Capital Project 966

Substation Feasibility Assessment - Woodland 220kV Connection

321084AE-REP-011 | A

27 April 2020

EirGrid

CP966

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Executive Summary

Jacobs was requested to prepare a set of substation feasibility reports for the 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. The project will therefore require substation modifications 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 substation modification 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 been 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 220kV circuit entries (overhead line or HV cable) into Woodland 220kV substation associated with the 220kV underground cable option and the turn in of the Gorman 220kV circuit associated with the up-voltage option. The report 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 connection of the incoming 220kV underground cable circuit at Woodland substation is technically feasible as a generally standard EirGrid bay can be implemented however, it does meet some challenges due to associated requirement for reactive compensation.

The connection of the incoming Gorman 220kV circuit is technically feasible, although a standard EirGrid HV Cable bay is more favourable as this can be accommodated within the existing substation arrangements whereas an overhead line entry would require the implementation of a C-type extension to provide an entry point onto the busbar. Another factor in the decision on which side of the bulbar this connection is constructed on, is depending on obtaining a balanced flow on the busbar conductors. All of the above facts should feed into the ultimate decision.

Overall, all 220kV connections at Woodland substation are all feasible across the board and pose little risk.

1. Introduction

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.

1.1 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 website1. 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/

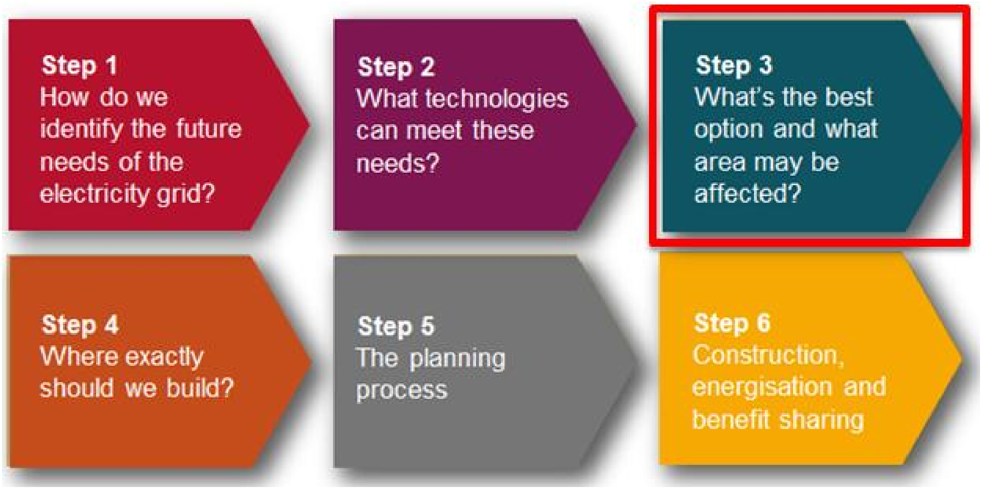

Figure 1 : EirGrid's Six-Step Framework for Grid Development

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.

1.2 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 a 220kV cable connection at Woodland Substation and investigate the 220kV Gorman turn-in connection. The finding will feed into EirGrid's overall evaluation of the four remaining options.

1.3 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 – CP966 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.

1.4 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:

More significant/difficult/risk

Less significant/difficult/risk

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).

1.5 Relationship to other technical documents

Parallel to this report, Cable Feasibility, Environmental and 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 – CP966 Cable Route Feasibility Report
- 321084AE-REP-002 – CP966 Environmental Feasibility Report
- 321084AE-REP-003 – CP966 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 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 : Map View of Woodland Substation (From Google Earth)

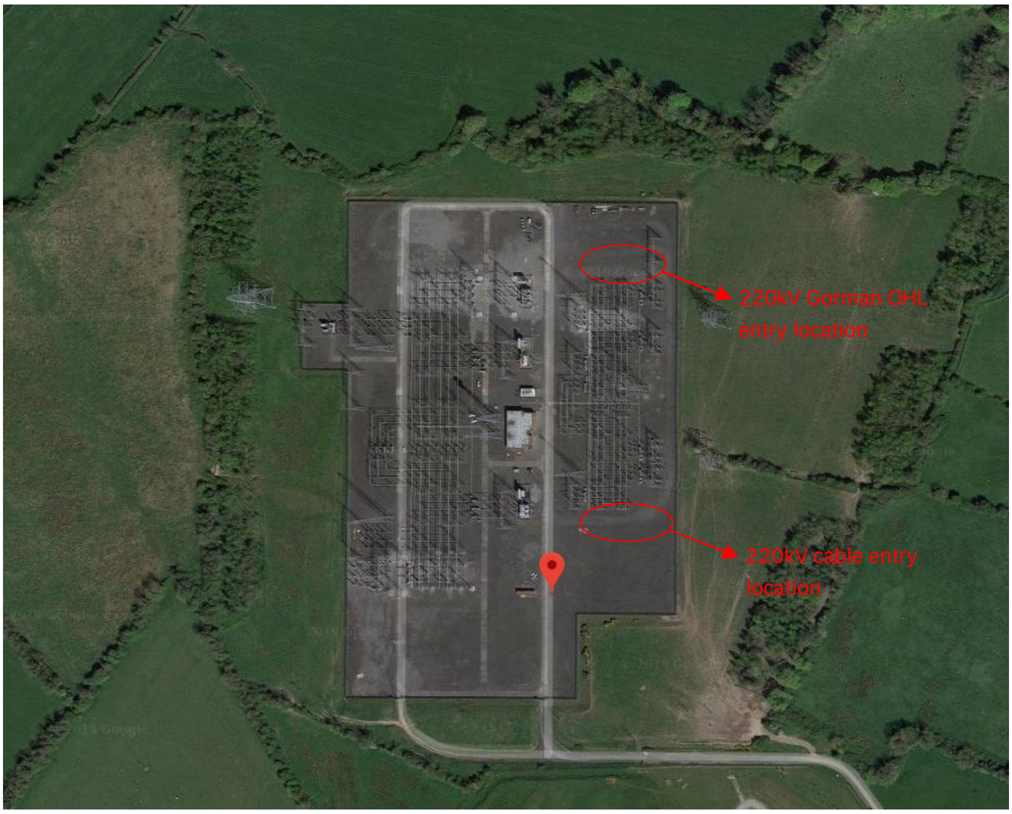

Figure 3: Location of 220kV extension (From Google Earth)

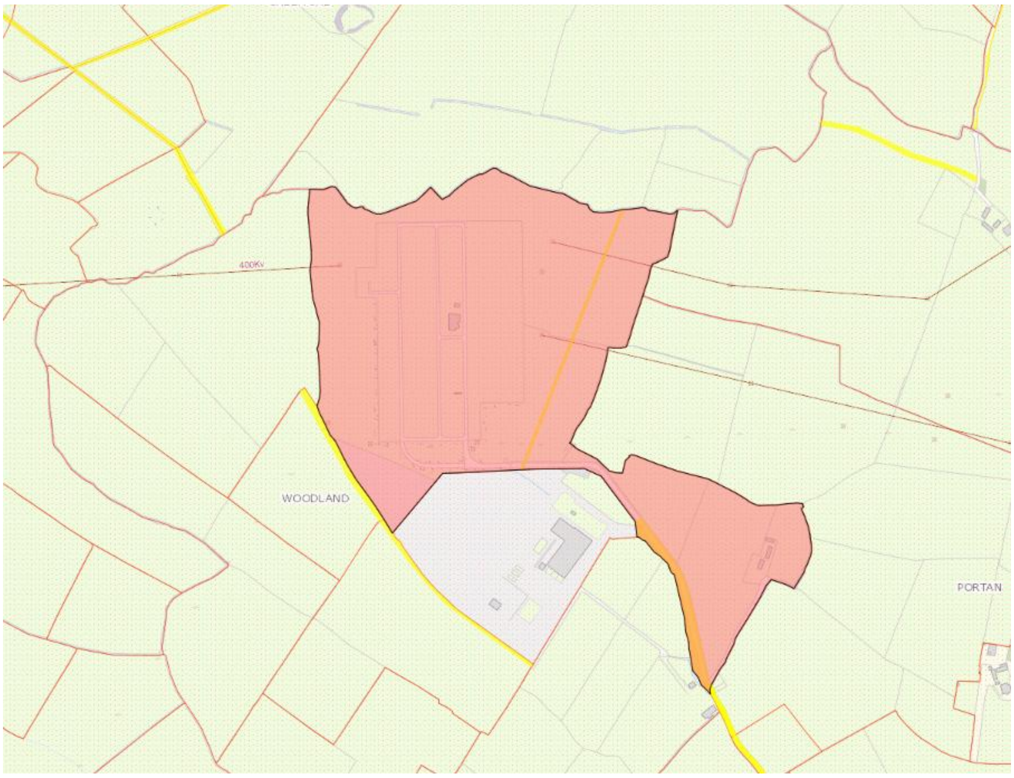

Figure 4: Extent of Land ownership boundary

2.2 Objective

This report will provide a feasibility assessment of the works required to accommodate the CP966 220kV connections at Woodland Substation. This requires a 220kV circuit entry in support of either the 220kV underground cable option from Dunstown (requiring a new HV cable bay with Shunt Reactor) or the 220kV to 400kV up-voltage option (requiring a 220kV OHL or HV cable bay for the new Gorman – Woodland overhead line). This investigation looks at the connections into Woodland substation only and not the OHL or cable routes. For the Gorman turn in option, a typical OHL and cable entry has been assumed at this stage of the project (see report 321084AE-REP-009 for full turn in investigation).

2.3 Technical

2.3.1 Project Requirements

The new 220kV connection 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. The 220kV line bay is based on the existing line bay designs at Woodland substation.

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 substation layout arrangement of the proposed works, see the drawings listed below and in Appendix A:

(i) 321084AE-LAY-014 (UGC Connection)

(ii) 321084AE-LAY-015 (Gorman Cable)

(iii) 321084AE-LAY-016 (Gorman OHL)

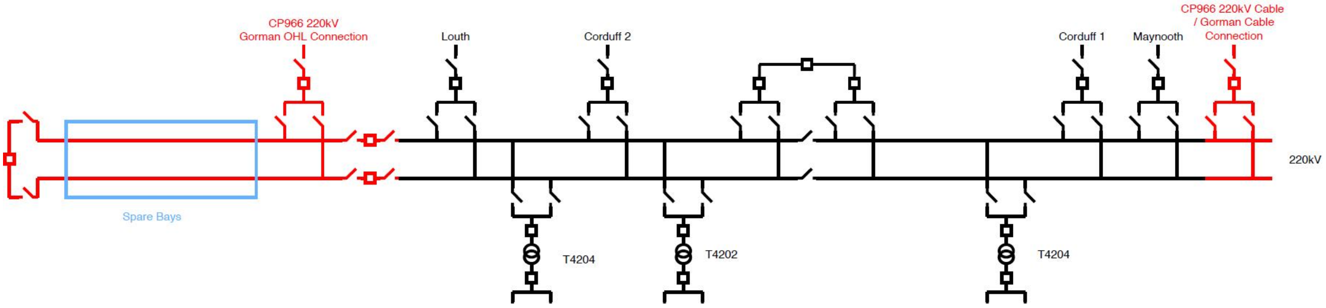

Figure 5: Woodland 220kV Connection

In support of the 220kV underground cable (UGC) option, the CP966 connection bay has been shown as a single cable per phase circuit. EirGrid have indicated that reactive compensation will be required with the 220kV underground cable option in order to offset reactive power due to the capacitive nature of UGC's once energised. This has been specified a value of 99MVAr, therefore additional space is needed to accommodate this equipment. A 100MVAr shunt reactor has been shown on the layout drawing 321084AE-LAY-014 in Appendix A for the purposes of reactive compensation for the new cable connection. For this UGC option, it is possible to add an additional bay to the other side of BB (A1/B1 beside Maynooth circuit) at south end of the 220kV substation as shown in Figure 5 above and drawing 321084AE-LAY-014 in Appendix A.

In support of the 220kV to 400kV up-voltage option for the new Gorman – Woodland circuit, the CP966 Gorman cable connection has been shown as an HV cable entry (refer to layout drawing 321084AE-LAY-015) but without the need for the 100MVAr shunt reactor required for the 220kV UGC option (due to the significantly shorter HV cable connection that would likely be utilised).

Alternatively, the Gorman connection bay has also been shown as an OHL entry in conjunction with the C-type extension works discussed in report 321084AE-REP-004 (refer to layout drawing 321084AE-LAY-016 in Appendix A) due to the preliminary indicative OHL route investigated in report 321084AE-REP-009. Simply adding a new OHL bay in a manner similar to that of the underground cable options is not considered technically feasible as it would require to under/over sail multiple other overhead line circuits due to its location and as such is considered impractical (this issue is discussed in more detail in report 321084AE-REP-009). The implications of the C-type extension works are not assessed as part of this report.

2.3.2 Other Requirements

Although associated work with the new 220kV UGC new bay build and connection 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 220kV connections. The UGC connection option requires reactive compensation and therefore increases the technical complexity of the works and is therefore assigned a moderate-low risk (Green). The Gorman cable option uses standard EirGrid cable bay connections and therefore will not cause any technical issues and has been assigned low risk (Cream). Similarly, the Gorman OHL connection is an EirGrid standard and therefore is not technically challenging. Although the C-Type extension works discussed in report 321084AE-REP-004 are required, only the OHL connection is assessed in this report and it has therefore been assigned a low risk (Cream).

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

220kV Connection Options	
UGC Connection	
Gorman Cable	
Gorman OHL	

2.4 Site Modifications

The following site modifications will be required to accommodate the new extension for the 220kV UGC option as per drawing 321084AE-LAY-014 in Appendix A.

- Existing palisade fence will need to be removed and new palisade fencing to be installed to accommodate the extended substation perimeter fence (approx. 9.3m) to accommodate cable sealing ends and shunt reactor required for compensation. Further to this, associated civil earthworks to provide a flat and level platform for the extended substation are required.
- A new section of access roadway is required for the shunt reactor associated with this UGC option.

For the HV Cable solution for the Gorman circuit turn in associated with the up-voltage option as per drawing 321084AE-LAY-015 in Appendix A, the works will be carried out within the existing substation perimeter fence and no site extension would be required.

For the OHL solution for the Gorman circuit turn in associated with the up-voltage option as per drawing 321084AE-LAY-016 in Appendix A, the works will be carried out within the existing substation perimeter fence and no site extension would be required. In respect of the associated C-Type extension works, please refer to report 321084AE-REP-004 for the footprint requirement and site modifications needed.

Figure 3 shows the location of proposed site extension work and Figure 4 shows the extent of the land ownership boundary of the substation and from this, no third-party land will be required for any of the substation options reviewed in this report.

2.5 Environmental Constraints

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; and
- Temporary loss of foraging habitat for mammals such as badger and bat
- During operation, there would be a permanent loss of small area of grassland habitat.

As such there is a low risk to 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 some but very limited potential for significant impacts to the Tolka_020 as a result of in-stream works, silty water runoff, and the potential for other deleterious substances to enter the water body from the construction site. The river is over 250m from the site.

As a result, the risk to soils and water is considered to be low.

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 low 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 east of the substation, this would not be immediately visible to local residents, screened as it would be by the existing the Converter Station.

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

2.5.5 Cultural Heritage

There are two National Monuments (RMP and SMR sites) within 1km of the Woodland substation. Both are on the far side of the substation from the proposed extension and neither is within 300m of the boundaries of the proposed works 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 Environmental impacts

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

Table 2.1 Constraints Risk Assessment for 200kV Connection into Woodland Substation

Constraint	Risk
Biodiversity	
Soil & Water	
Land Use	

Constraint	Risk
Landscape & Visual	
Cultural Heritage	
Environmental Summary	

Risk to the environment are almost all low; with land use being neutral. As a result, overall environmental effects are considered to be low.

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 adjacent to the existing substation, to the rear of the Converter Station 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 220kV Connection into 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, adjacent to the existing substation and to the rear of the Converter Station 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

No significant issues are identified for the deliverability of the new 220kV bay and cable connection as the works are in accordance with standard substation construction parameters. New foundations and cable troughs will be required. This is the same for the Gorman turn in options.

As per section 2.3, for the new HV cable bay in support of the 220kV UGC connection option, a 100MVAr shunt reactor is to be installed as part of the CP966 line bay for reactive compensation. A temporary or permanent access roadway and set down area will be needed for the shunt reactor delivery and to provide general maintenance access, as this is a large unit that will require specialised vehicle for delivery. A proposed access roadway is shown on layout drawing 321084AE-LAY-014. The deliverability of the Gorman cable option is however not affected by this issue.

2.7.2 Outage Requirements

The majority of the construction and earthworks for both the new 220kV UGC connection and the Gorman HV Cable or OHL options can be done as an offline build without the need for outages. Single busbar outages will be required during final busbar connections and commissioning works. It is noted that any outage requirements associated with the C-type extension required for the Gorman OHL option are not considered in this report (please refer to report 321084AE-REP-004).

2.7.3 Deliverability

As per Section 1.5, the following scale is used to assess the deliverability of the new of the new 220kV connections. For the UGC connection, the deliverability issues linked to the reactive compensation such as delivery and access have ranked this option as moderate-low risk (Green). This is not included in the Gorman cable and therefore given a low risk rating (Cream). Similarly, the Gorman OHL entry will have little risk and is given a low risk rating (Cream).

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

220kV Connection Options	
UGC Connection	
Gorman HV Cable	
Gorman OHL	

2.8 Economic

2.8.1 Cost Estimate

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

- The cost has been developed based on standard equipment configuration using information from the Transmission Asset Owner (TAO) and includes the electrical plant items/works and associated civil works.
- The shunt reactor costs have been provided by Siemens and are only relevant for the new HV cable bay in support of the 220kV underground cable option. These have been priced for the units only.
- The OHL option in associated with the Gorman turn-in has been assumed to connect to the C-type extension which is found in 321084AE-REP-004. This report outlines OHL connection costing only.

2.8.2 220kV Underground Cable Connection

Item No.	TSDC Ref.	Item Description	TAO Rate Gross €	Quantity	Gross Cost Estimate Amount €
1	S220-11	New 220kV AIS Line Bay in existing 200kV Double Busbar Enhanced "C-Type" / Enhanced "Ring-type" Outdoor Station (Strung/Tubular Busbar)	€ 1,550,000	1	€ 1,550,000
2	NSS-10	Incremental Bay 220kV AIS	€ 90,000	1	€ 90,000
TOTAL					€ 1,640,000

Note: costing assumes feeder connections are lines however from a substation perspective, cable options will be priced the same as it is assumed the cable sealing end costs are associated with the HV cable option as a whole.

Siemens	New 100 MVAr 220kV 3ph 50Hz Shunt Reactor* (SH RX)	-	1	€1,550,000

Due to the non-standard application of reactive compensation, there are no standard pricing methodologies for the arrangements shown in drawings 321084AE-LAY-007 therefore, for comparison, a list of quantities is shown below.

Item No.	Item Name	Quantity
Electrical		
1	Bus Bar	100m
2	Post Insulator (PI)	12
3	Surge Arrestor (SA)	3
Civils		
	Post-Insulator type Foundations	15
	Reactor Foundation & Bund Wall	1
	Multi-core Troughing	30m

* this Shunt Reactor cost represents an additional cost associated with the new HV cable bay in support of the 220kV underground cable option only.

2.8.3 Cable – Gorman Turn-in

Item No.	TSDC Ref.	Item Description	TAO Rate Gross €	Quantity	Gross Cost Estimate Amount €
1	S220-11	New 220kV AIS Line Bay in existing 200kV Double Busbar Enhanced "C-Type" / Enhanced "Ring-type" Outdoor Station (Strung/Tubular Busbar)	€ 1,550,000	1	€ 1,550,000
2	NSS-10	Incremental Bay 220kV AIS	€ 90,000	1	€ 90,000
TOTAL					€ 1,640,000

Note: costing assumes feeder connections are lines however from a substation perspective, cable options will be priced the same as it is assumed the cable sealing end costs are associated with the HV cable option as a whole.

2.8.4 Overhead Line – Gorman Turn-in

Item No.	TSDC Ref.	Item Description	TAO Rate Gross €	Quantity	Gross Cost Estimate Amount €
1	S220-11	New 220kV AIS Line Bay in existing 200kV Double Busbar Enhanced "C-Type" / Enhanced "Ring-type" Outdoor Station (Strung/Tubular Busbar)	€ 1,550,000	1	€ 1,550,000

Costs associated with the required C-type extension do however have an impact and therefore must be taken into consideration when considering this option.

2.8.5 Economic Feasibility

As per Section 1.5, the following scale is used to assess the economic feasibility of this option. The 220kV UGC connection option has the significant additional costs for all equipment for reactive compensation. This has therefore led to a moderate risk rating (Dark Green).

The Gorman HV cable and OHL options are broadly comparable in terms of cost and therefore have a low-cost risk (Cream).

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

220kV Connection Options	
UGC Connection	
Gorman Cable	
Gorman OHL	

3. Conclusion

The 220kV connections at Woodland substation are all feasible across the board and pose little risk.

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

220kV Connection Options	Technical Feasibility	Environmental Feasibility	Social Feasibility	Deliverability	Economic Feasibility	Combined Performance
220kV Connection						
Gorman Cable						
Gorman OHL						

Appendix A. Drawings

321084AE-LAY-014 - Woodland 220kV Cable Connection RevA

321084AE-LAY-015 - Woodland 220kV Gorman Cable Connection RevA

321084AE-LAY-016 - Woodland 220kV Gorman OHL Connection RevA