SONI - KELLS TO RASHARKIN

Corridor Options Constraint Modelling

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1 INTRODUCTION

RPS were commissioned by SONI to undertake constraint modelling for a proposed new 110kV transmission line between Kells Main substation and Rasharkin Main substation, which is required as a result of increasing growth in renewable generation in the area. SONI is investigating the feasibility of several proposed circuits between Kells and Rasharkin, Ballymena and Kells, Ballymena and Rasharkin, Creagh and Kells, and Creagh and Rasharkin.

Previously in 2018 RPS undertook environmental constraints modelling analysis for the same proposed transmission line between Kells Main substation and Rasharkin Main substation. The purpose of this analysis was to determine the least constrained corridor for development of an 110kV overhead line (OHL) between Kells and Rasharkin. This environmental constraints modelling identified the most and least sensitive corridors between the two substations. This analysis used an extended constraints model which included a large range of environmental, technical and social constraints. The outcome of this analysis was that SONI could streamline their strategic corridor options and move away from the less sustainable corridor options.

In 2019 Mott MacDonald conducted a more detailed feasibility study for a corridor selection assessment. Using the Holford rules to conduct their multi criteria assessment which used environmental, social, cultural and technical constrains and option cost to inform SONI and refine the options. This feasibility study scored the corridor options and further refined these options for SONI, which are now being taken forward into this 2020 constraint analysis.

In this 2020 constraint analysis RPS have used a refined set of constraints to conduct a constraints modelling analysis on the new refined set of corridor options as provided by SONI. The purpose of this study is to try to identify environmental, social and cultural constraints along the proposed corridors in order to ascertain with option is most sustainable so that SONI can use this data and separately apply a multi-criteria assessment. This would include lifecycle and capital costs. The overall study area is shown in Figure 1.1.

Figure 1.1 – Study area

2 METHODOLOGY

Environmental Constraints Modelling is the digital representation and modelling of spatially related constraints that could hinder a proposed development.

The following **sections 2.1.1** to **2.1.3** give a brief introduction to the principles behind the constraints modelling process. As the modelling was developed and undertaken using ArcGIS 10.5 and ArcGIS Spatial Analyst, much of the text used is sourced from the ArcGIS Resource Centre (ESRI, 2018): http://resources.arcgis.com/en/help/main/10.2/

2.1.1 Cost Surface

A *cost surface* raster identifies the cost of travelling through each cell in a raster. To create this raster, the relative cost (constraint value) of constructing electricity lines through each cell was determined. Although the cost surface raster is a single dataset, it represents multiple criteria. **Section 3** of this report provides more detail on the constraints that were combined to make the *cost surface* for this study. The cost of each option was extracted based on the corridors provided by SONI. A cost was extracted based on the potential corridor of each option and the centreline of each corridor option.

2.1.2 Cost-Distance Modelling

The *cost distance* tool creates an output raster in which each cell is assigned the accumulative cost to the closest source cell. The algorithm utilises the node/link cell representation used in graph theory. In the node/link representation, the centre of a cell is considered a node and each node is connected to its adjacent nodes by multiple links. Every link has an impedance associated with it which is derived from the costs associated with the cells at each end of the link (from the cost surface) and from the direction of movement through the cells. The final value is the cumulative cost across the cells.

2.1.3 Summary

In summary a cost surface model was developed to represent the study area, which is the accumulation of all potential strategic constraints into one layer. This is the surface that the electricity lines have to cross to get from one substation to the next. Some areas of this surface will be more costly to cross than others, as they have environmental, social or cultural constraints. This cost surface is the digital representation of the cumulative constraints. This is the basis of the *environmental constraints model*.

2.2 Assumptions

To build a strategic level constraints model, several assumptions had to be made, which can be summarised as follows:

- Substation locations were provided by SONI. These locations provided the strategic start and end points for the corridor sections.
- A 100m cell size was selected for the purposes of this analysis.
- Constraints values are relative to one another and are not representative of actual financial costs.
- The constraint score of the OHL was based on the environmental, social and cultural constraints model.
- On agreement with SONI the constraints scores for indicative cable routes, OHL uprates and substation entries were based solely on the constraint of river crossing within the model. This model was used as cables are laid in the public road which has no environmental, social or cultural

implications, except when crossing a river where it is not generally possible to lay cable across the bridge and the cable route must leave the public road and cross under the river using directional drilling. The uprates use existing infrastructure so the environmental impacts should be minimal.

2.3 Study Area

The study area extents can be summarised as being the area between Kells in the south east, Creagh in the south west, and Rasharkin in the north west. Within the study area there are six main options being assessed, which have 18 sub-options. These corridors are not final, as they are sample corridors within each of the main option areas. The start and end points of the various legs of these corridors were defined by strategic nodes corresponding to the substations in Kells, Creagh and Rasharkin. Using the OHL corridors/centrelines, indicative cable routes, OHL uprates and substation entries via indicative cable routes 18 sub options were formed. Figure 2.1 shows and overview of the six strategic corridor options.

- **Option A** – Option A is formed of 2 sub-options; A1 and A2.
    - **A1** – Is formed of OHL 8
    - **A2** – Is formed of OHL 9
- **Option D** – Option D is formed of 4 sub-options; D1, D2, D3 and D4.
    - **D1** – Is formed of OHL 10, cable D1, GIS and uprate of the Ballymena-Kells circuits A and B (Portal circuits)
    - **D2** - Is formed of OHL 11, cable D2, GIS and uprate of the Ballymena-Kells circuits A and B (Portal circuits)
    - **D3** - Is formed of OHL 12, cable D3, GIS and uprate of the Ballymena-Kells circuits A and B (Portal circuits)
    - **D4** - Is formed of OHL 15, cable D4, GIS and uprate of the Ballymena-Kells circuits A and B (Portal circuits)
- **Option G** – Option G is formed of 5 sub-options; G1, G2, G3, G4 and G5.
    - **G1** – Is formed of OHL 5, OHL 10 and cable G1
    - **G2** – Is formed of OHL 5, OHL 11 and cable G2
    - **G3** – Is formed of OHL 5, OHL 12 and cable G3
    - **G4** – Is formed of OHL 5, OHL 15 and cable G4
    - **G5** – Is formed of OHL 4, OHL 15 and cable G5
- **Option H** – Option H is formed of 3 sub-options; H1, H2 and H3
    - **H1** – is formed of OHL 1 and Creagh - Kells (full circuit uprate)
    - **H2** – is formed of OHL 2 and Creagh - Kells (full circuit uprate)
    - **H3** – is formed of OHL 3 and Creagh - Kells (full circuit uprate)
- **Option I** – Option I is formed of 2 sub-options; I1 and I2
    - **I1** – Is formed of OHL 13A, OHL 14 and Kells - Terrygowan (one side of L4 tower circuit) only
    - **I2** – Is formed of OHL 13B, OHL 14 and Kells - Terrygowan (one side of L4 tower circuit) only
- **Option Terrygowan** – Option Terrygowan is formed of 2 sub-options: Terrygowan A and Terrygowan B
    - **Terrygowan A** – Is formed of OHL 13A and Kells - Terrygowan (one side of L4 tower circuit) only
    - **Terrygowan B** – Is formed of OHL 13B and Kells - Terrygowan (one side of L4 tower circuit) only

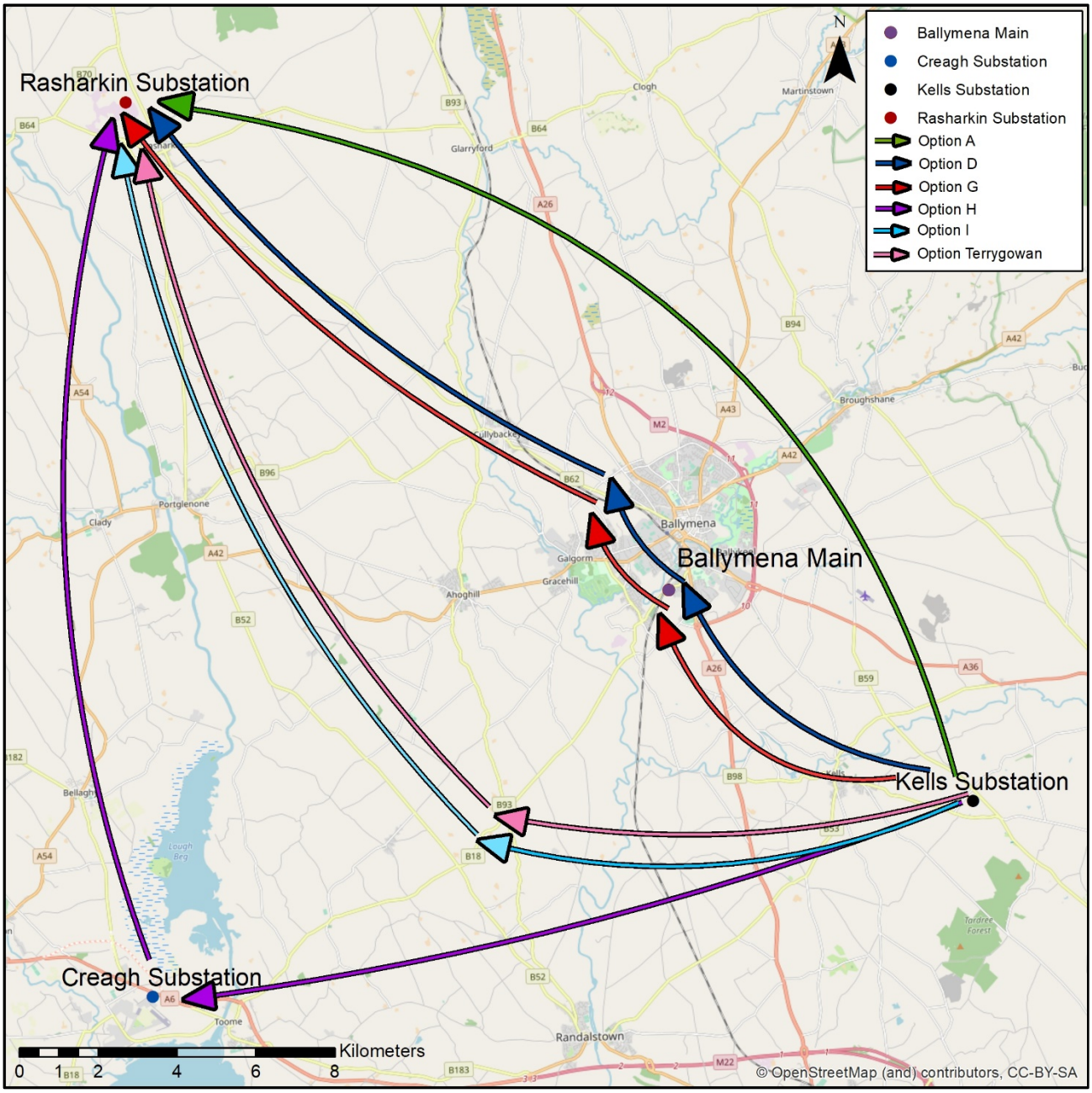

Figure 2.1 – Overview of strategic options

3 ENVIRONMENTAL, SOCIAL AND CULTURAL CONSTRAINTS

Areas of environmental constraints arise due to there being environmentally sensitive habitats or species present and the areas designated through international, European, national or local planning legislation. Areas of social constraints are where there is likely to be disturbance to or risk to the local population. Areas of cultural constraints are where there is likely to be impacts on designated heritage features.

Table 1 below presents the constraints information used in this analysis, a description of the constraint and their relative constraint scorings, which were assigned to the various constraints used to develop the constraints model. The higher the constraints score given to the data, the greater the perceived constraint to development of electricity transmission lines. The highest possible score for any one constraint was 10, and this was reserved for any constraint that would make it very difficult to develop electricity transmission infrastructure across an area and hence avoidance should be the preferred approach if possible.

These layers of individual constraints were combined to create the cost surface (constraints), shown in the form of a "heat map" in Figure 3.1. The scale runs from green to red, with the lowest constraint areas being shown by the darker green and the highest constraint areas being the darker red.

This constraint model is a cost raster (not financial) that identifies the relative cost of travelling through each cell (100m x 100m), which is to represent the ease or difficulty in developing a transmission line across a given area in the real world. The more constraints within an area the more difficult it is to cross in the model, replicating how it will be more difficult to plan and construct a line through highly constrained areas.

Table 3.1 – Constraints and scores

Category	Constraints	Description	Relative Constraint Score (to cross 100m)
Environmental	Special Protection Areas (SPA)	Areas designated under the EU Directive on the Conservation of Wilds (EC/79/409). The areas are important for breeding, feeding, wintering or migration of rare and vulnerable bird species.	10
Environmental	Special Areas of Conservation (SAC)	Areas designated under the Habitats Directive (92/43/EEC) for the conservation of certain habitats and species.	10
Environmental	Scheduled Areas	Zones scheduled for protection under Article 3 of The Historic Monuments and Archaeological Objects (Northern Ireland). A Scheduled Monument Consent is required for any works within Scheduled Areas.	10
Environmental / Social	Upland Areas	Lands greater than 150m elevation – Upland areas are harder to access, generally have exposed steep slopes, shallower soils and poor ground conditions.	10
Environmental	Area of Special Scientific Interest (ASSI)	Areas protected under the Environment (Northern Ireland) Order 2002. The Northern Ireland Environment Agency (NIEA) to designate land as an ASSI that it considers to be of special scientific interest, owing to the flora or fauna present, or the presence of geological features.	5
Cultural / Social	Listed Buildings	Listed Buildings within Northern Ireland.	5
Cultural	Industrial Heritage Record (IHR)	Industrial Heritage Sites	5

Cultural	Scheduled Monument Record (SMR)	Archaeological monuments recorded in the Northern Ireland Sites and Monuments Record	5
Cultural	Historic Gardens	Boundaries of protected historic parks, gardens and demesnes in Northern Ireland which are considered of exceptional importance. Northern Ireland Heritage Gardens Archive.	5
Environmental	Lakes	Water Framework Directive designated lakes in order to prevent deterioration and to enhance the status of aquatic ecosystems, promote sustainable water use and reduce pollution.	5
Environmental	Rivers	Water Framework Directive designated rivers in order to prevent deterioration and to enhance the status of aquatic ecosystems, promote sustainable water use and reduce pollution.	3
Environmental	Site of Local Nature Conservation Interest (SLNCI)	Local planning designations.	3

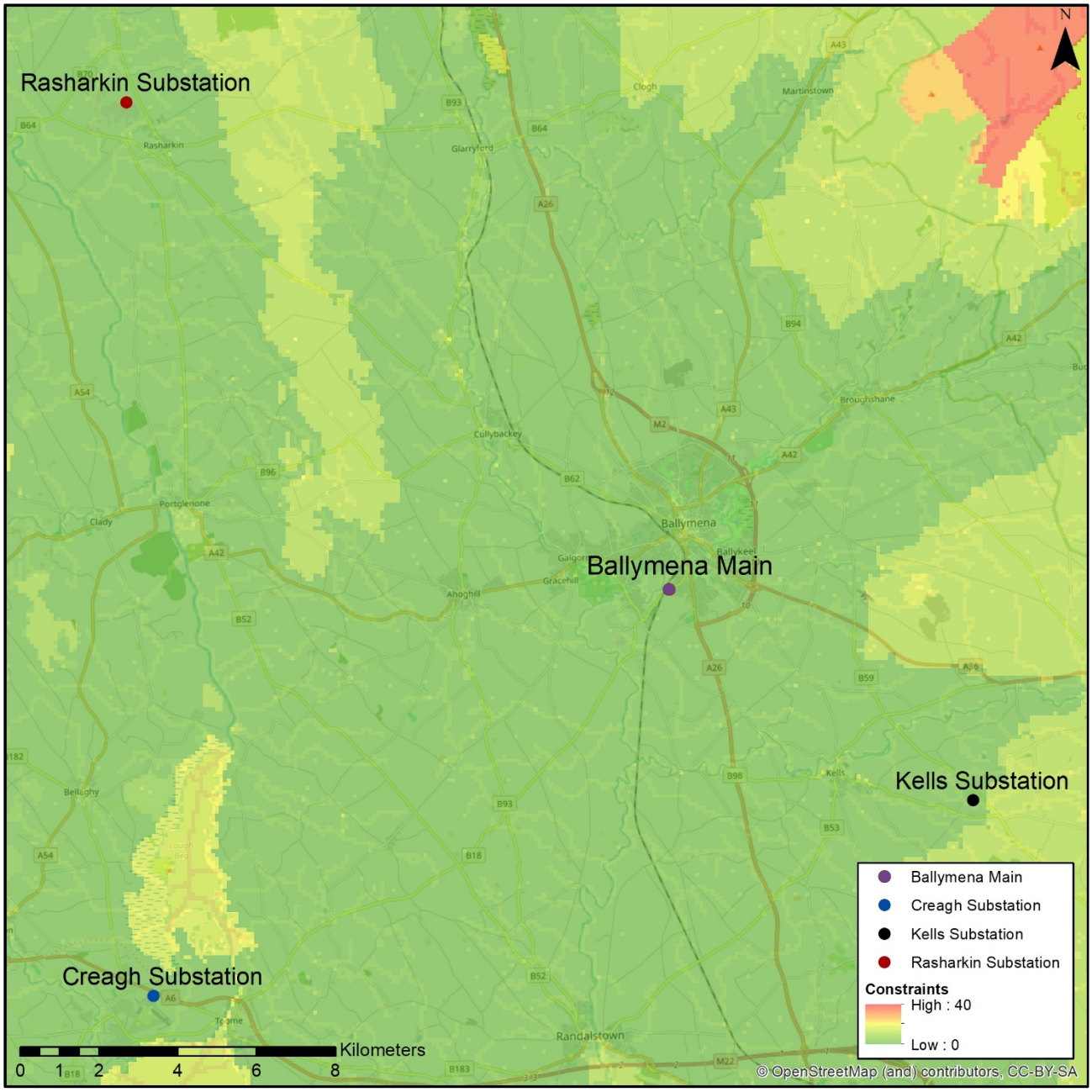

Figure 3.1 – Constraints Model Outputs

4 ENVIRONMENTAL, SOCIAL AND CULTURAL CONSTRAINT MODELLING

The analysis was run on the 18 different sub-options. The constraints model was then used to extract the constraint score of each of the proposed new OHL corridors and then on the centreline of each corridor. A separate constraint model consisting of only rivers was used to extract a score for each section of cable and OHL uprate. As cables will be laid within public roads and uprates are completed on existing infrastructure the only constraint they encounter is when they need to cross a river. The total constraint score for each option was calculated. These scores were then ranked to show the potentially most constrained and least constrained options. A description of the constraints encountered along each of the six strategic options, along with the constraints scores for each individual option using the OHL corridors and the OHL centrelines are given in the following section.

The information in the constraint scoring tables is as follows:

- **Corridor Score** – scoring of OHL corridors/centrelines based on the environmental, social and cultural constraints model
- **Uprate Score** – scoring of the uprate based on the rivers constraints model
- **Cable Score** – scoring of cables based on the river constraints model
- **GIS Score** – scoring for GIS cables based on the river constraints model (note, all GIS cables scored 0)
- **Entry Score** – scoring of entry to substations based on the river constraints model
- **Total Score** – Sum of all the scores with make up the respective sub-option
- **Rank** – Ranking of total score of each corridor or centreline in respect to one another

4.1 Option A

Within Option A there are two potential corridors; these are A1 and A2, as shown in Figure 4.1. The path of Option A encounters a number of environmental constraints, including an ASSI, upland areas and numerous rivers. These constraints affect both OHL 8 and OHL 9.

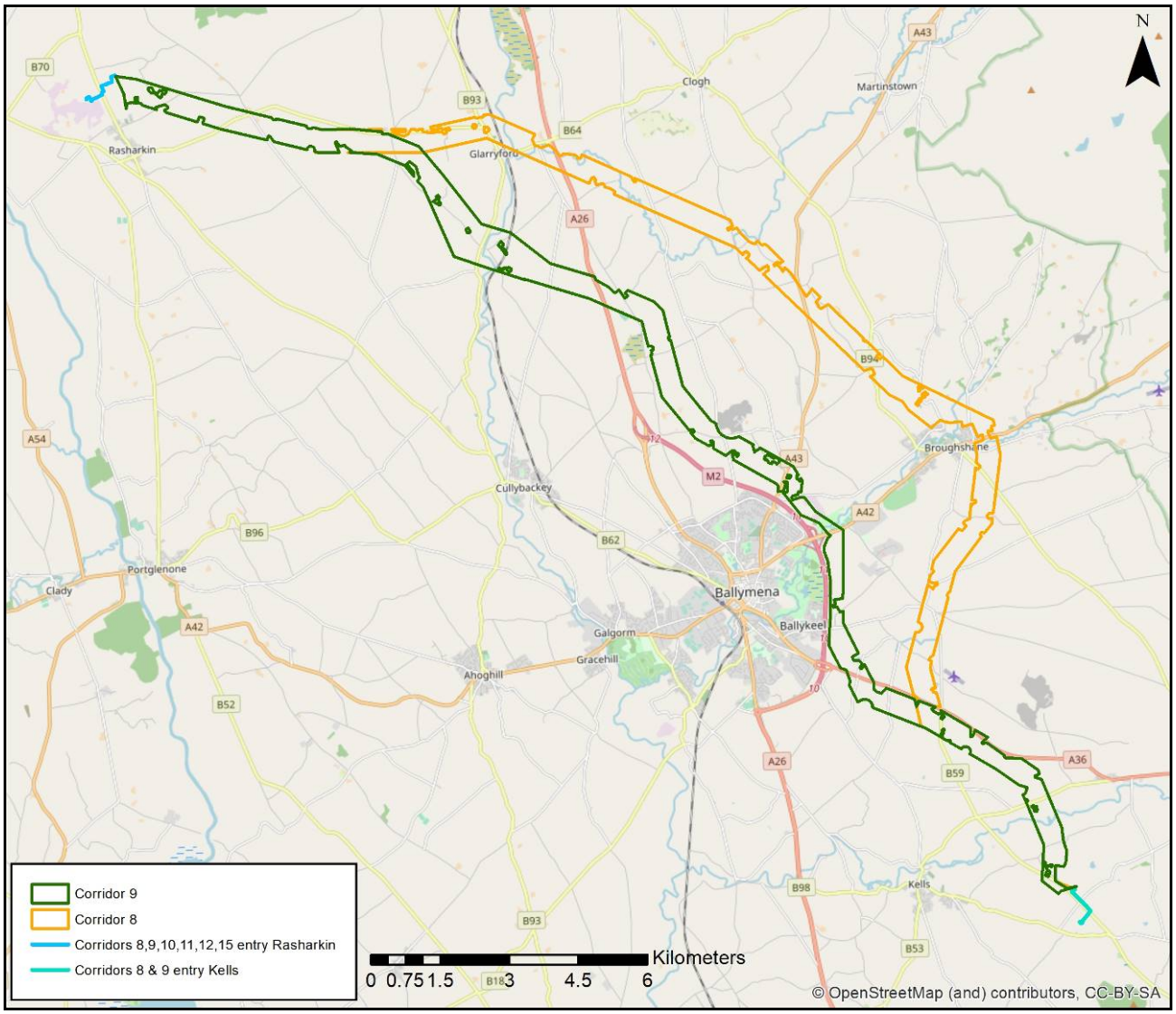

Figure 4.1 – Option A routes

Option A passes through the Glarryford ASSI, which is designated for Earth Science interest due to its physiographical features that need to be protected. All types of construction and development are listed as potentially having a negative impact on the physiographical features of the ASSI. Development that may have a potential impact on an ASSI will require consent from DAERA NIEA.

Option A also passes through approximately 4km of upland areas which reach elevations of over 200m. Upland areas may prove more difficult to develop on due to them being harder to access, generally having exposed steep slopes, shallower soils and poor ground conditions. Peat bogs are often more prevalent in upland areas, which may be more difficult to build on, as well as often having legislative environmental protection. Upland areas are often also more visible in the general landscape, where it would be more difficult to conceal a transmission line.

Option A also crosses a number of small rivers along its course. These rivers are potential constraints as the land surrounding them are often floodplains, which may lead to difficult construction conditions, with poor ground conditions. Development in the floodplain may require a justification test to ensure there is no knock

on impacts to other receptors from the displacement of flood waters. Some of the rivers in the area may have legislative environmental protection for salmonids.

There are also listed buildings, industrial heritage records and scheduled monument records along the option which may put planning restrictions on developments in their vicinity.

The Option A corridors also encounter a number of other constraints, including potential ancient woodlands, unstable ground, railway lines, roads, gas transmission lines and potentially contaminated historic land uses.

The constraints scores for the Option A sub options are given in Table 4.1. Option A constraints scores are high due to the number of constraints encountered along its length. Option A encounters 6 different constraints, and as the Option encounters this many constraints the scores accumulate. The biggest constraint encountered by Option A is upland areas. The Option passes through approximately 4km of upland area, and the high score is to reflect the potential difficulty for development in this area. The Glarryford ASSI encountered also contributes to the higher constraint score of the Option.

Table 4.1 – Option A sub-options constraints scores

Option	Sub-Option	Corridor Score	Uprate Score	Cable Score	Entry Score	Total Score
A	A1	3,138 (OHL 8)	-	-	21	3,204
A	A2	2,873 (OHL 9)	-	-	21	2,894

Option	Sub-Option	Centreline Score	Uprate Score	Cable Score	Entry Score	Total Score
A	A1	890 (OHL 8)	-	-	21	911
A	A2	797 (OHL 9)	-	-	21	818

4.2 Option D

Within Option D there are four potential corridors, which are D1, D2, D3 and D4, as shown in Figure 4.2. The path of Option D encounters a number of constraints, including an ASSI, upland areas, rivers, listed buildings, scheduled zones and scheduled monuments. The OHL uprates, cables and GIS which form these sub-options encounter a number of river crossings.

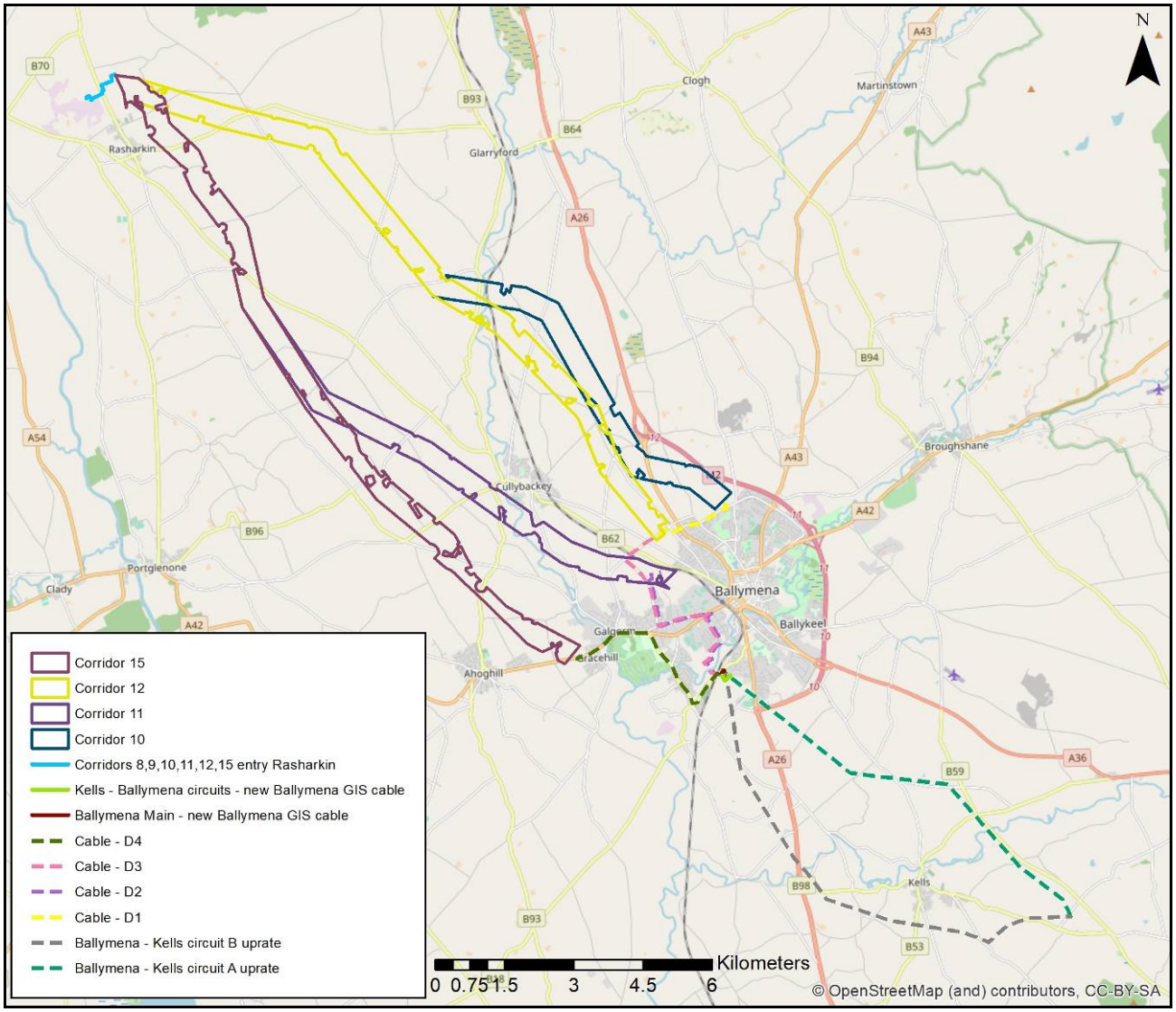

Figure 4.2 – Option D routes

Corridor options 10 and 12 of Option D (D1 and D3) pass through the Glarryford ASSI which is designated due to its Earth Science Interest due to its physiographical features and that need to be protected. All types of construction and development are listed as potentially having a negative impact of the physiographical features of the ASSI. Development that may have a potential impact on an ASSI will require consent from DAERA NIEA.

Option D also passes through large stretches of upland areas which reach elevations above 150m. Upland areas may prove more difficult to develop on due to them being harder to access, generally having exposed steep slopes, shallower soils and poor ground conditions. Peat bogs are often more prevalent in upland areas, which may be more difficult to build on, as well as often having legislative environmental protection. Upland areas are often also more visible in the general landscape, where it would be more difficult to conceal a transmission line.

Option D also crosses over a number of rivers, these rivers are potential constraints as the land surrounding them are often floodplains, which may lead to difficult construction conditions, with poor ground conditions. Development in the floodplain may require a justification test to ensure there is no knock on impacts to other receptors from the displacement of flood waters. Some of the rivers in the area may have legislative environmental protection for salmonids.

Within Option D there are listed buildings, scheduled monuments and scheduled zones, these may put planning restrictions on development within the vicinity.

The Option D corridors also encounter a number of other constraints, including potential ancient woodlands, unstable ground, railway lines, roads, gas transmission lines and potentially contaminated historic land uses.

The constraints scores for the Option D sub-options are given in Table 4.2. Option D constraints scores are relatively high due to the number of constraints encountered along its length. The main constraints scores come from the stretches of upland land the option passes through. Options D2 and D4 have higher constraints scores due to the longer stretches of upland land they pass through in comparison to Options D1 and D3.

Table 4.2 – Option D sub-options constraints scores

Option	Sub-Options	Corridor Score	Uprate Score	Cable Score	Entry Score	Total Score
D	D1	1,967 (OHL 10)	87 51	21	3	2,078
D	D2	2,397 (OHL 11)	87 51	24	3	2,562
D	D3	1,950 (OHL 12)	87 51	21	3	2,112
D	D4	2,833 (OHL 15)	87 51	12	3	2,986

Option	Sub-Options	Centreline Score	Uprate Score	Cable Score	Entry Score	Total Score
D	D1	505 (OHL 10)	87 51	21	3	667
D	D2	683 (OHL 11)	87 51	24	3	848
D	D3	556 (OHL 12)	87 51	21	3	718
D	D4	857 (OHL 15)	87 51	12	3	1,010

4.3 Option G

Within Option G there are five potential sub-options, which are G1, G2, G3, G4 and G5, as shown in Figure 4.3. Some of the sub-options of Option G encounter the same constraints as Option D, which are an ASSI, upland areas, rivers, listed buildings, scheduled monuments and scheduled zones. The only constraint which affects the cables which form these sub-options are river crossings.

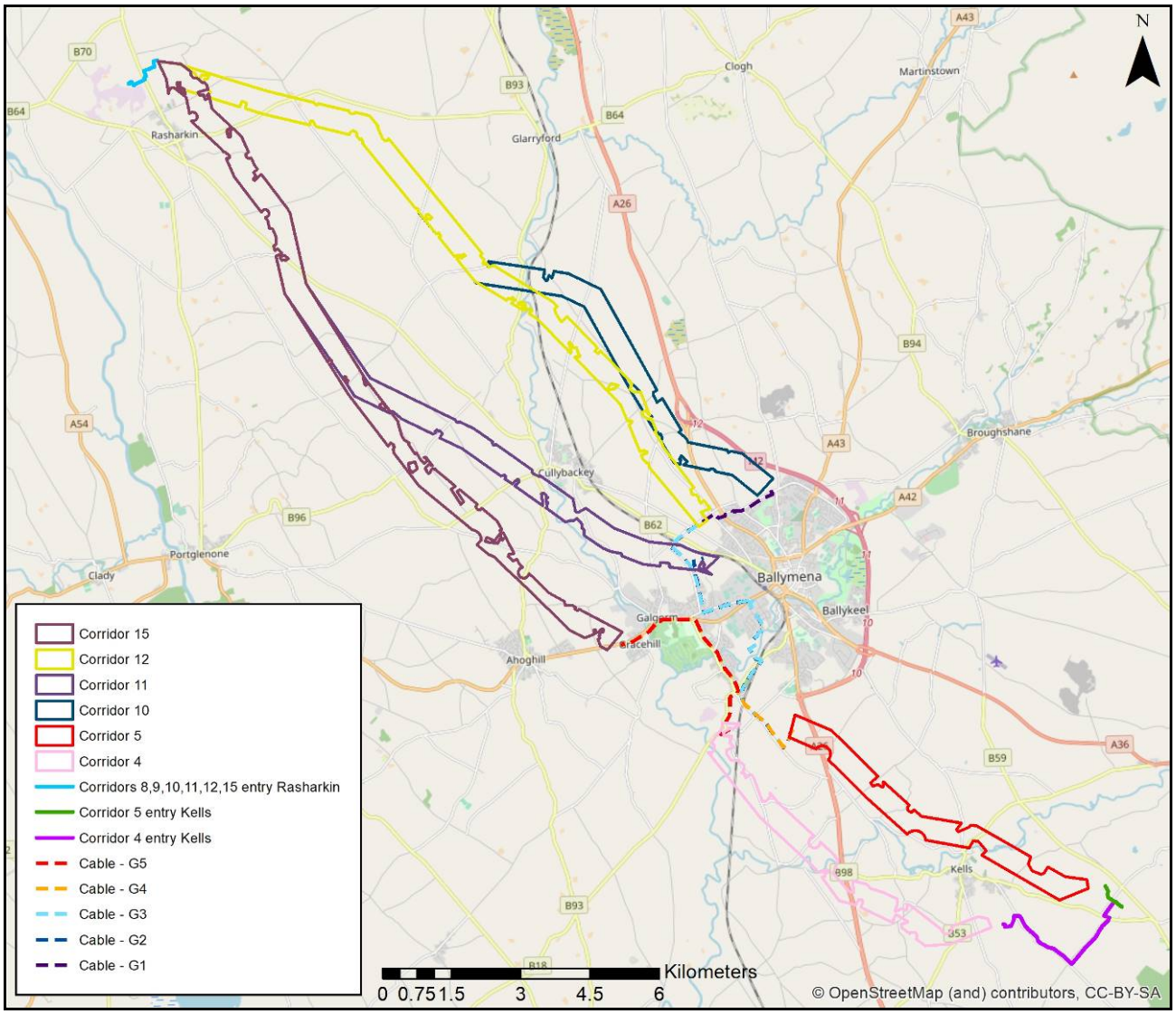

Figure 4.3 – Option G routes

Corridor options 10 and 12 of Option G (G1 and G3) pass through the Glarryford ASSI. The designation of Glarryford ASSI due to its Earth Science Interest could make development of the land harder due to the protection of the physiographical features. All types of construction and development are listed as potentially having a negative impact on the physiographical features of the ASSI. Development that may have a potential impact on an ASSI will require consent from DAERA NIEA.

As with Option D, this option passes through upland areas. These upland areas may prove more difficult to develop on due to them being harder to access, generally having exposed steep slopes, shallower soils and poor ground conditions. Peat bogs are often more prevalent in upland areas, which may be more difficult to

build on, as well as often having legislative environmental protection. Upland areas are often also more visible in the general landscape, where it would be more difficult to conceal a transmission line.

Option G also crosses over a number of rivers, these rivers are potential constraints as the land surrounding them are often floodplains, which may lead to difficult construction conditions, with poor ground conditions. Development in the floodplain may require a justification test to ensure there is no knock on impacts to other receptors from the displacement of flood waters. Some of the rivers in the area may have legislative environmental protection for salmonids.

As with Option D, Option G contains listed buildings, scheduled monuments and scheduled zones. These are a constraint as development in the area surrounding them may require planning permission.

Option G encounters a number of wider constraints along its path, these include ancient woodland, unstable ground, historic land use, land sensitivity to wind farm development, pollution prevention and control sites (PPC sites), railways, roads and gas transmission lines.

The constraints scores for the Option G sub-options are given in Table 4.3. There are many constraints encountered by Option G so the scores accumulate, with some sub options having a higher score than others, such as G4 and G5. The higher constraint scores in these sub-options are due to OHL 15 passing though longer stretches of upland area, hence increasing the score. Other sub-options within Option G score lower, such as G3, as they pass through less upland area.

Table 4.3 – Option G sub-options constraints scores

Option	Sub-Option	Corridor Score	Uprate Score	Cable Score	Entry Score	Total Score
G	G1	139 (OHL5) 1,967 (OHL10)	-	33	24	2,163
G	G2	139 (OHL5) 2,397 (OHL 11)	-	24	24	2,584
G	G3	139 (OHL 5) 1,950 (OHL12)	-	24	24	2,137
G	G4	139 (OHL 5) 2,833 (OHL15)	-	12	24	3,008
G	G5	248 (OHL 4) 2,833 (OHL 15)	-	18	57	3,156

Option	Sub-Option	Centreline Score	Uprate Score	Cable Score	Entry Score	Total Score
G	G1	43 (OHL 5) 505 (OHL 10)	-	33	24	605
G	G2	43 (OHL 5) 683 (OHL 11)	-	24	24	774
G	G3	43 (OHL 5) 556 (OHL 12)	-	24	24	647
G	G4	43 (OHL 5) 857 (OHL 15)	-	12	24	936
G	G5	99 (OHL 4) 857 (OHL 15)	-	18	57	1,031

4.4 Option H

Within Option H there are three potential sub-option corridors, which are H1, H2 and H3, as shown in Figure 4.4. Option H encounters environmental constraints, which include an SPA, ASSI, SLNCI, Rivers, Historic Gardens and Scheduled Monument Record. The only constraint which affects the potential uprate is river crossings.

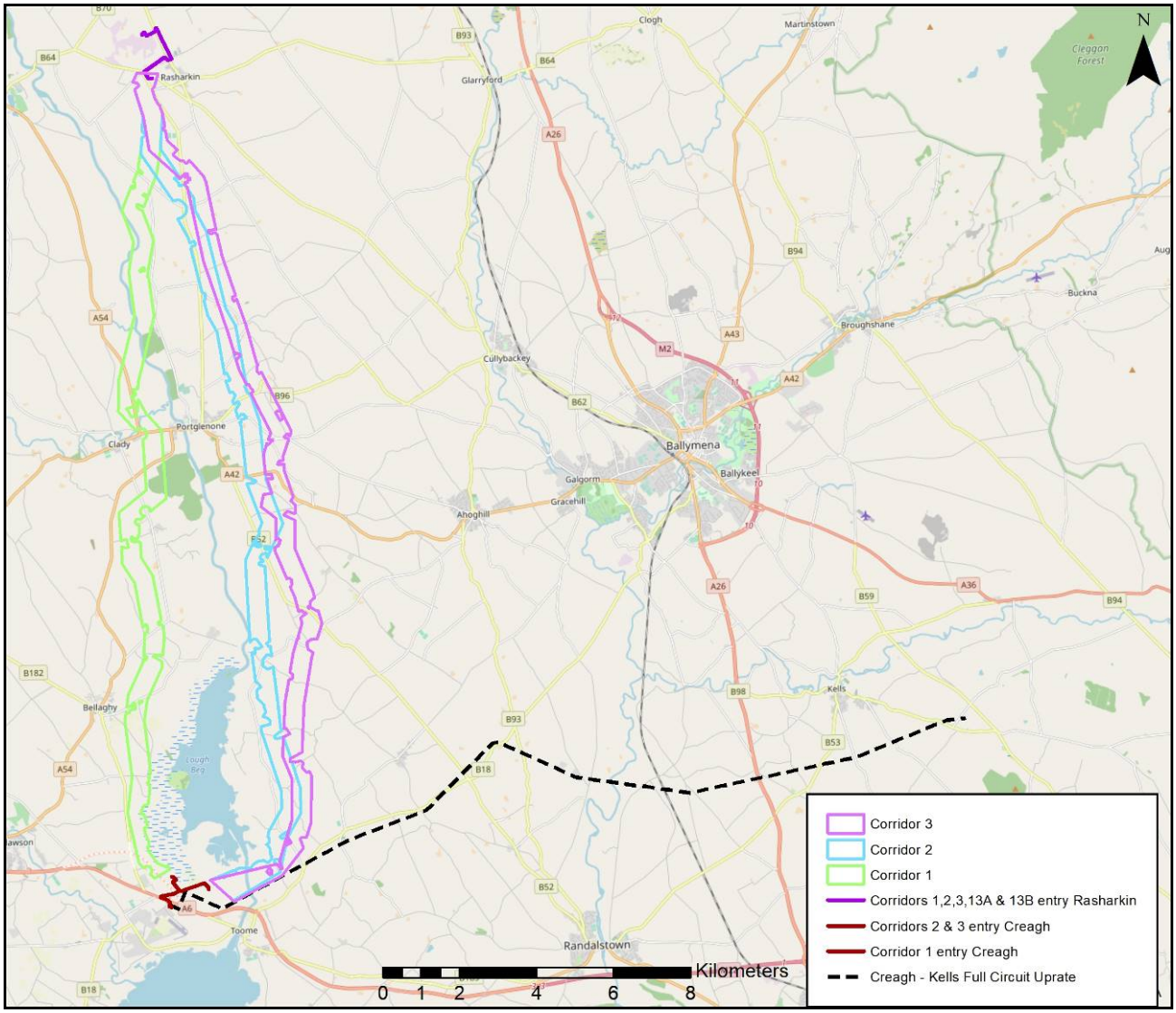

Figure 4.4 – Option H routes

Corridor options 2 and 3 of Option H (H2 and H3) travel parallel to and pass across the River Bann which is part of the Lough Neagh and Lough Beg SPA, which is designated due to its conservation of wild birds. Development within or in the vicinity of an SPA is likely to need assessed under the Habitats Directive, to ensure no negative impacts on the protected species in the area. A linear construction project like this, which runs parallel to and transects the designated area has the potential for direct and indirect impacts on the protected bird species and their habitat. Such potential impacts include habitat loss, damage or fragmentation as well as change in hydrology of wetland habitats, hazards to birds through collision and/or electrocution and loss of species, changes to waterbody morphology (with the potential to impact upon issues such as bank stability and vegetation, the riparian buffer zone and infiltration of riverbed substrate with silt and fines), water quality (and thus aquatic ecology), water flows and water levels. Also, the introduction of more people to these areas during construction, maintenance or decommission phases, has the potential for increased disturbance to local habitats and species, as well as introducing new vectors for the spread of alien and invasive species.

This option also passes through Lough Beg ASSI which is designated due to the diversity of habitats and wildlife it supports. Development that may have a potential impact on an ASSI will require consent from DAERA NIEA. This Option also passes close to McCallen's Town SLNCI.

Option H crosses a number of rivers. One major river which the option crosses is the River Bann both north and south of Lough Beg. These rivers are potential constraints as the land surrounding them are often floodplains, which may lead to difficult construction conditions, with poor ground conditions. Development in the floodplain may require a justification test to ensure there is no knock on impacts to other receptors from the displacement of flood waters. Some of the rivers in the area may have legislative environmental protection for salmonids.

Option H also passes through historic gardens and through a number of scheduled monuments along the option which may put planning restrictions on developments in their vicinity.

The Option H corridors also encounter a number of other constraints, including potentially contaminated historic land uses, potential ancient woodlands, forest service lands, unstable grounds, roads and gas transmission lines.

The constraints scores for the Option H sub-options are given in Table 4.4. The Option H sub-options are relatively low scoring as most of the Option is uprating of existing overhead line and cables, which is only scored for river crossings, thus not accumulating as many constraints as other Options.

Option H is one of the lowest scoring options despite encountering the Lough Neagh and Lough Beg SPA and Lough Beg ASSI, as in the constraints model the corridors only cross a small section of the designated areas. Option H2 and H3 have slightly higher constraints scores than Option H1 as sections of the two options pass across the River Bann which forms part of the ASSI and SPA, while Option H1 does not.

Although the constraint scores for Option H sub-options are relatively low, the fact that they all run parallel to the Lough Neagh and Lough Beg SPA for a long distance and that Options H2 and H3 have to cross the designated area, there are potentially significant constraints to their development. As previously mentioned, any development within or in the vicinity of an SPA is likely to need assessed under the Habitats Directive, as the possibility of likely significant effects cannot be discounted on these sites at this stage. Project level Appropriate Assessment including further evaluation and analysis, and the application of measures intended to avoid or reduce the harmful effects of the potential project on the Lough Neagh and Lough Beg SPA will likely be required.

Table 4.4 – Option H sub-options constraints scores

Option	Sub-Options	Corridor Score	Uprate Score	Cable Score	Entry Score	Total Score
H	H1	559 (OHL 1)	144	-	21	724
H	H2	704 (OHL 2)	144	-	30	878
H	H3	663 (OHL 3)	144	-	30	837

Option	Sub-Options	Centreline Score	Uprate Score	Cable Score	Entry Score	Total Score
H	H1	134 (OHL 1)	144	-	21	299
H	H2	193 (OHL 2)	144	-	30	367
H	H3	166 (OHL 3)	144	-	30	340

4.5 Option I

Within Option I there are two potential sub-options, these are I1 and I2, as shown in Figure 4.5. Option I encounters constraints including rivers, upland areas and scheduled monuments. The only constraint which affects the uprates is river crossings of which there are a number encountered.

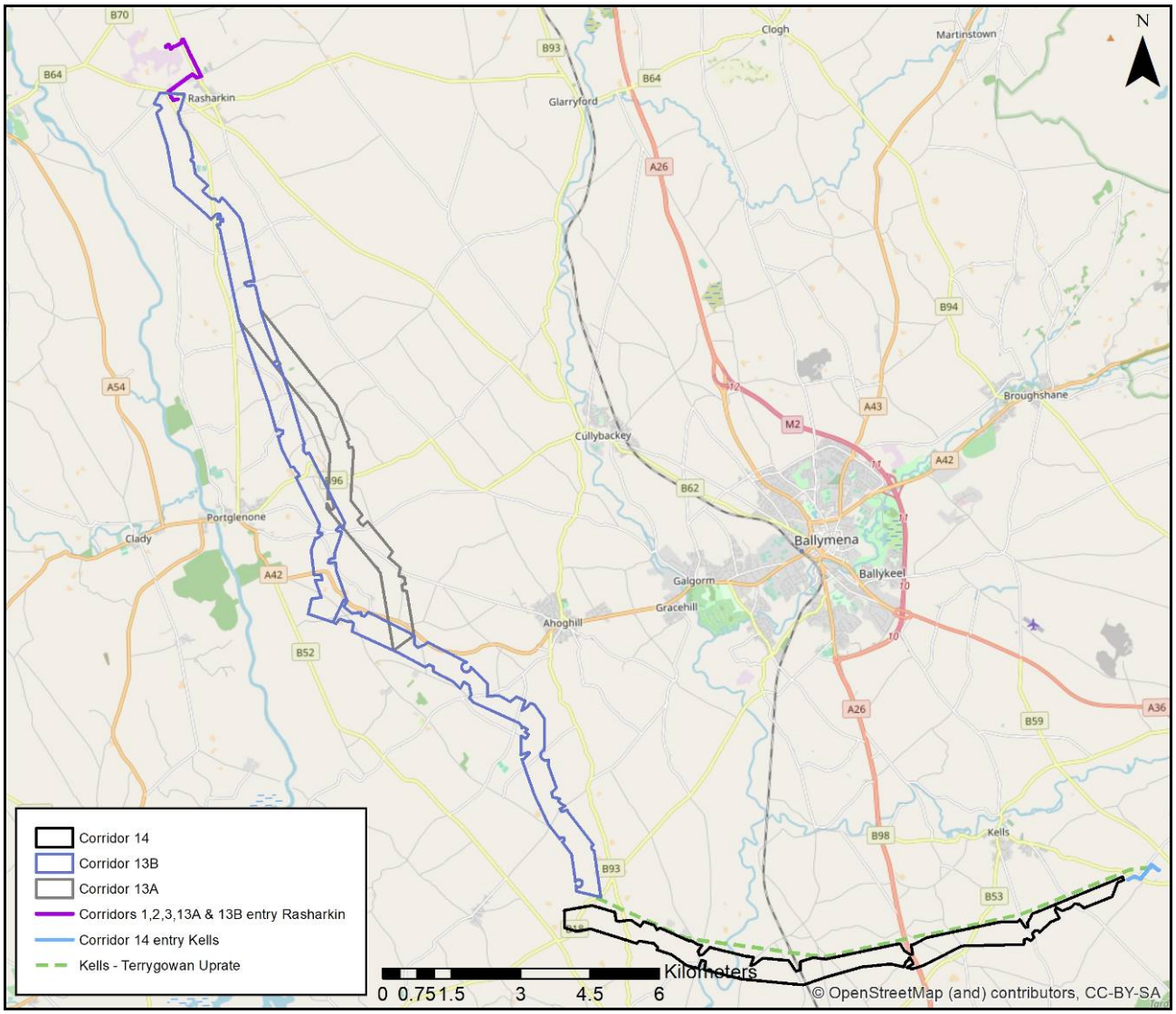

Figure 4.5 – Option I routes

Similar to the other options, Option I has to cross a number of rivers, which are potential constraints as the land surrounding them are often floodplains, which may lead to difficult construction conditions, with poor ground conditions. Development in the floodplain may require a justification test to ensure there is no knock on impacts to other receptors from the displacement of flood waters. Some of the rivers in the area may have legislative environmental protection for salmonids.

Corridor 13A which forms part of Option I also passes through approximately 2km of upland area, this upland area exceeds elevations of 150m. Upland areas may prove more difficult to develop on due to them being harder to access, generally having exposed steep slopes, shallower soils and poor ground conditions. Peat bogs are often more prevalent in upland areas, which may be more difficult to build on, as well as often having legislative environmental protection. Upland areas are often also more visible in the general landscape, where it would be more difficult to conceal a transmission line.

Along Option I there is also a number of scheduled monuments, which are a constraint as they may have planning restrictions which restrict development in their vicinity.

Option I also encounters a number of other constraints, including potentially contaminated historic land uses, potential ancient woodlands, unstable grounds, roads, railways and gas transmission lines.

The constraints scores for the Option I sub-options are given in Table 4.5. Option I encounters a relatively low number of constraints, which results in a lower overall constraint score and a better ranking for both I1 and I2. Corridor I2 has slightly lower constraint scores than I1 as it does not pass through any upland areas.

Table 4.5 – Option I sub-options constraints scores

Option	Sub-Options	Corridor Score	Uprate Score	Cable Score	Entry Score	Total Score
I	I1	1,527 (OHL13A) 239 (OHL 14)	99	-	42	1,907
I	I2	541 (OHL 13B) 239 (OHL 14)	99	-	42	921

Option	Sub-Options	Centreline Score	Uprate Score	Cable Score	Entry Score	Total Score
I	I1	401 (OHL 13A) 75 (OHL 14)	99	-	42	617
I	I1	146 (OHL 13B) 75 (OHL 14)	99	-	42	362

4.6 Option Terrygowan

Within Option Terrygowan there are two potential corridors, which are Terrygowan A and Terrygowan B, as shown in Figure 4.6. The Option Terrygowan is closely related to Option I, so corridors 13A and 13B will encounter similar constraints as Option I. These constraints include rivers, upland areas and scheduled monument records. The only constraint which affects the uprates is river crossings of which there are a number encountered.

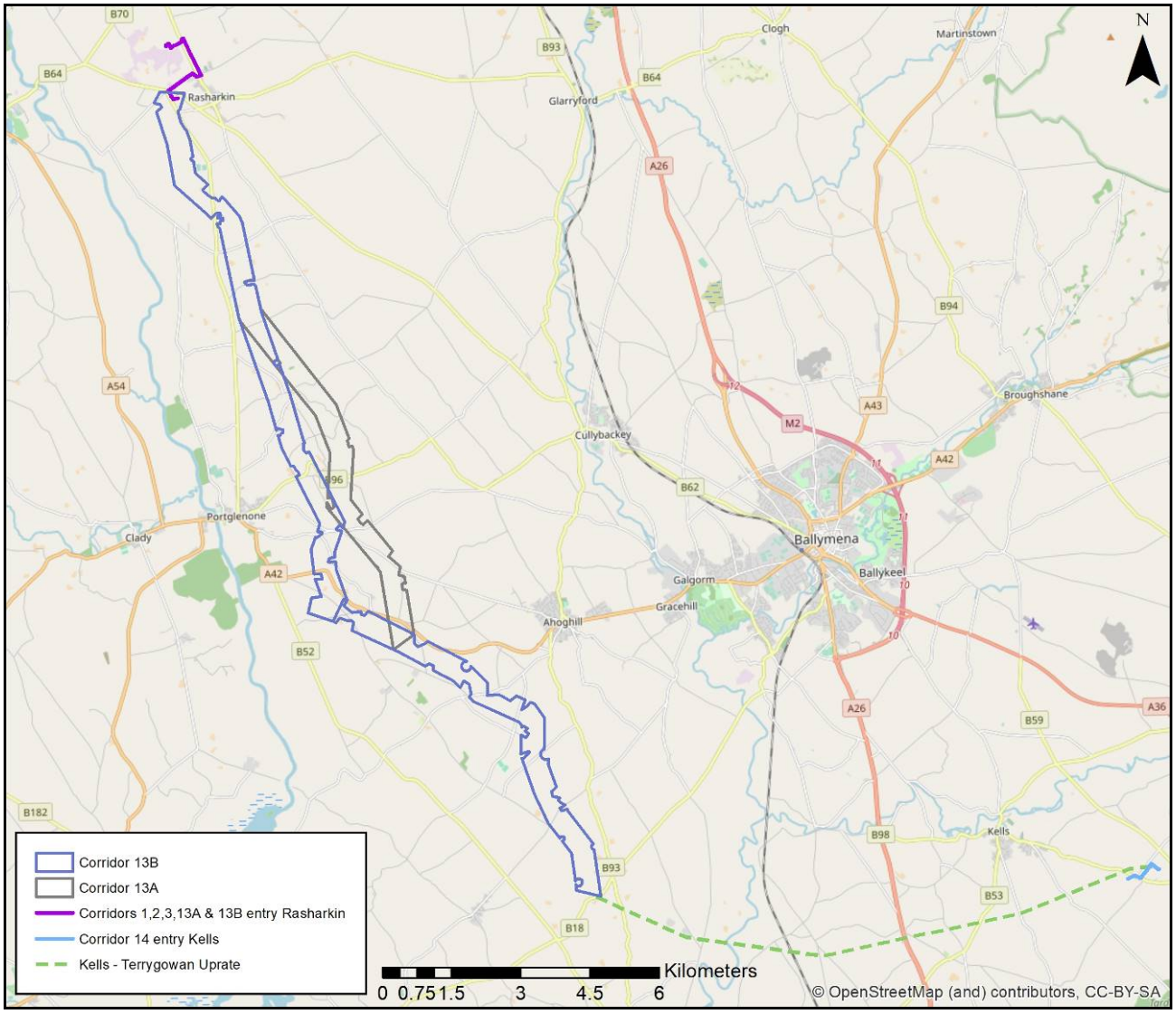

Figure 4.6 – Option Terrygowan routes

The Option Terrygowan has to cross a number of rivers. These rivers are potential constraints as the land surrounding them are often floodplains, which may lead to difficult construction conditions, with poor ground conditions. Development in the floodplain may require a justification test to ensure there is no knock on impacts to other receptors from the displacement of flood waters. Some of the rivers in the area may have legislative environmental protection for salmonids.

Corridor 13A which forms part of Option Terrygowan also passes through approximately 2km of upland area, this upland area exceeds elevations of 150m. Upland areas may prove more difficult to develop on due to them being harder to access, generally having exposed steep slopes, shallower soils and poor ground conditions. Peat bogs are often more prevalent in upland areas, which may be more difficult to build on, as well as often

having legislative environmental protection. Upland areas are often also more visible in the general landscape, where it would be more difficult to conceal a transmission line.

Along the Option Terrygowan there is also a number of scheduled monuments, these are a constraint as they may have planning restrictions which restrict development in their vicinity.

The Option Terrygowan encounters a number of other constraints, including potentially contaminated historic land uses, potential ancient woodlands, unstable grounds, roads, railways and gas transmission lines.

The constraints scores for the Option Terrygowan sub-options are given in Table 4.6. Similar to Option I, Option Terrygowan encounters relatively few constraints. Option Terrygowan B has one of the lowest constraint scores out of all the Options as it doesn't pass through any upland area, and only encounters rivers and scheduled monument records in the constraints model. Option Terrygowan A has a relatively low constraints score, however it is still higher than Terrygowan B as crosses a stretch of upland area.

Table 4.6 – Option Terrygowan sub-options constraints scores

Option	Sub-Options	Corridor Score	Uprate Score	Cable Score	Entry Score	Total Score
Terrygowan	Terrygowan A	1,527 (OHL 13A)	99	-	21	1,647
Terrygowan	Terrygowan B	541 (OHL 13B)	99	-	21	661

Option	Sub-Options	Centreline Score	Uprate Score	Cable Score	Entry Score	Total Score
Terrygowan	Terrygowan A	401 (OHL 13A)	99	-	21	521
Terrygowan	Terrygowan B	146 (OHL 13B)	99	-	21	266

5 SUMMARY AND NEXT STEPS

Table 5.1 provides a summary of the constraints scores for all corridors, while Table 5.2 provides a summary of the constraints scores for all corridor centrelines. Included within these tables is the ranking of these scores, which demonstrates the most and least constrained options / corridors, based on the constraint information used in the model.

Table 5.1 – Constraint scoring and ranking of option corridors

Option	Sub-Option	Corridor Score	Corridor	Uprate Score	Cable Score	Entry Score	Total Score	Rank
A	A1	3,138	OHL 8	-	-	21	3,204	18
A	A2	2,873	OHL 9	-	-	21	2,894	14
D	D1	1,967	OHL 10	87 51	21	3	2,078	8
D	D2	2,397	OHL 11	87 51	24	3	2,562	12
D	D3	1,950	OHL 12	87 51	21	3	2,112	9
D	D4	2,833	OHL 15	87 51	12	3	2,986	15
G	G1	139 1,967	OHL 5 OHL 10	-	33	24	2,163	11
G	G2	139 2,397	OHL 5 OHL 11	-	24	24	2,584	13
G	G3	139 1,950	OHL 5 OHL 12	-	24	24	2,137	10
G	G4	139 2,833	OHL 5 OHL 15	-	12	24	3,008	16
G	G5	248 2,833	OHL 4 OHL 15	-	18	57	3,156	17
H	H1	559	OHL 1	144	-	21	724	2
H	H2	704	OHL 2	144	-	30	878	4
H	H3	663	OHL 3	144	-	30	837	3
I	I1	1,527 239	OHL 13A OHL 14	99	-	42	1,907	7
I	I2	541 239	OHL 13B OHL 14	99	-	42	921	5
Terrygowan	Terrygowan A	1,527	OHL 13A	99	-	21	1,647	6
Terrygowan	Terrygowan B	541	OHL 13B	99	-	21	661	1

Table 5.2 – Constraint scoring and ranking of option corridor centerlines

Option	Sub-option	Centreline Score	Corridor	Uprate Score	Cable Score	Entry Score	Total Score	Rank
A	A1	890	OHL8	-	-	21	911	15
A	A2	797	OHL 9	-	-	21	818	13
D	D1	505	OHL 10	87 51	21	3	667	10
D	D2	683	OHL 11	87 51	24	3	848	14
D	D3	556	OHL 12	87 51	21	3	718	11
D	D4	857	OHL 15	87 51	12	3	1,010	17
G	G1	43 505	OHL 5 OHL 10	-	33	24	605	7
G	G2	43 683	OHL 5 OHL 11	-	24	24	774	12
G	G3	43 556	OHL 5 OHL 12	-	24	24	647	9
G	G4	43 857	OHL 5 OHL 15	-	12	24	936	16
G	G5	99 857	OHL 4 OHL 15	-	18	57	1,031	18
H	H1	134	OHL 1	144	-	21	299	2
H	H2	193	OHL 2	144	-	30	367	5
H	H3	166	OHL 3	144	-	30	340	3
I	I1	401 75	OHL 13A OHL 14	99	-	42	617	8
I	I1	146 75	OHL 13B OHL 14	99	-	42	362	4
Terrygowan	Terrygowan A	401	OHL 13A	99	-	21	521	6
Terrygowan	Terrygowan B	146	OHL 13B	99	-	21	266	1

5.1 Next Steps

Following this study the next steps should be to use the information provided to assess which of the potential 6 options SONI should be shortlisted and evaluated in more detail. The environmental, social and cultural constraint scoring, and ranking of options can be used to assist in the selection of the most sustainable transmission option.

SONI are at part 1 of the grid development framework process, which identifies the optimum solution and what area may be affected. SONI will determine a preliminary preferred option based on a multi criteria assessment and the information completed by RPS will help to assist in the selection of a preliminary preferred option.

Following approval from the utility regulator for the preferred option and from stakeholder engagement SONI will progress internal governance for part 1 and once approved will move into step 2 of the grid development framework process which will identify where the project will be built. This will involve investigating a smaller area in greater detail, and so the sample corridors investigated in part 1 may not progress or may be subject to change.