Refer to section 4.6 page 103 of this study for additional detail on the selection of this buried cable route preference.

Figure 72 shows the key plan for cable route UGC6E. Figure 73, Figure 74, Figure 75, Figure 76 and Figure 77 show a map of cable route UGC6E, where the route is marked with a black line. For detail relating to the numbering on the map, refer to sections 4.6.7 and 4.6.8 of this study.







Figure 73 – Black line showing cable route UGC6E sections 9C+17C(part)

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Figure 74 – Black line showing cable route UGC6E section 17C(part)

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Figure 75 – Black line showing cable route UGC6E section 17C(part)

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Figure 76 – Black line showing cable route UGC6E sections 17C(part)+23C+26C+28C(part)



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Figure 77 – Black line showing cable route UGC6E sections 23C(part)+26C+28C+31C+32C+33C



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7 Future Detailed Development of Preferred Cable Routes

CCI has identified subsequent detailed design work for each preferred cable route option, in order to enable the definition of the UGC cable route alternatives to an OHL. This detailed design work includes:

- Cable trench cross sections
- Thermal ratings against MVA
- Swathe calculation and drawings
- Route access points and joint bay arrangements
- Bill of quantities for each cable route
- Additional site visits targeted at specific locations of interest along the preferred cable routes

This information would be compiled and submitted in a separate final cable routeing report.

S Lloyd D Carpenter

Appendix 1 – SPEN Document Defining the Kendoon to Tongland Reinforcement Project

Kendoon to Tongland Reinforcement (KTR) Project

The following intends to set out a brief update on the Kendoon to Tongland Reinforcement (KTR) Project, specifically SP Energy Network's (SPEN) intention to undertake an appraisal of underground cable options as part of the Environmental Impact Assessment (EIA) process.

SPEN's Approach

SPEN's approach to routeing is set out in its published document "Major Infrastructure Projects: Approach to Routeing and Environmental Impact Assessment" which can be viewed under the Project Documents tab of the KTR website at www.spendgsr.co.uk. This document underpins the work undertaken to date to develop a proposal for the required reinforcement of the transmission network between Kendoon and Tongland.

On the basis of the detailed routeing work undertaken to date, informed by the previous three rounds of stakeholder consultation, SPEN remains of the view that the use of an overhead line on the selected routes meets the Statutory and Transmission License holder obligations under the Electricity Act 1989. However, in line with the overall approach, SPEN recognises that routeing the overhead line is an iterative process and will continue to review both the routes and the apparatus used throughout the consultation and Environmental Impact Assessment (EIA) stages of the KTR Project.

Background to the Cable Study

A fundamental part of the EIA process is the consideration of alternatives. For overhead line projects, this is taken to mean consideration of alternative overhead line routes. Notwithstanding SPEN's published approach to routeing major electrical infrastructure projects, the Scottish Ministers, in their scoping opinion (October 2017) stated that SPEN's Environmental Impact Assessment Report (EIA-R) for KTR should "include information on alternative measures, including undergrounding, which have been considered to avoid, prevent or reduce and if possible offset the likely significant adverse landscape and visual effects where these have been identified through consultation feedback from affected communities or the routeing process e.g. 'pinch points' or cumulative effects on sensitive receptors."

In response to the Scottish Ministers' scoping opinion, taken with consultation feedback received from stakeholders and communities affected by the KTR Project, SPEN propose to undertake a study of underground options for the areas identified through the three rounds of pre-application consultation. The areas identified for inclusion in this study are as follows:

- Polquhanity to Kendoon
- Queen's Way Crossing
- Bennan, Slogarie and Laurieston Forests
- A75 crossing
- Consideration of undergrounding the proposed Gienlee to Tongland route in its entirety

Study Aims and Outputs

The main aim of the study is to undertake a comparative appraisal of underground cable and overhead lines for the identified areas. The findings of the resulting appraisals will be presented as alternatives in the KTR EIA Report (EIA-R) which will accompany the applications for consent to the Scottish Minsters. This appraisal will focus on a range of factors under the following broad headings:

- technical
- economic
- environmental

Identification of Cable Routes

For a variety of reasons an underground cable will not necessarily follow the route of the proposed overhead line, therefore, it is proposed that potential cable route options will be identified and appraised for each of the areas, culminating in the selection of a cable route for each area.

In a similar method to developing an overhead line route, a cable routeing objective has been developed to "identify a technically feasible and economically viable cable route, between the specified points, which causes on balance the least disturbance to people and the environment." Cable routes will therefore have to establish a balance between engineering requirements, economic viability, land use and the environment. This approach is consistent with SPEN's transmission license duties and environmental obligations under Schedule 9 of the Electricity Act 1989.

The criteria for the identification of cable routes may include the following:

- safety and reliability;
- constructability
- Suitable locations for transition between OHL and cable;
- ease of access for construction and maintenance along route of cable;
- likely impact on the local environment during construction and ability to mitigate this;
- disruption to third parties during construction and ability to mitigate this;
- ground conditions, including risk of contamination and also ground stability;
- the need to cross wet areas and/or habitats that are difficult to reinstate successfully;
- flood risk, proximity to water supplies and ability to cross watercourses at their narrowest point;
- long term visibility of the cable route post construction, including the length that will be seen and the distance at which it will be visible;
- likely long term loss of landscape features such as hedges or individual trees;
- likely long term impact on known and unknown archaeology.

Appraisal of Cable and Overhead Line

The final cable routes for each area will be used as the basis for a comparative appraisal against the proposed overhead line routes developed to date. SPEN will consider the outcome of this study as part of the EIA process and will publish its overall conclusions as part of the EIA Report.

Roles and Responsibilities

SPEN have brought together a multi-disciplinary team consisting of both in-house and external expertise to undertake this appraisal. The broad roles and responsibilities for each discipline are set out in the table below.

Project Team Member	Responsibilities
Cable Consulting International Limited (CCI)	Identify technically feasible cable routes Technical commentary on cable options
SPEN	Economic assessment of cable options provided by CCI Economic assessment of overhead line options by CCI Technical assessment of overhead line sections
Land Use Consultants (LUC)	Provide landscape and environmental information/site input to inform CCI work on identification of cable options. Provide landscape and environmental commentary on cable options provided by CCI. Provide landscape and environmental commentary on overhead line sections provided by SPEN.
Copper Consultants	Community relations, consultation and managing public and stakeholder enquiries for the KTR Project. Note: Any queries regarding the cable study should be made to the existing KTR contact centre Freephone 0800 157 7353 Email dgsr@communityrelations.co.uk

Cable Consulting International Limited (CCI) CV

Cable Consulting International Ltd (CCI) is a wholly independent specialist engineering consultancy providing power cable engineering support to underground and subsea power cable system owners, operators, developers and insurers.

CCI's experience and expertise in all aspects of land and subsea power cable systems from 10kV to above S00kV mean they are well placed to lead on the identification of potential cable options for the KTR cable study.

CCI has a range of experience on large infrastructure projects, including:

- An underground cable route survey for a 275kV underground cable connection between Kirkby and Liverpool.
- Cable route studies in England for a 600kV HVDC cable connection between Scotland and England.
- Providing expert witness evidence on 400kV and 275kV power cable route options and costs to the Beauly-Denny Inquiry.

CCI Cable Consulting International Ltd

PO Box 1, Sevenoaks TN14 7EN United Kingdom

Land Use Consultants CV

LUC provides award winning planning, impact assessment, landscape design and ecology services to a wide range of public and private sector clients.

LUC's extensive experience in grid connection development encompasses projects throughout Scotland, including leading on the routeing and assessment work for the KTR Project to date. Their sound knowledge of the landscape, environmental and community issues on the KTR Project will enable them to identify key issues, constraints to be fed into the design of cable options and help to ensure the successful delivery of high quality outputs.

LUC has also secured the Institute of Environmental Management and Assessment (IEMA)'s Quality Mark, demonstrating their commitment to ensuring the high quality of their EIA Reports, as well as contributing to and developing good practice.

Copper Consultants CV

Copper Consultancy is a leading expert in communications, community relations, public consultation and stakeholder engagement during the planning and construction of major infrastructure projects, with particular expertise in electricity transmission and distribution.

Copper has provided the interface between SPEN and the community on the KTR Project since work commenced in 2015 and will continue to assist in fielding external enquiries from stakeholders and communities as the cable study progresses.

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Appendix 2 – Cable Route Appraisal Document By LUC

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Lintenon	Sub-Orteria	IA	18	10
Section Description	N/A	CCI route alternative	CCI route alternative with OHL into Kendoon S/S	Undergrounding proposed OHL route
KTR Tower Numbers	N/A	N230 - Substation (S/S)	N230 - PK10	N230 - S/S
Approximate Length of Route (km)	N/A	3.2 km	2.9 km (UGC = 2.37km and OHL = 0.53km)	29 km
Biodiversity and Geological Conservation	Scottish Natural Heritage (SNH) Priority Peatland Habitats ²	Class 3 peatland habitat is present at two locations adjacent to the east and west of the point at which 1A crosses the Water of Ken. Unlike Class 1/2 peatland, Class 3 peatland is not identified as a "hationally important resource".	Class 3 peatland habitet is present at two locations adjacent to the east and west of the point at which IB crosses the Water of Kan (as an OHL). Unlike Class J2 peatland, Class 3 peatland is not identified as a hadroally important resource?	Class 3 peatland habitat is present at two locations adjacent to the east and west of the point at which 1c cnoses the Water of Ken. Unlike Class 12 peatland, Class 3 peatland is not identified as a habionally important resource.
Landscape	Regional Scenic Areas	All options are located within the Galloway Hills RSA.		
and Visual Amenity	Landscape Character / Landscape Features	1A follows the road carriageway of the A713 between Polquhanity and Dundeupt, before crossing enclosed pastructigrazing and the Water of Ken within the Upper Jalle (155) LCT. Key characteristics of the LCT unlikely to be adversely affected. Permanent loss of landscape features is unlikely, however temporary disturbance and reinstatement to stone dykes is likely to be required.	Follows the road carriageway of the AV13 between Polguhanity and Drudeuph, before crossing into enclosed pasture (grazing within the Upper Dale (165) LCT west of the AV13. Key characteristics of the LCT unlikely to be adversely affected. The LCT unlikely to be adversely affected. The CT unlikely to be adversely affected and overhead line connection rists (kendoon from west of the AV13 will result in localised significant effects on the LCT. Permainent loss of landscape features unlikely, to be required, disturbance and reinstatement to stone dykes likely to be required.	Follows the proposed OHL note corridor between Polpuhanity and Durdway, herbre: crossing enclosed sature/grazing and the Water of Ken within the Upper Dale (165) LCT. Key characteristics of the LCT unlikely to be adversely affected. Solle comfort will pass through existing commercial forestry creating a permanent and perceptible linear feature within this area of the Gallowsy Forest Park. Permanent loss of other landscape features unlikely, however temporay distribance and reinstatement to stone dykes likely to be required.
	Visual Amenity / Tourism and Recreation (e.g. SUSTRANS routes, Core Paths, hong distance traffs, nourist paths, hong distance traffs, nourist attractions and recreational areas such as golf courses)	14 follows the Galloway Tourist Route/A713 and crosses the Bredemond-Trail head (Core Path) to the west of Dundeugh and the Dundeugh 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.	18 follows the Galloway Tourist Route(A713 and crosses the apdreamoch trail head (Core Path) to the west of Dundeugh and the Dundeugh 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 does to the licensed caravan/ campsite adjacent to the property of Hawkrigg.	IC crosses the Bardemoch thail west of Dundeugh within the insertity. There is a picnic site associated with Polmaddy medieval and post- medieval sectlement Scheduled Monument to which there is a willing trail however this is over 200m to the west of the route. The majority of this route passes through the eastern extents of the Galloway forest Paic.
	Residential Visual Amenity	No effects on residential visual amenity will occur following completion of construction and restoration works.	No effects on residential visual amenity will occur following completion of construction and restoration works associated with the cable route between Polquhanity and the terminal tower near Dundeugh. The introduction of the sealing end compound, terminal tower and overhead line connection into Kendoon S/S is likely to result in significant visual effects from residential properties at the southem extent of Dundeugh and properties at the southem	No effects on residential visual amenity will occur following completion of construction and restoration works.
Cultural Heritage	Scheduled Monuments	There is one Scheduled Monument, Dundeugh Castle (\$M2476) approximately 250m east of 14. The principal views from Dundeugh Castle are to the vest towards the UGC, however it is not anticipated the scheduled monument will be affected during or post construction.	There is one Scheduled Monument, Dundeugh Castle (SM2476) approximately 250m east of 18. The principal views from Dindeugh Castle are to the west towards the UGC, however it is not anticipated the scheduled monument will be affected during or post construction.	As noted above, Polmaddy Scheduled Monument is located to the west of 1C but will not be directly affected by the route.
	Listed Buildings Category A, B and C	There are two Category B Listed Buildings (Kendoon Power Station and Kendoon Nake House) boared approximately 60m to the north of the route at Kendoon S/S. There are two Category C Listed Building (Dalshangan, Dovecot and Dalshangan, Stables) focared approximately 30m to the north- east of the route at Dalshangan House. No adverse effects are anticipated as a result of the UGC.	There are two Category B Listed Buildings (Kendoon Power Station north of Neuro Nave House) located approximately 150m to the north of the route at Kendoon S/S. There are two Category C Listed Building (Dalshangan, Powecot there are two Category C Listed Building (Dalshangan, Powecot to the north-east of the route at Dalshangan House. No adverse effects are anticipated as a result of the UGC.	There are two Category B Listed Buildings (Kendoon Power Station and Kendoon Valve House) located approximately 130m to the north of the route at Kendoon S(s). There are two Category C Listed Building (Dalshangan, Dovecot There are two Category C Listed Building (Dalshangan, Dovecot to the north-east of the route at Dalshangan House. No adverse effects are anticipated as a result of the UGC.
Forestry and Woodland	Ancient Woodland (AWI) Native Woodland (NWSS) Forestry (NFI)	1A avoids forestry for much of its length by running alongside the existing A713 carriageway. However, the UGC passes through an area of NWSS adjacent to Kendoon S/S.	1B avoids forestry for much of its length by running alongside the existing A713 carriageway. However, the OHL section of this connection passes through an area of NWSS adjacent to Kendoon S/G.	1C is located almost entirely within forestry (NFI).

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Criterion Su Flood Risk Flo	Environmental N/ Summary
b-Otterta od Zones and Waterbodies	¥
1A 1A crosses two areas within the 1/200yr and 1/1000yr flood risk 20nes; one area adjacent to Dundeugh and one to south west of Kendoon, where the Water of Deugh meets the Water of Ken. The route crosses a number of watercourses. Mitting most of these afready crossed by the A713, it is recommended that the route into afready crossed by the A713, it is recommended that the route into	the vicinity of kendoon is reviewed to rationalise this and minimise the number of crossings if possible. Als slightly longer than 1B and 1C due primarily to the loop aroun Option 1A crosses through two areas of Class 3 peatand, while 1C, west of the Water of Ken however, this can be spanned by the OH. All options are in the Galloway Hills RSA, and although some disturt all options are in proximity to a number of cultural heritage feature: All options ares to proximity to a number of cultural heritage feature: all options ares to areas within the 1/2000/r fload in Less forestry felling would be required for options 1A and 1B as the On balance option 1B is the environmental preference. Option indicape and visual effects will arise from the introduction:
18 B crosses two areas within the 1/200yr and 1/1000yr flood risk zones; one area adjacent to Dundeuph and one to the wast of Kendoon where the Water of Deugh meets the Water of Ken. The route crosses a number of watercourses. Millits most of these already crossed by the A713, it is recommended that the route in toute in	the violing of kendoon is reviewed to rationalise this and minimise the number of crossings if possible, actins section is where the DNL section of this route is located there may the option to span flood zones. In the south of Kendoon S/S from south and east. I crosses through an area of Class 3 peadand to the west of the Water of L section of the noute. I crosses through an area of Class 3 peadand to the west of the Water of L section of the noute. I crosses through an area of Class 3 peadand to the west of the Water of the noute of the noute. I crosses through an area of Class 3 peadand to the west of the Water of the zones. Is so the noute of the noute options. This zones. In And 1B require less felling than option 1C. Additionally, in on 1A and 1B require less felling than option 1C. Additionally, in or 3 sealing end compound and ferminial tower to facilitate the the ord.
1C Consers two areas within the 1/200yr and 1/1000yr flood risk consers one area adjacent to Dundeugh and one to south west of Kendoon, where the Water of Deugh meets the Water of Ken. The roue crosses a number of varerocourses. It is recommended that the route in the vicinity of Kendoon is reviewed to rationalis	this and minimise the number of crossings if possible. f Ken, which is unavoidable. IB also passes through this area to the sult in any permanent loss of landscape features. comparison to 1A. 1B can span the Water of Ken (as an OHL ity of Kene (as an OHL)

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Criterion	Sub-Criteria	24	28	20
Section	N/A	CCI route alternative	CCI route alternative with OHL into Kendoon and Glenlee S/S	Undergrounding proposed OHL route
KTR Tower Numbers	N/A	S/S - S/S	PKIO - PK33	S/S - S/S
Approximate Length of Route (km)	N/A	8.97 km	8.43 km (UGC = 7.3km and OHL = 1.13km)	7.7 km
Biodiversity and Geological Conservation	Special Site of Scientific Interest (SSSI) Sites	To the south of the Glenlee S/S where the route crosses Coom Bridge it runs immediately adjacent to the Water of Ken Woods SSSI (designated for upland oak woodland and lichen assemblage).	N/A	
	Scottish Natural Heritage (SNH) Priority Peatland HabitatsError! Bookmark not defined.	Class 3 peatland habitat is present at two locations adjacent to the east and west of the point at which 2A crosses the Water of Ken. Unlike Class 1/2 peatland, Class 3 peatland is not identified as a hationally important resource.	Class 3 peadand habitat is present to the west of the point at which 28 crosses the Water of Ken via OHL. Unlike Class 1/2 peadand, Class 3 peadand is not identified as a 'nationally important resource'.	Class 3 peatland habitat is present to the west of the point at which 2C crosses the Water of Ken. Unlike Class 1/2 peatland. Class 3 peatland is not identified as a hationally important resource.
andscape	Regional Scenic Areas	All options are located within the Galloway Hills RSA.		
and Visual Amenity	Landscape Character / Landscape Features	24 follows the road carriageway of the A713 and A762 between kendoon and Ganelee Six, within the Upper Date LCT. Key characteristics of the LCT unitely to be adversely affected. Permanent loss of landscape features unlikely, however temporary disturbance and reinstatement of stone dykes and woodfand may vocur where the cable route passes through enclosed pasture grazing and crosses the Water of Ken between kendoon S/S and the A713, and crosses the Water of Ken between the Water of Ken near St. John's Town of Dalty.	28 follows the road carriageway of the A713 and A762 between kendoon and Glanlees C/S, which the Upper Dale LCT. Key characteristics of the LCT unlikely to be adversely affected. Creation of sealing and compounds and overhead line connection into kendoon S/S from west of the A713 and into Gjaleles D/S from near Waterside will result in localised significant effects on the LCT. Permanent loss of landscape features unlikely, however temporary disturbance and reinstatement of store dylves and woodland may doccur where the cable route passes through areas of enclosed pasture/grazing between the sealing end compound near Waterside.	2C follows the proposed OHL route corridor between Kendoon SUS and Dundeugh. Defore rorosing endosed pature/grazing and the Water of Ken within the Upper Dale LCT. Key characteristics of the LCT unlikely to be adversely affected. Permanent loss of other landscape features unlikely, however temporary disturbance and reinstatement to stone dykes likely to be required. The the LOC corridor would be within the Risk and an assumed that the USC corridor would be within the Risk and an assumed that the USC corridor would be within the result in additional loss of woodland.
	Visual Amenity / Tourism and Recreation (e.g. SUSTRANS routes, Core Paths, long distance trails, pourist attractions and teretational areas such as golf courses)	24 follows the Galloway Tourist Route/A713 for much of its length. The noute crosses the Southern Upland Way to the north- west of St. John's Town of Dalty and then the Glenlee Core Path to the north of Coom Bridge.	2B follows the Galloway Tourist Route/A713 for much of its length. The route arcosses the Southen Majarid Way to the north-west of SL John S. Town of Daily and then the Glenlee Gore. The math where it crosses the Coom Burn to the north of Glenlee S/S.	2C crosses the Southern Upland Way to the north-west of St John 5 Town of Dairy and then the Glenlee Core Path where it where it crosses the Coom Burn to the north of Glenlee S/S.
	Residential Visual Amenity	No effects on residential visual amenity will occur following completion of construction and restoration works,	No effects on residential visual amenity will occur following completion of construction and restoration works associated with the cable rouce between the terminal tower sealing end compound near Dundeugh ad terminal tower and sealing end compound near Waterside. The introduction of the sealing end compound, terminal tower and overhead line connection into kendoon S/S is likely to result in significant visual effects from residential properties at the southern The introduction of the sealing end compound terminal tower and overhead line connection into Glerides S/S is unlikely to result in significant visual effects from residential properties at the southern the introduction of the sealing end compound terminal tower and overhead line connection into Glerides S/S is unlikely to result in significant visual effects from vegetation.	No effects on residential visual amenity will occur following completion of construction and restoration works.
Cultural Heritage	Listed Buildings Category A, B and C	There are a number of Category B listed buildings directly adjacent volthe route in the area anound Allanghoun, Glenee S/S and Polharrow Bridge, which itself is Category B listed. There are also a number of Category C Listed Buildings adjacent to the X13. The route crosses Coom Bridge a Category C Listed structure. No adverse effects are anticipated as a result of 2A.	There are a number of Category B listed buildings directly adjacent to the trunce in the area around filangibbon, to Rehnee S15 and Polharrow Bidge, which itself is Category B listed. There are also a number of Category C Listed Buildings adjacent to the A713. No adverse effects are anticipated as a result of 2B.	There are a number of Category B listed buildings directly adjacent to the route in the area around Gienet S/S and Polharrow Bridge, which fraeff is Category B listed. There are also as a number of Category C Listed Buildings to the east of the route adjacent to the A713. No adverse effects are anticipated as a result of 2C.
	Archaeologically Sensitive Areas (ASA)	24 and 2B passes immediately to the east of Polharrow Burn ASA. No long-term significant adverse effects are anticipated as a result	t of the UGC.	2C passes through Polharrow Burn ASA. Careful consideration of the route through the ASA would be

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	28	2C
		required to ensure no effects arise during construction.
ses approximately 100m east of Knocknalling MIDL in the reway of the A713 and immediately adjacent to Glenlee IDL in the public road. • the updificant adverse effects are anticipated as a of the UGC.	2B passes approximately 100m east of Knocknalling NIDL. No long-term significant adverse effects are anticipated as a result of the UGC.	2C passes through the eastern edge of Knocknalling NIDL and immediately adjacent to Glenlee park NIDL. No long-term significant adverse effects are anticipated as a result of the UGC.
ids forestry for much of its length by running alongside string A713 and A762 carriageways. However, where 2A is to avoid Earlstourn Power Station in the vicinity of to avoid Earlstourn Power Station in the vicinity of boon and adjacent to Kendoon S/S it crosses an area of	28 avoids forestry for much of its length by running alongside the existing A713 carriageway. However, where 28 is routed to avoid Earlistour Power Station in the vicinity of Allangtibon it will cross an area of NWSS. The OHL section of this connection to the north passes through an area of NWSS adjacent to Kendoon S/S. Whilst the OHL section to the south passes through two separate areas of NWSS to the north of Gleines S/S.	2B crosses multiple areas of forestry to the west of the A713, including areas of NWSS at Knocknalling Wood to the north of Polharrow and two separate areas of NWSS to the north of Glenlee S/S.
sees four areas within the 1/200yr and 1/1000yr flood rick one area to the sourch of Kendoon S/S, nown of Daily and Glenlee in the vicinity of Knockensee. Most of these are the crosses a number of vaterourses. Most of these are the crosseds a number of vaterourses would be difficult to without considerable revisions.	2B crosses four areas within the 1/200yr and 1/1000yr flood rick comes: one areas within the 1/200yr and 1/1000yr flood rick Polharrow Bridge, one to the vest of Ks John's Town of Dalry and one at Glenlee in the vicinity of Coom Burn. The none orgses a number of watercourses. Most of these are already crossed by the A713 and A752 and would be difficult to avoid without considerable revisions. As two of these locations occur where the OHL scored of this route is located, there may the option to span flood conts.	2C crosses three areas within the 1/200yr and 1/1000yr flood orbs: one areas to the south of kendoon 5/5, one to the north orbs: one areas to the south of kendoon 5/5, one to the north orbs: one areas to the area one at Glenlee in the vicinity of Coom Burn. The nore crosses a number of watercourses which would be difficult to avoid without considerable revisions.
be slightly longer than 2B and 2C due to the loop around the 2A corsees through two areas of class 3 peatland, while 2C, the Water of Kan however, this can be spanned by the OHL nons are in the Galloway Hills RSA, and although some distur- he options will cross tourist and recreational routes, including to could have no effects on residential visual amenity, while 2 E would have no accention between OHL and UGC. 2 B pass immediately adjacent to Polharrow Burn ASA while 2 B pass immediately adjacent to Polharrow Burn ASA while 2 B pass immediately adjacent to Polharrow Burn ASA while 2 B pass immediately adjacent to Polharrow Burn ASA while 2 B pass immediately adjacent to Polharrow Burn ASA while 2 B pass immediately adjacent to Polharrow Burn ASA while 2 B pass immediately adjacent to Polharrow Burn ASA while	s south of Kendoon S/S from south and east. crosses through an area of Class 3 peetland to the west of the Water of k section of the route. section of the route. He Southern Upland Way. e 2C would likely have significant visual and localised effects on the LCT	(en, which is unavoidable. 2B also passes through this area to the , none will result in any permanent loss of landscape features. as a result of the need for a sealing end compound and terminal
uires the least felling as it parallels the existing A713 and A7 sees the fewest flood risk zones.	co peoses unrough the easem reuge and would require caretur routering. 52 carriageway for much of its length.	to ensure no significant effects on archaeological features.
Sold For Fire Sold Sold For State	s forestry for much of its length by running alongside ine AJ13 and ASC arringeom where XA is no void Eafstoun Power Station in the vicinity of for and adjacent to Kendoon S/S it crosses an area of be for a reas whin the 1/200Y and 1/1000Y flood risk the area to the work of St John's Town of Dalty and where in the vicinity of Knockensee. It crosses a nurdinity of Knockensee. It crosses and a crosses of Class 3 peetland, while 2C, the Water of Ken however, this can be spanned by the QNL or strend in the Gloway Hills can be spanned by the QNL is are in the Gloway Hills can be spanned by the QNL or strend in cross tower and although some distuid of clicate the transition between ONL and UGC.	Forestry for much of its length by running alongside the work synthes 248 avoids forestry for much of its length by running alongside the invoid Earlstoum Power Station in the vicinity of strangeways, thosever, where 24 is avoid Earlstoum Power Station in the vicinity of strangeyens, thosever, where 24 is avoid Earlstoum Power Station in the vicinity of strangeyens, the OHL service of MMSS adjacent to Kendoon S/S it crosses an area of MMSS adjacent to Kendoon S/S it crosses an area of MMSS adjacent to Kendoon S/S it crosses an area of MMSS adjacent to Kendoon S/S it crosses an area of MMSS adjacent to Kendoon S/S it crosses an area of MMSS adjacent to Kendoon S/S, while the OHL section to the south of Sachon S/S, one to the north of Glenke S/S, its area to the south of Kendoon S/S, one to the north of Glenke S/S, its area to the south of Kendoon S/S, one to the north of Glenke S/S, its area to the south of Kendoon S/S, one to the north of Glenke S/S, its area to the south of Kendoon S/S, one to the north of Glenke S/S, its area to the south of Kendoon S/S, one to the north of Glenke S/S, its area to the south of kendon S/S, one to the north of Glenke S/S, its area to the south of Kendoon S/S, one to the north of Glenke S/S, its area to the south of kendon S/S, one to the north of the north of Glenke S/S, its area to the south of kendon S/S, one to the north of Glenke S/S, its area to the south of kendon S/S, one to the north of Glenke S/S, and would be difficult to nort considerable revisions. As two of these locations coccur where the OHL nort considerable revisions. As two of these locations coccur where the OHL nort considerable revisions. As two of these locations for the area it area. Area explored to the south of kendon S/S from south and east.

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Criterion	Sub-Criteria	34	38
Section Description	N/A	OCI route alternative	Undergrounding proposed OHL route
KTR Tower Numbers	N/A	GT08 - GT21	GT08 - GT21
Approximate Length of Route (km)	N/A	4.2 km	3.6 km
Landscape	Regional Scenic Areas (RSA)	Both options are located within the Galloway Hills RSA.	
and Visual Amenity	Landscape Character / Landscape Features	3A passes through the Foothills with Forest (176) and Rugged Uplands with Forest (131) LCTs. Key characteristics of these large scale LCTs are unlikely, to be adversely affected. Permanent loss of landscape features unlikely, however temporary disturbance and reinstatement of prome dykes and woodland more unlikely, however temporary disturbance and reinstatement of the Quen's Way/A712. Introduction of the Quen's Way/A712. The cable route passes through enclosed pasture/grazing north of the Quen's Way/A712. Introduction of the Quen's Way/A712. The cable correct of pass through exciting and constrained to the A712 creating a permanent and perceptible linear feature within this area of the Gallowsy forest Plank.	3B passes through the Foothills with Forest (176) and Rugged Uplands with Forest (181) LCTs, along the route of the proposed OHL. Key characteristics of these large scale LCTs are unlikely to be adversely affected. Permanent loss of landscape features unlikely, however temporary disturbance and reinstatement of stome dykes and woldand may occur where the cable route passes through enclosed pasture/grazing introduction of terminal towers likely to result in very localised significant effects on the LCT. The color of terminal towers likely to result in very localised significant effects on the LCT. The cable corridor will pass through existing commercial forestry south of the A712 creating a permanent and proceeptible intervent with this area of the Galloway Forest Park.
	Visual Amenity / Tourism and Recreation (e.g. SUSTRANS routes, Core Parks, hong discrete brails, bourist attractions and recreational areas such as golf courses)	Option 3A crosses the Robert the Bruce Trail and a section of the Galloway Kite Trail (between New Galloway and Cateringshave Looh) which corresponds to the Queen's Wy the Robert New Galloway and Cateringshave Looh) which corresponds to the Queen's Wy the route passes through the Galloway Forest Park. The Robert's Way the route passes through the Galloway Forest Park. The Robert of the Queen's work the route passes through the Galloway Forest Park.	Option 3B crosses the Robert the Bruce Trail and a section of the Galloway Kite Trail (between New Galloway and Clateringshaws Lock) which corresponds to the Queen's Way / the A712 between New Galloway and Menon Stewart, crossing the road perpendicular to the north of Peal Hill, South of the Queen's Way the norte passes through the Galloway Forest Park.
	Residential Visual Amenity	Effects on residential visual amenity predicted in relation to the terminal tower location north-west of to occur.	Airie (views possible from access track and curtilage); however significant effects are considered unlikely
Forestry and Woodland	Ancient Woodland (AWI) Native Woodland (NWSS) Forestry (NFI)	The most southern section of 3A 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.	Approximately two thirds of route 3B is located within forestry to the west of Peal Hill and an area of AMI is crossed to the south of the Queen's Way.
Flood Risk	Flood Zones and Waterbodies	Both 3A and 3B cross the Knocknairling Burn which is within the 1/200yr and 1/1000yr flood risk zone	is to the north of Peal Hill (Knocknairling Burn).
Environmental Summary	N/A	34 will be slightly longer than 38. Both 3A and 38 are in the Galloway Hills RSA, and although some disturbance to stone dykes and wor Both 3A and 38 will cross towinst and recreational routes, which correspond to the Queen's Way. Both 3A and 38 wuld likely have very localised significant effects on the LCT as a result of the need f Effects on residential visual amenity are likely in relation to the terminal tower location north-west of. Both 3A and 38 will require fivest felling on the eastern and western slopes of Paal Hill respectively. C Both 3A and 38 mult require fivest felling on the eastern and western slopes of Paal Hill respectively. C Both 3A and 38 cross one small area within the 1/200yr and 1/1000yr flood risk zones (Knocknairling On balance, although longer, option 3A is the environmental preference, primarily as less fo	oldand may be required for both options, neither will result in any permanent loss of landscape features. or a sealing end compound and terminal tower to facilitate the transition between OHL and UGC. Arine however, these will not be significant. Domparatively however, 3A will affect less forestry through utilising existing wayleaves and forest breaks. Burn).

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Criterion	Sub-Criteria	44	48	40	
Section Description	N/A	CCI route alternative	Undergrounding proposed OHL route	CCI route alternative	-
KTR Tower Numbers	N/A	GT25 - GT74	GT25 - GT74	GT25 – GT78	-
Approximate Length of Route (km)	N/A	14.2 km	13 km	16.2 km	
Biodiversity and Geological Conservation	Special Site of Scientific Interest (SSSI) Sites	4A rurs directly adjacent to the Laughenghie and Airie Hills SSSI and breeding bird assemblage including osprey, parogander, goldeneye and non-freal greying geese, golden plover and curlew and a wide range of other moodland geeces. Tack and it will be for some of the process of the plover and curlew possible to avoid locating infrastructure within the SSSI.	48 is approximately 130m from the Laughenghie and Airie Hills SSSI at Stroan Loch.	4C runs directly adjacent to the Laughenghie and Airie Hills SSSI Stroan Lock. Further no the south the norub also runs adjacent to the east of the Woodhall Loch SSI designated for beelfac. Caddisfly, Fen Meadow and Oligotrophic loch freshwater habitat. As 4C is proposed within is an existing access track to the north infrastructure within the SSSIs.	-
Landscape	Regional Scenic Areas (RSAs)	The majority of 4A, 4B and 4C are located within the Galloway Hills	RSA. The southern extent of the route in the vicinity of Laurieston Fore	est is located outside the RSA.	-
and Visual Amenity	Landscape Character / Landscape Features	4A passes through the Rugged Uplands with Forest (181) and colonilis with forest (175). Licrs, key transacteristics of these large scale LITs are unlikely to be adversely affected. Cable corridor will pass through existing commercial forestry within the Bernan and Laurieston forest areas tonadiy following existing forestry access tracks, however some actions of wayleave will create a permanent and perceptible linear feature within this area of the Gloway Forest Park. Introduction of terminal towers is likely to result in very localised significant effects on the LCIS, however list position within sumounding commercial forestry will limit perceptibility aross the wider landscape. Remanent loss of landscape features is unlikely, however temoarent of sturbance and reinstatement to stone of view level to be required.	At passes through the Rugged Uplands with Forest (181) and coulding with forest (121) Circs, key that arcatectristics of these large scale LCTS are unlikely to be adversely affected. Cable corridor will pass through existing commercial forestry within the Bernian and Laurieston forest areas proady following existing forestry access track, however some new sections of wayleave will create a permanent and perceptible linear feature within this area of the Galloway Forest Park. Introduction of reminat towers is likely to result in very localised significant feats on the LCTs, however their position within significant feats on the LCTs, however wider landscape. Permanent os of and-scape features is unlikely, however Remonany discurbance and reinstatement to stone dykes is likely to be required.	4A passes through the Rugged Uplands with Forest (181) and cochills with forest (1/2) (LTS, Key Valiraizdenistics of these large scale LCTs are unlikely to be adversely affected. Cable corridor will pass through existing commercial forestry within the Bennan and Laurisston forest areas to roady following existing for the Bennan and Laurisston forest areas to roady following existing for eachy a caress tracks, however some new sections of wayleave will create a permanent and perceptible linear feature within this area of the Galloway Forest Park. Introduction of terminal towers is likely to result in very localised significant effects on the LCTs, however their position within surrounding commercial forestry will limit perceptibility across the wider landscape. Permanent So of landscape features is unlikely, however temporary disturbance and reinstratement to stone dykes is likely to be required.	1
	Visual Amenity / Tourism and Recreations (e.g. SUSTRANS routes, Core Paths, long distance trails, tourist attractions and recreational areas such as golf courses)	From north to south 4A runs along the Raiders Road Kenmuir Link core Path, unlising the wayleave formed by the existing nead. The nouce then turns south east following the Raiders Road to Mossdale section of the Core Path which also forms part of the Galloway Kite Tail. Both the northern and southern extents of this route pass through necreational receptors related to the park to the east of Stroan Loch. In route continues to follow the Raiders road to Mossdale, where at the southern banks of Stroan Loch, it turns south running the southern banks of Stroan Loch, it turns south running failway Walk. At its southern externeity the neure then usset the Retreat Wood Laurieston Core Path before terminating at GT74.	As crosses a number of Core Paths at various points, including the Radies Road Nermure Link wass of Carion Edward HII Core Path to the north east of Stroan Loch as well salivals Waak to the sast of Stroan Loch. At this point the route aslivary Waak to the Galloway Kite Trail. Further south the assort of Stroan Loch. At this point the route also crosses a section of the Galloway Kite Trail. Further south the Both the northern and southern extents of this route pass through the eastern extent of the Galloway Kite Trail. Further south the necreational receptors related to the park to the east of Stroan Loch as well as to the east of the route whin Laurieston Forest.	From north to south 4C runs along the Raidens Road Kemmuir Link forme Path as far as the Sucou Loch viaduct a section of which also forms part of the Galloway Nite Trail. The northern extent of this route passes through the eastern strent of the Galloway Froms that. The note diverts to the east to the A762 at Mossfale utilising the existing wayleave created by the Mossfale to Galloway the Galloway kine trail/A762 before terminating at GT78, west of the A762.	
	Residential Visual Amenity	Terminal tower at GT74 is likely to be visible from nearby property of Edgarton Cothouse, but effects on nesidential visual amenity unlikely to be significant due to distance and presence of intervening landform and confierous forestry to the north of property.	Terminal tower at GT74 is likely to be visible from nearby property of Edgarton Cothouse, but effects on residential visual amenity unlikely to be significant due to distance and presence of intervening landform and conferous brestry to the north of property.	Terminal tower at GT78 is likely to be visible from nearby property of Edgarton, but effects on residential visual amenity unlikely to be significant due to distance and presence of intervening landform and woodland to the north-east of property.	
Cultural Heritage	Scheduled Monuments	NA		There are two Scheduled Monuments, Edgatron Mote Fort (\$M1119) and Little Ductures Fort (\$M1077) located aproximately 365m south west and within 25m of 4C respectively. The principal views from Edgatron Mote are to the south therefore at this visits race visibility would be reduced by intervening topography. Duchreat Fort is located immediately adjacent to the A762. In advesse effects on any of the SMs are anticipated as a result of the UGC.	
	Listed Buildings Category A, B and C	The closest listed building is over 100m away from both 4A and 4B	at Stroan Viaduct (Category B listed),	There are a number of Category B and C listed buildings directly adjacent to the route adjacent to the A762 in the areas around	-

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No adverse effects are anticipated as a result of the UGC. An unstandal <
Archaeologically Sensitive hues of the Grobdale KSA, associated with the area.& He runs through Grobdale KSA and a number of local features sessociated with the area.Areas (ASA)No adverse effects are anticipated as a result of the USC.Rerue through the KSA would be required to ensure no effects arise during construction.Carden Indecapes (CDU) and Non- Bogare NIDL allog existing accesses at heir closest points.N/ARerue through the KSA would be required to ensure no effects arise during construction.Forestry and Woodland (WUS)An one directly to the west of Laurieston Hall and to the east of Slogare NIDL.N/AN/AForestry and Mative Woodland (WUS)Both A and Ad Bass string accesses at heir closest points.N/AForestry and Mative Woodland (WUS)Both And Ad Bass of predominantly commercing the east of points.N/AForestry and Mative Woodland (WUS)Both And Ad Bass of predominantly comprising the existing forest roads south of his point.Forestry and Mative Woodland (WUS)Both And Ad Bass of predominantly comprising the existing forest roads south of his point.Forestry and Mative Woodland (WUS)Both And Ad Bass of forestry comprising the existing forest roads south of his point.Food RiskHood Zones and WaterbodieA conse string the L/200yr and L/1000yr flood raFood RiskHood Zones and WaterbodiesAn ad Care and An ad Ad.Food RiskHood Zones and WaterbodiesAn ad Care and L/1000yr flood raFood RiskHood Zones and WaterbodiesAn ad Care and Ad ad Care
Forestry and west of Lawrestone Stopare MDL along existing accesses at their closest points. MA Forestry and woodland Ka runs directly to the west of Laurieston Hall and to the east of lawdscapes (NDL) MA Forestry and woodland Ancient Woodland (AWT) Both 4A and 4B pass through areas of forestry comprising the eastern extents of the Galloway Forest Park and Laurieston Forest. B or the UGC. MA Forestry virth Both 4A and 4B pass through areas of forestry comprising the eastern extents of the Galloway Forest Park and Laurieston Forest. B or the UGC. MA Forestry VIRT) Both 4A and 4B pass through areas of forestry to marking its printerest areas of MFI parking its or the UGC. MA Forestry VIRT) Both 4A and 4B pass through areas of forestry to marking its printerest areas of MFI parking its or the UGC. MA Fold Torient Woodland Maximin Wasson Both 4A and 4B pass through areas of forestry but will also increast y and MFI parking its print. MA Fold Risk Fold Zones and Waterbodies An coste string advict and where possible existing forest roads south of this point. Jandes to mark in Laurieston Forest to MAL MASS Flood Risk Flood Risk Hood Zones and Waterbodies An coste fore and the HIL 200Yr and 1/1000/r flood risk An coste fore and run unsection forest roads south of this point. Flood Risk Hood Zones and Waterbodies An coste are areas with
Forestry and Woodland (AWT)Both 4A and 4B pass through areas of forestry comprising the eastern extents of the Galloway Forest Park and Laurieston Forest. B weter social mediand for westsWoodland Woodland (WWSs)Extension areas of predominantly commercial forestry but will also increase areas of MF1 pandical we west put will also increase areas of MF1 pandical we west put west will also increase areas of MF1 pandical we west pot westWoodland Woodland (WWSs)Extension and 4B pass through areas of forestry but will also increase areas of MF1 pandical we west pot westWoodland Forestry (NF1)Increase areas of predominantly commercial forestry and were possible existing forest roads south of this point.Flood RiskFlood RiskA crosses three areas within the 1/200yr and 1/1000yr flood riskFlood RiskFlood Zones and WaterbodiesA crosses three areas within the 1/200yr and 1/1000yr flood riskFlood RiskFlood Zones and WaterbodiesA crosses three areas within the 1/200yr and 1/1000yr flood riskFlood RiskFlood RiskA crosses three areas within the 1/200yr and 1/1000yr flood riskFlood RiskFlood RiskA crosses three areas within the 1/200yr and 1/1000yr flood riskFlood RiskHood Zones and WaterbodiesA crosses three areas within the 1/200yr and 1/1000yr flood riskFlood RiskFlood RiskA crosses three areas within the 1/200yr and 1/1000yr flood riskFlood RiskFlood RiskA crosses three areas within the 1/200yr and 1/1000yr flood riskFlood RiskFlood RiskA crosses three areas within the 1/200yr and 1/1000yr flood riskFlood RiskFlood RiskA crosses thre
Flood Risk Flood Zones and Waterbodies A crosses three areas within the 1/200yr flood risk A crosses two areas within the 1/200yr and 1/1000yr flood risk Zones (one north and east of Slogarie, and once within the 200 method in a crosses three areas within Laurieston Forest Zones (one north and areas of Slogarie, and once within Laurieston Forest Environmental N/A 4C will be longer than 4A and 4B. Zones (one writhin an existing forestry track. 4B is approximating the majority of 4A, 4B and 4C are located within the Galloway Hills RSA. Annery And 4C are adjacent to Lughenghie and Aine Hills SSSI at Stroan Loch but are writhin an existing forestry track. 4B is approximating the explores will cross trunts and recreational routes, including the Raide's Road.
Environmental N/A 4C will be longer than 4.8. Summary The majority of 4A, 4B and 4.6 are adjacent to Lughenghie and Airie Hills SSSI at Stroan Loch but are writin an existing forestry track. 4B is approximat The majority of 4A, 4B and 4C are located within the Galloway Hills RSA. All of the options will cross tourist and recreational routes, including the Raider's Road.
For all condex, increase, increase increase is neery to restart wery oreased sogminant ereters on met. LCI, inverser transmiss and reinstatement to stone ofker Mill of the option would likely have significant very localised effects on LCT, however their position within surrounding commercial for towers for all of the options would be visible from nearby property of Edgatron Cochouse, significant effects are considered unlikely forestry. An and 4C evoid the Grobdale AGA while 4B route would pass through this area. If taken forward, 4B should be modified to avoid a All of the options will require forest falling, however the 4C will impact less forestry through utilising existing wayleaves and forest b All of the options will require forest falling, however the 4C will impact less forestry through utilising existing wayleaves and forest All and the options will require fealing to however the 4C will impact less forestry through utilising existing wayleaves and forest All and the options will require fealing.

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Unterion	Sub-Criteria	54	B,
Section Description	N/A	OCT route alternative	Undergrounding proposed OHL route
KTR Tower Numbers	N/A	GT97 - GT104	GT97 - GT104
Approximate Length of Route (km)	N/A	2.2 km	2.03 km
Landscape and Visual Amenity	Landscape Character / Landscape Features	SA passes through the Drumlin Pastures (169) LCT, although key characteristics of the LCT are unlikely to be adversely affected. The calle corridor passes through actosed pasture/grazing to the north and south of the A75. Throuduction of meminal townes likely to nesult in very localised significant effects on the LCT, however their position in relation to adjacent landform will limit perceptibility across the wider landscape. Permanent loss of landscape features is unlikely, however temporary disturbance and reinstatement to stone dykes is likely to be required.	SB passes through the Drumlin Pastures (163) LCT along the i characteristics of the LCT are unlikely to be adversely affected cale context passes through inclosed pasture grazing to the wer route of the proposed OHL. Introduction of terminal towers like effects on the LCT, however their position in relation to adjace across the wider landscape. The across the wider landscape. The prometer loss of landscape features is unlikely, however tem the prometer loss of landscape to a tunes.
	Visual Amenity / Tourism and Recreation (e.g. SUSTRANS routes, Core Paths, Jong distance trails, rourist attractions and recreational areas such as golf courses)	Visibility of terminal towers (tower G197 and GT104) will be largely imperceptible in views from the A:	e A75, whilst the cable corridor crosses this busy road route between
	Residential Visual Amenity	Although terminal tower at GT97 is located in relatively close proximity to Upper Balannan Farm, effec and large-scale agricultural buildings to the north, north-east of the property.	ffects on residential visual amenity are unlikely to be significant due
Forestry and Woodland	Ancient Woodland (AWI) Native Woodland (NWSS) Forestry (NFI)	Both 5A and 5B are close to an area of AMI adjacent to Argrennan Cottages but unlikely to directly aff	v affect it.
Summary	I N/A	SA will be slightly longer than SB. Neither option will result in any effects on the LCT. Permanent loss of landscape features is unlikely, however temporary disturbance and reinstatement to No significant effects in relation to visual amenity are anticipated. Both options are dose to an area of AVII but neither is likely to affect it directly. There is no environmental preference between 5A and 5B due to the presence of very few en alignment of the existing 132kV OHL.	at to stone dykes is likely to be required for both options. <i>N</i> environmental constraints along the route options, Both 5A i

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Section	Sub-Criteria N/A	6A CCI route alternative following the west side of Loch Ken	68 CCI route alternative following the proposed OHL wayles to the Queen's Way crossing before following the west side of Loch Ken	6C CCT route alternative following west side of Loch Ken and crossing the A/3 close to the proposed OHL wayleave	0 0 5	D CI route alternative following the east de of Loch Ken
KTR Tower Numbers	N/A	Glenlee S/S - Tongland S/S				
Approximate ength of Route (km)	N/A	31.24 km	31.34 km	33.15 km		37.79 km
iodiversity nd eological onservation	Special Protection Areas (SPA)	64, 68 and 6C pass immediately to the v as kamume biomes 5301, Qualifying fe fronted Goose Anser albitrons flavinostris As these routes would be in the carriage avoided.	rest of the Loch Ken and River Dee Marsh sures of the SPA include to populations of the as well as migratory Greykag Goose Area vay of the A762, it is assumed that infras	es SPA and Ramsar site (a) he Annex I listed Greenland <i>anser</i> tructure within the SPA itse	so designated 1 White- elf can be	so designated The route passes immediately to the ex 1 White - SPA and Pansar site. U outbifying teature Annex 1 listed Greenland White-fronteer ans as migratory Greylag Goose Anser anse elf can be As these routes would be in the carriag infrastructure within the SPA inself can
	Special Site of Scientific Interest (SSSI) Sites	To the south of the Glenlee S/S the noter rurs immediates by adjacent to the Water of ken Woods SSSI designated for upland oak woodland and lichen assemblage. At the northern reaches of Loch Ken, the route runs adjacent for Kennure Holmes SSSI, part of the Loch Ken and River Dee Marshes SPA and Ramsar site. South of Mossdale the route runs adjacent for freshwater, lowland ad designated for freshwater, lowland ad designated for freshwater, lowland ad freshwater, and inverter rans adjacent the cuble in proposed in provimity to the designations above, there the cuble is proposed in provinity to the designation above, therefore it is assumed that works detectly with the designation above, therefore it is assumed that works due evolded.	At the northern reaches of Loch Ken, the route runs adjacent to Kennure Holmas SSSI, part of the Loch Ken and River. Dee Marshes SPA and Ransar site. Souch of Mossdale the route runs adjacent to the Woohland and adjacent to the Woohland and Holman and Kennur and Kennurs Miner the cable is proposed in provimity to the designations above, where the cable is proposed when the provised works therefore it is assumed that works directly within the designated areas can be avoided.	To the south of the Glenk route runs: immediates by water of ken woods SSBs is upland oak woodland, assemblage. At the northerm reaches o the noute runs ediacent to Homes SSB, part of the Homes SSB, part of the Homes SSB, part of the River Dee Mashes SPA at River Dee Mashes SPA at River Dee Mashes SPA at Grant of Mossdale the rou- adjacent to the Woodhall designated for freshwater designated for freshwater provimity to the designate provimity to the designate therefore it is assumed the therefore it is assumed the	e S/S the givent to the designed then kennure Loch Ken Remar Rema	e S/S the end of the mortherm reaches of Loch Ken, of gipcents to the Loch Ken and digipcents of south of Mossdale the mous and and loten south of Mossdale the mous and south of Mossdale the mous muss disposed in provimin the public highwayers of a provimin where the cublic is proposed in the cublic designated areas can be avoided. I wundrand designated areas can be avoided. The cublic designated areas the dimention designated areas designated areas design
	Scottish Natural Heritage (SNH) Priority Peatland HabitatsError! Bookmark not defined.	Class 1 peatland habitat (designated as and west of the A762 near Beoch Moor. Class 3 peatland habitat is present at on It is assumed that 6A/6B/6C will be with	a 'nationally important resource') is prese e location adjacent to the east and west o n the carriageway of the A762 where Cla	nt at one location adjacent to if the A762 near Back Fell. ss 1 peatland is shown.	the east	the east Class 3 peatland habitat is present at o adjacent to Mid Tors. It is assumed that 6D/6E will be within 3 peatland is shown.
andscape	Regional Scenic Areas (RSA)	The routes are located within the Gallow	ay Hills RSA to the north and a small sect	ion of the Solway Coast RSA	to the south v	to the south where the UGC terminates at Tongland S/
d Visual	Landscape features / Landscape Features	Follows the road carriageway of the Follows the road carriageway of the Ringford, within the Upper Dale (165), Flooded Valley (164) and Drumlin Pasture (161) LCTs. Ney characteristics of the LCTs unlikely to be adversely affected. South of Ringford the table route passes through endosed passure grazing heritor erossing the A75 and continuing through endosed passure grazing fields east of the A75 and continuing through endosed passure grazing fields east of the A75 and continuing through woodland on the southern flanks of Castle Hill. Permanent of south endosed fiscultance and reinsteape features largely avoidable, however temporary dyses likely to a required and loss of woodland likely at Castle Hill.	Route heads west, south-west from Glenke S75 through enclosed pasture/grazing within the Upper Dale (164) and Foothills with Forest (176) (164) and Foothills with Forest (176) (164) and Foothills with forest (176) forest (131) LCT to the commercial forestry of the Rugged Uplands with A712 before continuing through of the A712 before continuing through the A712 before continuing through the seriolesed pasture/grazing fields west of the Karlageway at Burmbot Bidge on the A762.	As for 64 north of Glentariff Ar62. Rotte heads through enclos pesture/grazing fields of the pesture/grazing heads of the permething Tongland Sr3 and heading south thro approaching Tongland Sr3 west. Key characteristics of west. Key characteristics of west. Key characteristics of heamaent loss of landscap Permanent loss of landscap disturbance an entracteren disturbance an entracteren disturbance an entracteren disturbance an entracteren	on the red sed bine A762 assing the augh further from the frihe LCTs erted. ent to stone ent to stone	on the The route follows the A782 south from dealers (55) Before reacting the A713 on the bit A782. Secons can solve water of Ken at Meikle Isle in the foor of the bit A782. Secons of the A713 within the ugh further under the A713 within the under the route wellow. Second the analysis of the A713 within the Upper DBI (155) and Toode A718 within the Upper DBI (155) and Toode Valley fiche LCTs. Between Loch Wim Craigs eastwards through endoes in the LCTs are and constricted, lumb endoes dealer. The nouse the 1650 LCT passing over electures pesture (163) LCT passing out the and Drumlin pesture (163) LCT passing over defautes and Custorist full before descending south the River Dee. A713 and the River Dee. Balmaphie Bridge, which will create a a fundor at Barmboard Wood near Balmaphie Bridge, which will create a period at Barmboard Wood near Balmaphie Bridge, which will create a Balmaphie Bridge, which will create a balmaphie Bridge. Which will create balmaphie bridge. Which will create a balm

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	ute, running adjacent to Loch and Core Path twice, first (applefoot, Functher south terre strutted on Loch set the Chrichie and the noute then bypasses t, it crosses both the		 enclosure 300m SSW Mains SM1124), and Genicohar, Monford (SM12792) are ated as a result of the UCC. directly adjacent to the route ated as a result of the UGC. 	I close to a number of other at these locations. tred as a result of the UGC.	Following the line of the contropy for conservation of the route passes through the route turns south west, it of AWI and NFI at Balmaghie of AWI and NFI at Balmaghie of adjacent to Argrennan	
60 permanent linear feature in the landscape. Iandscape. South of here the runce passes through enclosed pasture/grazing fields before ecrossing the A/37 near Upper Balannan ecrossing the A/37 near Upper Balannan approaching Tongland S/5 from the approaching Tongland S/6 from the approaching Tongland Tongland S/6 from the approaching Tongland Ton	The route runs parallel with the Galloway Tourist Ro ken. The route then consest the Daily to new Gallow immediately to the south of Boat Knowe and then at the route passes to the east of the Galloway Activity Ken. At the southern reaches of Loch ken, the route cross Gengunnock Wood Cartoning Pacht, Further to the south Galloway Tourist Route and Robert Bruce Trail.		Crofts Mott, fort (9SM1065) and Castle earthworks, of Greenise (SM8110), and Kirkland Mote, Mote (SI Roman Fort, annexe, camps and barrows SOm E of h within 100m of the route. No long-term significant adverse effects are anticipal	There are a number of Category B listed buildings di in the area around Parton. No long-term significant adverse effects are anticipa	The routes pass through Balmaghie House NIDL and NIDLs, however they are within the public highway a No long-term significant adverse effects are anticipated on the three structures and the structure structures are activitient adverse effects are anticipated and structures are activitient adverse effects are anticipated as a structure structure structure structure structures are activitient adverse effects are activitient adverse effects are anticipated as a structure structure structure structure structure structures are activitient adverse effects are anticipated as a structure structure structure structure structure structure structures as a structure structure structure structure structure structure structure structure structures as a structure structu	The route follows a small section of the A762 before A713 south along the eastern banks for Loch Ken be to the north of Coxsmichael. To the south of Loch K a small section of NWSS and NFT at Barony Isle. As t runs along the farm access track, avoiding an area o Bridge. At its southerm extent the route skirts an area of AW Cottages.
y	The route then rurs along the all year round calloway (ME Trail adjacent to ucund calloway (ME Trail adjacent to ucoth Ken, crossing the Ar12/Queent's Way to the west of New Galloway the route crosses the New Galloway deal cut- corses the New Galloway Galloway deal continuing south the route crosses a section of the Caim Edward HII Core path before passing does to a number of recreational receptors to the east of Bernan HIII. The route crosses the Mossidale to Gatehouse Station Railway walk at Nostada. At its southem extern the route crosses the Earling and Barstobrick Core paths and Barstobrick Core paths and Barstobrick Core paths and Barstobrick Core	on and restoration works.	he route, east of the A762. On the ects on the Scheduled Monument will	e, south of Massdale.	The route is directly adjacent to denieve prix MDL, Hando House MDL and Laurieston Hall MDD, within the carriageway of the A7S2. It also passes through Kemmure Castle MDL. It is recommended that the route is realigned to avoid passing through Kemmure Castle by continuing along the A7S2.	The route follows the A762 from Glealee S75 before doning more country at White Hill, Art this point the route crosses a small area of NFL. Further south the route crosses an area of AWL, MWSS and NFI at High Wood to the south of New Gallowary Codi CLU before skirning Burnhoot Cottage and re-roining the allonment
8	The noute runs in parallel with the New Galloway west Core Path before turning south, mossing the Queen's way/N212 and the nouse of the Robert Buve Trail and Galloway Kite Trail to the vest of New Galloway. To the south of New Galloway the noute passes through a strail section of the asstem extents of the Galloway Forest passes through a AFSQI all and Galloway Ker Trail. chosain round Galloway Ker Trail. chosain round Barta and Barstobrick visitor centre path and Barstobrick visitor centre north of Ringford.	il occur following completion of constructio	t (SM1077) is located directly adjacent to the carriageway of the A762, any direct el	ectly adjacent to the route at Hensol Lodg re anticipated as a result of the UGC.	The note is directly adjacent to Hensol Nouse and Laurosco Hall NIDLs within the carriageway of the A762, No long-term significant adverse effects are anticipated as a result of the UGC.	The route passes through an area of AWI, MNSS and NFI 35 and NFI 35 aptr of the Black Bank wood before tuning south. The route then passes through an area of NMSS and NFI to the north of Peal HIII as well as a small section of Burnfoot Wood, before joining the AFJ2 hadry gouth alloy the wester this druch Ken. To the west this
ě	The route then runs along the all year round Galloway fore Trail adjacent to Loch Kan, mossing the A7120/Leen's Way to the west of New Galloway. To the south of New Galloway to route consistent of New Galloway of Club. Contributing south the route crosses a section of the Caim Edward Hill Core Pabli before good the train Edward Mill Core Bernan Hill. The route concinues to follow the Galloway kine Trail south crossing the Mosstelle to Gatehouse Station Railway Walk at Mossfelle. At its southern extent the route crosses the Path sand Barstobrick Core Paths and Barstobrick Core Paths and Barstobrick Core paths and Barstobrick Core	No effects on residential visual amenity w	Little Duchrae Fort Scheduled Monument assumption that the route will be within the be avoided.	A Category B listed building is located dire No long-term significant adverse effects a	The rouce is directly adjacent to Glenke PRA MUL, Harol House NDL and Laurieston Hall Within the carriageway of the AXS. It also passes through Kemmure Castle MIDL. It is recommended that the route is realigned to avoid passing through Kemmure Castle by continuing along the AXS.	The route follows the A762 from Glenkes C75 Sebrore drycning cross- country at White Hill, At this point the route crosses a small area of NF1. Eurber south the route crosses an area of AW1, NWS5 and NF1 at High Wood to the south of New Gallowary Gof CUb Bebre skirring Burnfoot Cottaoa and re-roining the allowary
Sub-Criteria	Visual Amenity / Tourism and Recreation (e.g. SUSTRANS noutes, Core Paths, long distance trails, tourist attractions and recreational areas such as golf courses)	Residential Visual Amenity	Scheduled Monuments	Listed Buildings Category A, B and C	Garden and Designed Landscapes (SDL) and Non- Inventory Designated Landscapes (NIDL)	Ancient Woodland (AWI) Native Woodland (NWSS) Forestry (NFI)
Criterion			Cultural Heritage			Forestry and Woodland

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	H I	within the 1/200yr and 1/1000yr flood risk zones h east of Glenlee S/S (Coom Burn and the Water of of Longwood (Black Bridge Burn).	on longer than 6D. provinitity to a number of natural heritage foctors areas 3 a partial nhaltage to follow existing linear transcripts a partial nhaltage to follow existing linear r. This areas is adjacent to the A713. along which the transcripts overhead line wayleares. This areas could g detailed alignment depending on which the Galloway Hills RSA to the onth and a small RSA to the south where the UGC terminates at will cross tourist and recreational routes, including geleavied alignment loss of landscape features considered will cross tourist and recreational routes, including galaxy kite Trail. Will cross tourist and recreational routes including galaxy kite Trail. Will cross tourist and recreational routes including galaxy kite Trail. Will cross tourist and recreation of the proposed to be required. I heritage features would be directly affected by the une forest fields, however this can be minimised pathway kite areas would be directly affected by the une forest predix in patholiar those formed doch Ken. Both of the proposed cable routes will forestry. Ammental preference between 0D and 6E due to minimised and inference in route length. The option receptors than the option solor of as although longer, these affects on tourism and recreation receptors than
6	8	6D and 6E cross four areas (two to the immediate sour Ken); and two to the north Ken); and two to the north	Cable route 6E is only 0.53 decip options are located in designations however all of a cost options however all of a cost proprions thore were all of the proper such and the with features such as proper the activity be avoided duri features such as a sounded of potentially be avoided duri section of the Solway Coass Tongland S/S. Both proposed cable routes the Robert Bruce Trail and For all of the Cable routes and versely affected with the adversely affected with the diversa and hedgerows likely divers and hedgerows likely the Robert routes re- diversal erroutes re- both of the cable routes for diversal and hedgerows likely the Robert and hedgerows likely the RAJ3 to the each of the cable through utilising existing wi by the AJ3 and the east of the react in similar impacts on result in similar impacts on potions with only a marge tal preference would be root thest potential to minimise
	of the A7G3 heading south along the western bank of Loch Ken. To the west western bank of Loch Ken. To the west western bank of Loch Ken. To the west this section is heavily wooded with sees of MM1. NWSS and NFI forming the Galloway Forest Park. The route comprese south following the line of the evising A7Z2 passing intermitten compresed of NWSS adjacent to the compresed for NWSS adjacent to the areas of MW1, NWSS and NFI stuated AW1, NWSS and NFI stuated at Underwood.	This route crosses eight areas within the 1/2004 and 1/2004 flood risk canes (to the immediate south ass of Glenles S/S (Coron Burn): to the west of Burnfoot Bridge (Knocchnailing Burn): to the east of Bernan Hil (Loch Ken): to the mrediate south of Mossdale (Kner Dee); to the north of Mossdale (Kner Dee); to the north of Kendk Burn): to the east of White Hill (Taff Water): and two to the north west of Ringford (Taff Water).	slightly longer due to deviating east to lee SJS, before crossing the A75 to the nowever all options are within the public the avoided east and vest of the objectent to the east and vest of the areing principal to follow evisiting linear e unavoidable with the permanent loss of did reinstatement to stone dykes likely definearly reduced forestry through reinficantly reduced forestry through the notes. He notes. The option 68 is the evisiting linear of the article are are are avoid to the south opert Bruce Trail. Galloway Kite Trail define through the permanent loss of did reinstatement to stone dykes likely did reinstatement to stone dykes likely are notes. The notes. The notes. The notes are are are are are did to a super leaved of these are within the option 68 store are crossed within the option 68 stores are invitonmental sof AVI and MVSS and have the greatest risk zones are within the option 68 stores are are written are are option 68 stores are are written to while 68 the nors.
5	action is heavily wooded with areas of AMI, NWSS and NF forming the Gelloway the nouse continues souch following the line of the existing A762 passing intermittent areas of woodband, predominately comprised of NWSS adjacent to the comprised of NWSS adjacent to the following the nouse then diverges from A752 to the nouse then diverges from A752 to the nouse then diverges from A752 to the nouse of Rugford passing through an area of AWI, NWSS and NF1 situated at Underwood.	This route crosses 12 areas within the 12200yr and 121000yr and 12000yr west of (to the immediate south west of Glenles (S) (Coon Bunt) to the south meets Coon Bunt), two to the north meets Coon Bunt), two to the north and east of Peah HII (toothaniting) Bunt), to the east of Bennan HII (toothanting) Bunt), to the east of Bennan HII (toothanting) Ken); to the east of Bennan HII (toothanting) Ken); to the east of Bennan HII (toothanting) Ken); to the east of Bennan HII (toothanting) (toothanting), to the east of Mine HII (taff Water); three to the north west of fingrouf (taff Water); and to the south of Ringfood (taff Water).	B and 6C. The proposed cable route 6C is existing alignment of the A7S2 from Glan control of discret to the A7S2 from Glan set directly which the designated hasins: a real abless are routed in line with the key rou- and in higher adjacent to the asst and west of a cables are routed in line with the key rou- difficantly. Willis RSA to the north and a small sectio fields and another adjacent to the stand sector and incret provided to the sector of the LCGs are unlikely to be adverse addale, however the motors y disturbance a bly. exts on residential visual amenty. At the solute specificantly the adverse addale, however the cable routes will intro- tess on residential visual amenty. At the net cable routes routed with the A7SC are addale, however the cable routes will intro- tess on the directly affected by the cat bly. exts on residential visual amenty. The solut here achie routes and the A7SC are adding, however the cable routes and the A7SC are adding in the solution should be directly affected by the cable in the solut here achie routes and the A7SC are adding in the solution should be directly affected by the cable of a solution should be directly affected by the cable in the solution should be directly affected by the cable in the solution should be directly affected by the cable of a solution should be directly affected by the cable in the solution should be directly affected by the cable of the solution should be directly affected by the cable in the solution should be directly affected by the cable in the solution should be directly affected by the cable in the solution should be directly affected by the cable of the solution should be directly affected by the cable in the solution should be directly affected by the cable in the solution should be directly affected by the cable in the solution should be directly affected by the cable in the solution should be directly affected by the cable of food is of bound is a solution should be directly affected by the cable of in the solution should be directly affe
	on the AFG2 heading south along the western bank of Look Ken. To the western bank of Look Ken. To the western bank of Look Ken. To the western search of WNUSS and NET forming the Galloway Forest Park. The route of the existing AFG2 passing the line of the existing the line of the existing AFG2 passing through an area of AW1, WWSS and NFI situated at Underwood.	This route crosses 10 areas within the CLOOPY and 121000Vr find 121000Vr find 121000Vr find 121000Vr find areas of the west of Burnfoor Bridge (Knochnairling Burnf): to the used of Bernan Hill (Luch Messiale (River Dee): to the north of Messiale (River Dee): to the north west mick Burnis to the east of Withe Hill (Lach Messiale (River Dee): to the north west evence Burnis Burn): to the east of Withe Hill (Lach Water): to the north west find (Lach Water): to the north west find (Lach Water): and to the south of Ringford (Tarff Water).	Proposed cable route 6A is shorter than 6 month east of Ringford Taxing followed the north east of Ringford Taxing followed the north east of Ringford. Taxing build pro- 64/68/6C are all located in proximity to a All three cable notes cross two area of par- are adjacent to the A72, allowed the more and Class 3 peetla are adjacent to the A72, allowed the more and for the A72, allowed the A72, allowed the features such as reads or existry overheit are adjacent to the A72, allowed and S1 The proposed cable routes will cross touri and various Core Paths. The proposed cable routes will cross touri and various Core Paths. For all of the cable routes will result in effe Noar of the cable routes will result in effe Noar of the cable routes will result in effe Noar of the cable routes and routes the will affect marginally more forest the will affect marginally more forest the proved cable routes and forest be will affect marginally more forest the possible. Of the prosed cable routes of a chore the public highway, effects are unlikely to or the fore routes cross mulpipe area the forth of the cable routes of a chore prosed cable routes forest for the public highway; effects are unlikely the or the fore route or the stores and variest problement when the totes or the prosed cable routes for the fore the fore routes or the prosed cable routes for the public highway; effects are unlikely the or the fore route or the prosed cable routes for the fore routes or the prosed cable routes for the fore routes or the prosed cable routes for the route or the routes of for the route or the routes of the routes of the prosed cable routes of the route or the routes of the routes of the route or the route
and and		Flood Zones and Waterbodies	NA
	Criterion	Flood Risk	Summary

The skedoor to Torgland 112M Reinforcement Project

References

¹ SPEN publication Major Electrical Infrastructure Projects: Approach to Routeing and Environmental Impact Assessment

² Desktop Ground Investigation Study (Stage 1) – Geotechnical Assessment Kendoon – Tongland 132kV OHL Development (PK, RR, EG & GT Routes) by Energyline Report No 90ID727-Rep—01 Issue 2 April 2018

³ LUC maps drawing no. 6113-001-r0_KTR_Undergrounding_7500_index and 6113-001-r0_KTR_Undergrounding_E_Lochken_25K_index received in email dated 09.11.2018

⁴ SPEN publication The Kendoon to Tongland 132kV Reinforcement Project Summary of Feedback from Second Round of Consultation March 2017