Capital Project 966

Substation Feasibility Assessment - Woodland 400kV Ring Configuration

321084AE-REP-007 | B

27 April 2020

EirGrid

CP966

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Contents

Figures

Executive Summary

Jacobs was requested to prepare a set of substation feasibility reports for EirGrid CP966 project, which is a proposed development that will help transfer electricity to the east of the country and distribute it within the network in Meath, Kildare and Dublin. The project will help meet the growing demand for electricity in the east. This growth is due to increased economic activity and the planned connection of new data centres in the region. It will therefore require significant substation changes at Dunstown and Woodland to accommodate these system upgrades.

The report content and format are suitable to support EirGrid's network development process, in step 3. The options to be investigated by Jacobs are as follows:

- Woodland 220kV AIS C-Type Extension
- Woodland 220kV Connection
- Woodland 400kV Connection
- Woodland 400kV Ring configuration
- Dunstown 220kV AIS C-Type Extension
- Dunstown 220kV Connection
- Dunstown 400kV Connection

Specialists were sent during the month of November 2019, to visit each of the substation sites to investigate the current infrastructure and what would be needed for the proposed substation connections and modifications. Further to this, sets of drawings have produced for the reports to give an indicative view of how each of the above substation modifications will look and have been referenced throughout all the reports.

This technical report examines the options for a new 400kV ring configuration at Woodland substation and highlights these findings by describing technical, environmental, deliverability, and economic factors. Throughout each of the reports, the design methodology and construction approach, and their costs have been detailed.

The option to reconfigure the 400kV side of the substation to a ring configuration at Woodland substation is technically feasible with the modified bus section and will require the extension of the substation boundary fence.

No major planning works involving land acquisition are anticipated to be required. However, the works may encroach an existing water course in the north, where any construction activity is likely to be in very close proximity. This may cause a significant environmental impact and will need to be carefully considered. Earthworks and civil works will also be required for the site extension as well as a new access roadway to replace the existing road. Further to this, outages of major interconnector with a duration of approximately 1-2 days should be accounted for.

1. Introduction

1.1 What is Capital Project 966?

Capital Project 966 is a proposed development that will help transfer electricity to the east of the country and distribute it within the network in Meath, Kildare and Dublin.

The project will help meet the growing demand for electricity in the east. This growth is due to increased economic activity and the planned connection of new data centres in the region.

A significant number of Ireland's electricity generators are located in the south and south west. This is where many wind farms and some modern, conventional generators are located. This power needs to be transported to where it is needed.

The power is mainly transported cross-country on the two existing 400 kV lines from the Moneypoint station in Clare to the Dunstown substation in Kildare and Woodland substation in Meath. Transporting large amounts of electricity on these 400 kV lines could cause problems that would affect the security of electricity supply throughout Ireland, particularly if one of the lines is lost unexpectedly.

To solve this emerging issue, we need to strengthen the electricity network between Dunstown and Woodland to avoid capacity and voltage problems.

Capital Project 966 aims to strengthen the transmission network between Dunstown and Woodland substations. and suggests a number of technical solutions to do so.

1.2 Framework for grid development explained

EirGrid follow a six-step approach when they develop and implement the best performing solution option to any identified transmission network problem. This six-step approach is described in the document 'Have Your Say' published on EirGrid's website [1]. The six steps are shown on a high-level in Figure 1. Each step has a distinct purpose with defined deliverables and represents a lifecycle of a development from conception through to implementation and energisation.

[1] http://www.eirgridgroup.com/the-grid/have-your-say/

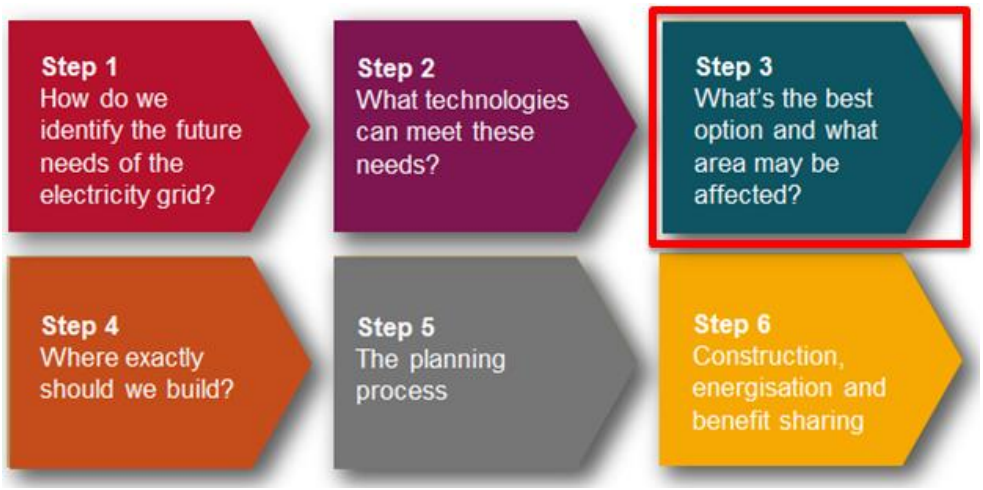

Figure 1 : EirGrid's Six-Step Framework for Grid Development

Capital Project 966 is in Step 3 of the above process. The aim of Step 3 is to identify a best performing solution option to the need identified. There are four remaining technical viable options to be investigated in Step 3. All options create a connection between Woodland and Dunstown substations and have common reinforcements associated in relation to voltage support devices and 110 kV uprates. The main four options are:

- Up-voltage existing 220 kV circuits to 400 kV to create new Dunstown – Woodland 400 kV overhead line (OHL);
- A new 400 kV overhead line;
- A new 220 kV underground cable,
- A new 400 kV underground cable.

Common reinforcements to all four options (outcome of Step 2, may change in Step 3):

- Uprating of the Bracklone – Portlaoise 110 kV overhead line
- Dynamic reactive support device in greater Dublin area rated at approximately ±250 Mvar

These options will be evaluated against five criteria: technical, economic, environmental, deliverability and socio-economic and each criteria incorporates a number of sub-criteria. It shall be noted that the overall assessment is carried out by EirGrid, but certain aspects are investigated and assessed by various consultants and their assessment will feed into the overall assessment.

1.3 Aim and context of this report

EirGrid (the Client) has engaged Jacobs to assess the required substation modifications at Woodland and Dunstown to accommodate these network changes specified by EirGrid. This report is aimed at presenting the findings of this investigation in regard to upgrading the Woodland Substation to a 400kV Ring Configuration. The findings may feed into EirGrid's overall evaluation of the four remaining options.

1.4 Description of criteria used to assess the options

This report uses the following criteria to assess each substation option:

- Technical

As part of technical feasibility assessment, substation layouts were developed in accordance with relevant EirGrid design standards to indicate a proposed solution. Constructability and health and safety implications for operation and maintenance activities through the achievement of appropriate electrical clearances have been considered.

- Environmental

As part of environmental feasibility, only the impact arising from any extension to the existing substation boundary has been identified and examined. For a broader environmental assessment, please refer to report 321084AE-REP-002 – Environmental Feasibility Report.

- Deliverability

As part of deliverability assessment, existing access roadways and operational/maintenance assessments were made to ensure that the solution can be safely constructed, maintained and operated.

- Economic

An approximate bill of quantities and cost estimate has been produced for each option.

- Socio-economic

As part of the social feasibility, a socio-economic assessment has been included as part of this report for the substation works only. For a broader social impact assessment, please refer to the report 321084AE-REP-003 – CP966 Social Impact Assessment Report.

1.5 Scale used to assess each criteria

The effect on each criteria parameter is presented along a range from “more significant”/”more difficult”/“more risk” to “less significant”/”less difficult”/“less risk”. The following scale is used to illustrate each criteria parameter:

In the text this scale is quantified by text for example mid-level/moderate (Dark Green), low-moderate (Green), low (Cream), high-moderate (Blue) or high (Dark Blue).

1.6 Relationship to other technical documents

Parallel to this report, Cable Feasibility, Environmental and a Social Impact studies are being prepared to investigate the impact of proposed solutions on the study area.

Please read in conjunction with the following reports;

- 321084AE-REP-001 – Cable Route Feasibility Report
- 321084AE-REP-002 – Environmental Feasibility Report
- 321084AE-REP-003 – Social Impact Report

2. The Project

2.1 Site Description

Woodland 400/220kV AIS substation is an existing substation located in County Meath and is surrounded by farmland in a rural area. Aerial views of the area and substation are shown in Figure 2 and Figure 3 respectively. Further to this, Figure 4 shows the extent of land ownership held by the Transmission Assets Owner (TAO).

The substation presently contains both 400kV and 220kV equipment in a double busbar arrangement with 3 x 400/220kV transformer bays, 2 x 400kV line bays and 4 x 220kV line bays.

Figure 2: Site Map (From Google Earth)

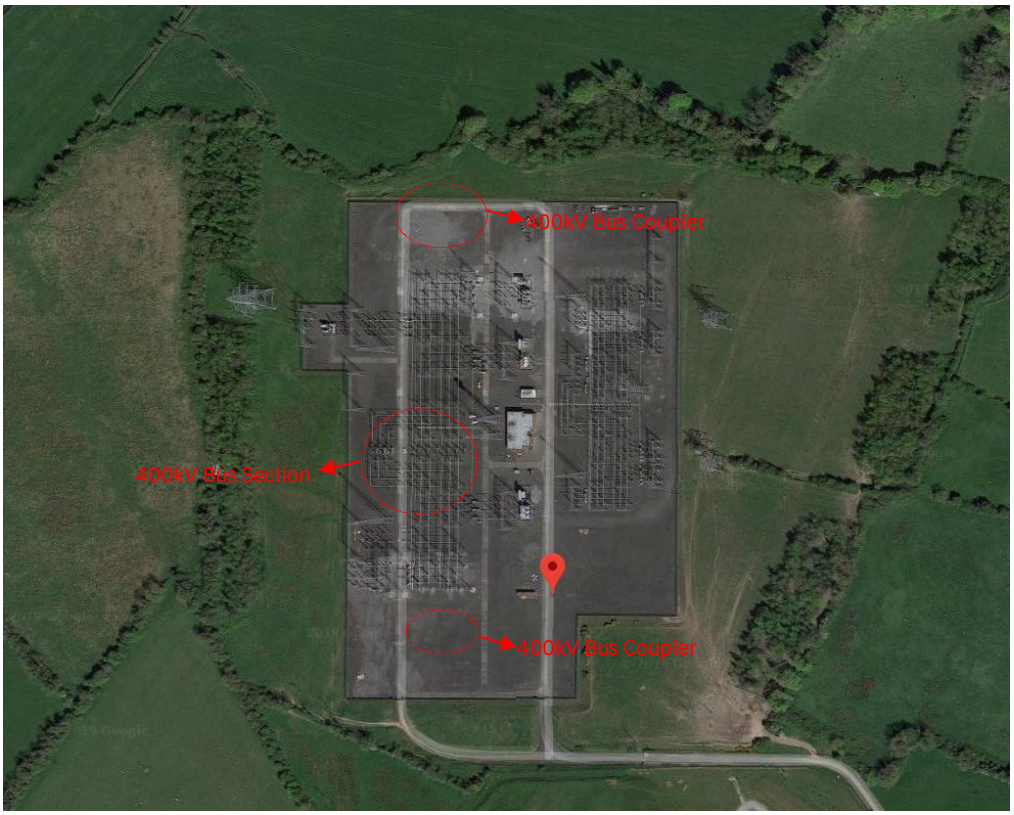

Figure 3: 400kV Ring Configuration (From Google Earth)

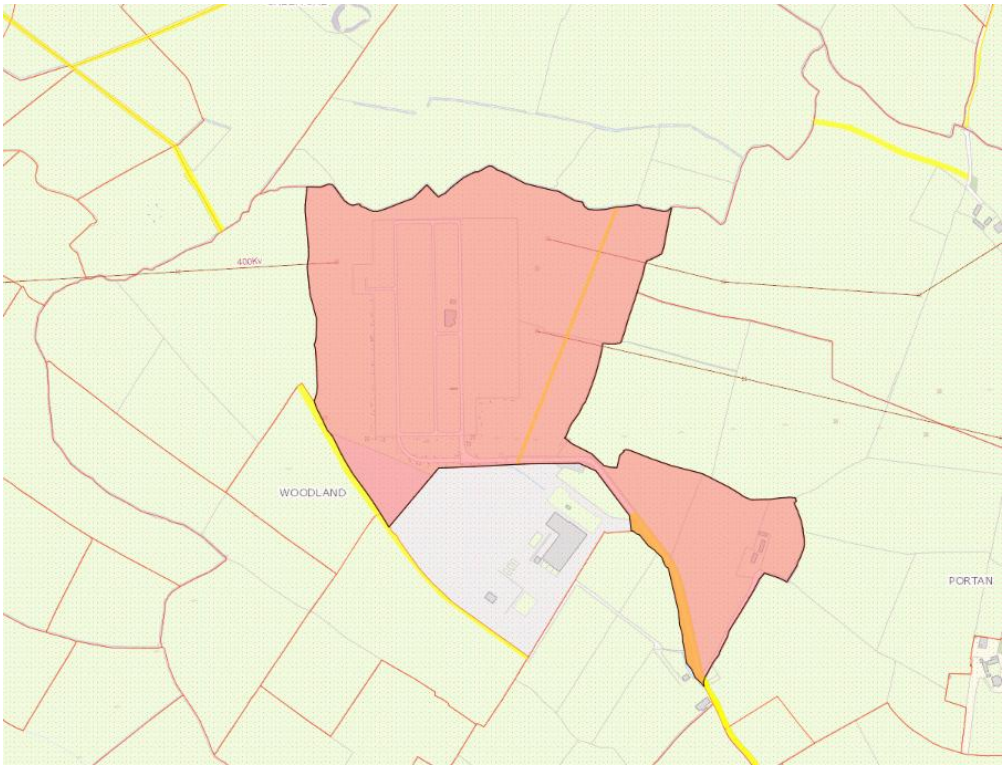

Figure 4: Extent of Land Ownership Boundary

2.2 Objective

This report will provide a feasibility assessment of an option to convert the Woodland 400kV substation to a ring configuration, which will include replacing the existing centre bus coupler bay to a bus section bay and adding bus coupler bays at either end of the busbars to form a ring between busbar A and busbar B.

2.3 Technical

2.3.1 Project Requirements

The 400kV ring configuration option utilises standard substation design parameters in determining the scope and extent of the substation extension works. These standard parameters ensure a safe and effective design. No 400kV standard EirGrid designs were available. The ring configuration is based on the EirGrid 220kV drawing PG406-D020-123-00, which includes 1 bus section and 2 bus couplers on either side. One existing spare 400kV bay will be dedicated to CP966 connection (see substation report 321084AE-REP-006 in Appendix A).

Refer to figure 5 for a single line diagram for a schematic representation of proposed extension works to the existing substation. Existing substation is indicated in black, new works are indicated in red with future spare bays in blue. For proposed site layout, see substation arrangement drawings in Appendix A:

(i) 321084AE-LAY-008A – Standard bus section arrangement

(ii) 321084AE-LAY-008B – Modified bus section arrangement

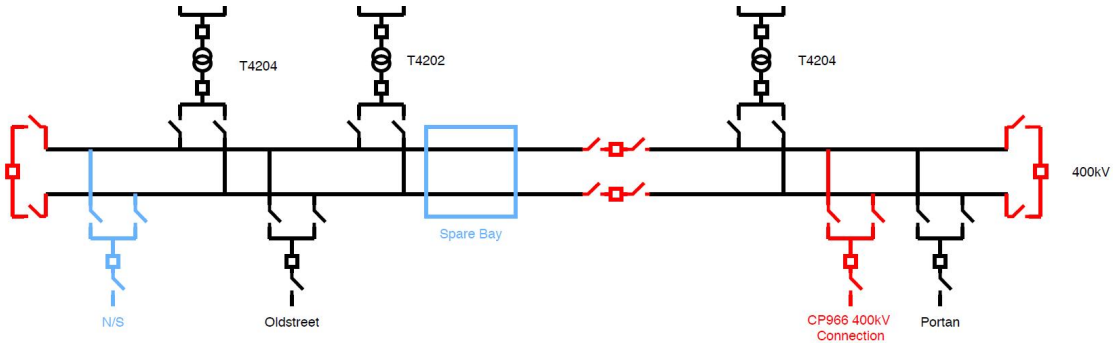

Figure 5: Woodland 400kV Ring Configuration

The new configuration will be equipped with a complete bus section and two bus couplers. An existing spare bay will be allocated to CP966. The CP966 line bay options have been discussed in Substation Feasibility Report 321084AE-REP-006.

For option (i) the standard bus section is unable to be accommodated into the existing site without major civil works to relocate the existing control building and access roadways, therefore option (ii) has been produced to provide an alternative solution, which allows for the bus section to be installed in the location of the existing centre bus coupler, without major site reconfiguration.

The new bus couplers have been based on 220kV bus couplers used in other substations layouts and modified to meet the clearances and specifications of EirGrid for 400kV applications.

2.3.2 Other Requirements

Although associated work with the new 400kV bus section and bus couplers includes investigating and allocating space for new protection panels in the existing control building and an assessment of the existing LVAC and DC systems to confirm adequate capacity, these elements have not been considered at this stage as they would have no material impact on the physical extent of the construction works required.

2.3.3 Technical Feasibility

As per Section 1.5, the following scale is used to assess the technical feasibility of the new 400kV ring configuration. Due to the lack of space for the standard EirGrid bus coupler option (i), it has a been assigned a high impact rating (Dark Blue) in the technical feasibility. Alternatively, the modified option (ii) has no technical issues and therefore has been given a low impact rating (Cream)

More significant/difficult/risk Less significant/difficult/risk

400kV Ring Configuration	Technical Feasibility
(i) Standard Bus Section	
(ii) Modified Bus Section	

As Option (i) is not a technically feasible solution, it has not been considered further in this report and will not be assessed against the remaining criteria.

2.4 Site Modifications

The following site modifications will be required to accommodate the new extension:

- Extend the substation perimeter fence on the north side by approximately 17 meters in order to accommodate the new wing coupler and access road.
- Existing palisade fence will need to be removed and a new palisade fencing to be installed to accommodate the larger substation boundary, along with associated civil earthworks to provide a flat and level platform for the extended substation.

Figure 3 shows the location of proposed site extension work and Figure 4 shows the extent of the land ownership boundary of the substation.

This option comes very close to the land ownership boundary of the substation on the north side and potentially encroaches on an existing water course which lies on this boundary. This extension is likely to also have a high environmental impact on the water course due to proximity of proposed construction area. The bus coupler located on the south side of the substation is within the existing confines of the substation palisade fence and poses no issues.

2.5 Environmental Constraints

Two of the three proposed modifications to the substation are within the substation itself. These would have no effects on environmental aspects. The assessment focuses on the modification to the north which requires an extension to the fence line.

2.5.1 Biodiversity

There are no designated sites in the vicinity of Woodland substation, however an extension to the substation footprint to facilitate works would have potential temporary and definite permanent impacts on biodiversity.

Potential impacts during construction include:

- Temporary loss of terrestrial habitat within the footprint of the Project to facilitate access roads and construction compounds;
- Disturbance, and temporary displacement of birds, mammals, amphibians, fish and other aquatic species in habitats within or in close proximity to the Project footprint;
- Temporary loss of foraging habitat for mammals such as badger and bat; and
- Pollution of the Tolka_020 from silty water runoff or other deleterious materials, leading to secondary effects on aquatic species, however this would moderate risk as the extension is more than 10m away from the river at its closest point.

During operation, there would be a permanent loss of grassland habitat, however this would be a small amount as a result of the 7.5m extension to the north.

As a result of both construction and operational impacts there is a low risk of effects on biodiversity.

2.5.2 Soils and Water Impacts

The subsoils around Woodland substation are shale and sandstone till (Namurian) with an area of Alluvium to the north of the substation. There is a significant Karst Landforms to the north west of Woodland Substation, however it is not within or in close proximity to the footprint of the proposed extension and so it is not likely that there would be any effects.

In terms of surface water, Woodland substation is within the Tolka WFD sub basin. The Tolka_020 water body, as has been outlined in Biodiversity, runs west to east immediately to the north of the substation. It is of Poor status and considered to be At Risk (www.epa.ie). Pressures on the water body, upstream and in the vicinity of the substation, are from diffuse agricultural sources, such as silage runoff and have resulted in nutrients being high which is the main reason for its Poor WFD status.

During construction, without mitigation, there is the potential for significant impacts to the Tolka_020 as a result of silty water runoff, and the potential for other deleterious substances to enter the water body from the construction site. The river is approximately 18m north of the substation at the closest point to the proposed extension. As such, the construction works could be maintained at least 10m from the river and so avoid many of the risks.

The effects on soil and water would be moderate.

2.5.3 Impact on Land Use (forestry, farmland, bogs/peats, horticulture, roads)

The lands immediately surrounding Woodland are arable agricultural lands. There is no forestry or peat/bogs present. The Trim Road is about 750m from the site. There would be some requirement for land outside of TAO ownership, although this is not expected to be a significant amount of land or that it would have a significant

impact on land use in this area, although it would be a permanent change of use. The risk to land use is considered to be of neutral risk.

2.5.4 Landscape & Visual

The substation is within the Tara Skryne Hills LCA which is a high sensitivity landscape. However, there are no protected views or prospects within 2km of the Woodland substation and the extension would be continuous development with the existing substation.

There is potential for effects on views but as the proposed extension is to the north of the substation, this would not be immediately visible to local residents, screened as it would be by the existing substation and the Converter Station.

As a result, it is anticipated that risks to landscape and visual receptors would be of low to moderate risk.

2.5.5 Cultural Heritage

There are two National Monuments (RMP and SMR sites) within 1km of the Woodland substation. Neither is within 300m of the boundaries of the proposed extension and so it is not anticipated there would be any impacts on these sites.

There may also be a risk of unrecorded or undiscovered heritage assets, including unknown archaeology within this area.

As a result, it is anticipated that risks to cultural heritage would be low to moderate.

2.5.6 Assessment of Substation Modifications at Woodland Substation

More significant/difficult/risk Less significant/difficult/risk

Table 2.1 Constraints Risk Assessment for Modifications at Woodland Substation

Constraint	Risk
Biodiversity	
Soil & Water	
Land Use	
Landscape & Visual	
Cultural Heritage	
Environmental Summary	

Effects on the environment are largely low to moderate risk. There is a potentially higher risk to soil and water but this could be mitigated by pollution control practices on the site during construction.

2.6 Social Constraints

2.6.1 Amenity and Health

There are several residential properties close to Woodland substation. The properties are quite dispersed but in places cluster to form small communities alongside local roads. Small Area statistics for this area show that all households are in houses or bungalows, none in apartments or mobile homes; this is typical of low-density populations. Given its rural nature, background noise levels in the area would be expected to be low; air quality would be good, and traffic would be at a low level: the local roads are narrow and largely serving the local community only.

In terms of amenity effects, these occur when there are two or more significant 'nuisance' effects on communities. These nuisance effects are generally taken to be visual impacts, traffic, noise and air quality. They are most likely to combine to create an amenity effect during the construction phase of any project. As has been stated under Section 2.5.4 Landscape and Visual, it is not considered that there would be significant visual impacts as a result of the proposed extension; traffic impacts are discussed further in 2.6.3 and it is likely that there would be a localised impact on highways and access during the construction phase only. In addition, noise and dust from the construction phase may also impact local properties. As a result, there is likely to be a combination of nuisance effects creating an effect on local amenity during construction.

During operation, there would be no traffic or air quality issues associated with the new equipment. Visual impacts are unlikely to be significant. There may be noise issues from the equipment but as it will be located to the rear of the existing substation and away from residential properties, it is unlikely to present a significant impact.

There is also potential for cumulative effects on the amenity of the area near Woodland Substation, as a result of other proposed electricity transmission projects in the vicinity. It is difficult to determine the likely extent of this at this stage. There are no timeframes for the construction of these projects, indeed some are still within the pre-planning phase. Two of the three projects are reinforcement or refurbishment; the North south interconnector is proposed to use the spare suspension arm of the double circuit towers of the existing 400kV OHL for its conductors. Notwithstanding this, if all projects were constructed at the same time or sequentially the magnitude on the amenity of the local community would be high as a result of large amounts of construction traffic and potential noise at once, or over a long period of time. This assessment Is not, however, included in the amenity impact assessment set out below.

It is considered that the effects on amenity would be low to moderate as much of the noise and dust impacts would be mitigated by distances from local populations, leaving only traffic as a potential impact.

2.6.2 Economy

In local communities close to Woodland Substation, there is a very low level of unemployment, with numbers ranging from 2 to 4%. Most of the working population in this area are in skilled or professional jobs, with a significant minority in the farming industry. In terms of impacts to local businesses or the economy, during construction there may be some disruption and access difficulties as a result of construction traffic to the substation, however this is unlikely to be a significant issue and would likely occur over a short period of time. It is not likely there would be a significant benefit from construction work or local expenditure as a result of this project. During operation there would be no significant effects on land use or existing commercial premises; no significant effects on local industry and commerce are expected.

Land use is discussed in Section 2.5.3; the land surrounding the substation is agricultural and arable. The land required to facilitate the extension is not considered to be enough to have an economic impact on the landowner or local farming community. Additional land required for construction compounds is also unlikely to cause a significant impact.

There are no tourist sites nearby and the local roads are not likely to be used by tourists en route to attractions as there are none near the substation.

As a result, effects on the economy from the proposed extension are likely to be neutral.

2.6.3 Traffic and Transport

75% of people in this area have journey to work, school or college times of under 45 minutes, indicating local schools and employment locations. Most of the journeys are by car. Local roads in the area are narrow, sometimes only 4m wide, especially near Woodland substation. During construction, the narrow local roads pose a significant constraint to the use of the public highway to deliver materials to the substation to carry out any works required there and the introduction of heavy vehicles on the local roads could have an impact on local communities and their ability to travel to work, school or college. During operation there would be no significant effects on traffic and transport.

As a result, effects on traffic and transport are likely to be moderate.

2.6.4 Utilities

Above ground utilities in the area include telephone network cables and OHLs. Near to Woodland substation, there is the existing Moneypoint to Woodland 400kV OHL travelling east to west; the Woodland to Maynooth 220kV OHL travelling north to south; and a 110kV OHL crossing to the south of Woodland substation in a north west to south east direction. During construction, there is some potential for underground utilities in the area of the proposed extension, which would need to be assessed and managed prior to construction commencing. However, given the nature of the land in this location it is not anticipated that this would be a significant issue. During operation, there are unlikely to be effects on third part utilities; any effects on the existing arrangements at the substation would be factored into the design of the proposed works.

As a result, the effects on third party utilities are likely to be neutral.

2.6.5 Assessment of Social Impacts

More significant/difficult/risk — Less significant/difficult/risk

Table 2.2 Constraints Risk Assessment for Substation Modifications at Woodland Substation

Constraint	Risk
Amenity & Health	
Economy	
Traffic & Transport	
Utilities	
Social Summary	

The proposed extension has a generally low to moderate risk of social impacts; the location of the extension to the rear of the existing substation mitigates or removes many risks that would otherwise have been present. Traffic issues are likely to be the main concern. These can be mitigated through the use of a Construction Traffic Management Plan; timings of deliveries, for example, to avoid hours when local people are travelling to work or school would reduce much of the impact discussed here.

2.7 Deliverability

2.7.1 Construction

New earthworks, foundations and cable troughs will be required for the new 400kV bays associated with the ring configuration.

The new bus coupler located at the north of the site will be positioned on an existing access roadway. Therefore, this roadway will need to be demolished and a new access roadway to be built to replace it. A proposed access roadway is shown on layout drawing 321084AE-LAY-008B in Appendix A along with the altered fences around the substation boundary.

This access road could be pushed closer to the wing coupler however, the distances used were based off current distances between busbars and access roads used in existing layout

The existing centre bus coupler will need to be removed and a new bus section will be positioned in its location.

2.7.2 Outage Requirements

For the two new bus couplers, construction and earthworks can be done as an offline build without the need for outages. Single busbar outages will be required during the final busbar connections and commissioning works.

For the new bus section, EirGrid system input will be required for any outage planning. Having the new bus couplers in place before the removal of the existing centre bus coupler will provide network flexibility. The centre bus coupler can be removed with single busbar outages. Depending on EirGrid's system requirements for extended outages, an offline build of the bus section can be done, and single busbar outages will be similarly required for the final busbar connections and commissioning works.

It is noted that the Portan circuit is the UK-Ireland interconnector and thus is a strategically important circuit. Works to the southern wing coupler will be taking place adjacent to the Portan bay, however a distance of approximately 10m is allowed between the new Bus Disconnectors and the existing Pantograph Disconnectors associated with the Portan bay and this clearance is considered sufficient to enable offline construction of the wing coupler without requiring proximity outages on the Portan circuit. However, to make final busbar connections would involve works within approximately 4m of the Portan bay, and for these works it is considered that proximity outages on the Portan circuit would be required. These outages would likely be of 1-2 days duration for each busbar.

2.7.3 Deliverability Feasibility

As per Section 1.5, the following scale is used to assess the deliverability of the new 400kV ring configuration. Due to the requirement of the outage of a major interconnector, this has been assigned a moderate risk rating (Green).

More significant/difficult/risk — Less significant/difficult/risk

400kV Ring Configuration	Deliverability Feasibility
(ii) Modified Bus Section	

2.8 Economic

2.8.1 Cost Estimate

The following assumptions have been made for the cost feasibility assessment:

§ No cost information is available from EirGrid for 400kV bays needed to construct a ring configuration. Therefore, a list of quantities has been proved below.

§ The works associated with demolition of existing bay, planning and extension of the substation boundary have not been included.

§ This assessment has been made using the information currently available and therefore indictive at this stage. A complete feasibility assessment using EirGrids scale has not been carried out.

§ There are outstanding stages to this extension and therefore costs outstanding meaning this should not be taken as end results for this configuration option.

Item No.	Item Name	Quantity
Electrical		
1	Bus Bar	Wing coupler 1 – 297m Wing coupler 2 - 297m Centre coupler – 330m
2	Bus Disconnector (BD)	8
3	Bus Support (BS)	6
4	Circuit Breaker (CB)	12
5	Current Transformer (CT)	18
6	Post Insulator (PI)	8

Civils		
	Foundations	40

3. Conclusion

The option to reconfigure the 400kV side of the substation to a ring configuration at Woodland substation is technically feasible with the modified bus section and will require the extension of the substation boundary fence.

No major planning works involving land acquisition are anticipated to be required. However, the works may encroach an existing water course in the north, where any construction activity is likely to be in very close proximity. This may cause a significant environmental impact and will need to be carefully considered. Earthworks and civil works will also be required for the site extension as well as a new access roadway to replace the existing road. Further to this, outages of major interconnector with a duration of approximately 1-2 days should be accounted for.

Assessment Criteria	Scale
Technical Feasibility	
Environmental Feasibility	
Social Feasibility	
Deliverability	
Combined Feasibility	

Appendix A. Drawings

321084AE-LAY-008A - Woodland 400kV Ring configuration - Standard RevA

321084AE-LAY-008B - Woodland 400kV Ring configuration - Modified RevA