The Grid West Project

EirGrid

Lead Consultant's Stage 1 Report

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TOBIN Consulting Engineers

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LEAD CONSULTANT'S STAGE 1 REPORT

PROJECT: **Grid West Project**

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Lead Consultant's Stage 1 Report

	Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Chapter 7	Chapter 8
Volume1 Stage 1 Report	**Chapter 1** Introduction	**Chapter 2** Strategic Planning Context	**Chapter 3** Technical Founding Report	**Chapter 4** Study Area	**Chapter 5** Constraints	**Chapter 6** Route Corridor Identification, Description and Evaluation	**Chapter 7** Substation Site Identification, Description and Evaluation	**Chapter 8** Lead Consultants Recommendations
Volume 2 Mapping				**Figure 4.1** Study Area	**Figure 5.1** Constraints Within Study Area	**Figure 6.1** Heat Mapping of the Study Area **Figure 6.2** Heat Mapping of the Study Area with Route Corridor Options		**Figure 8.1** Route Corridor Options with Study Areas **Figure 8.2** Bellacorick Route Corridor Options with Substation Study Area **Figure 8.3** Bellacorick Route Corridor Options with Substation Study Area and Constraints **Figure 8.4** Cashla Route Corridor Options with Substation Study Area **Figure 8.5** Cashla Route Corridor Options with Substation Study Area and Constraints **Figure 8.6** Flagford Route Corridor Options with Substation Study Area **Figure 8.7** Flagford Route Corridor Options with Substation Study Area and Constraints **Figure 8.8** Route Corridor Options and Substation Study Areas with the Least Constrained Route Corridor
Volume 3 Appendices			**Appendix 3.1** Grid West Initial Technical Studies' Report **Appendix 3.2** Technical Foundation Report **Appendix 3.3** Technical Report on Electromagnetic Fields	**Appendix 4.1** Report and Feedback on First Round of Public Consultation	**Appendix 5.1** Report and Feedback on Second Round of Public Consultation	**Appendix 6.1** Route Corridor and Substation Site Identification and Description **Appendix 6.2** Route Corridor Evaluation Report	**Appendix 7.1** Substation Site Evaluation Report	

Errata and Amendments

Page	Section	Amendment
2	1.2	First paragraph of Section 1.2 - “if at all” amended to read as “if required”
81	7.2.2	First paragraph - Reference to B2 corrected to B3
81	7.2.2	Second paragraph - Reference to B3 corrected to B2
91	7.3.3	First paragraph on page 91 has been redrafted to clarify lengths of route options

TABLE OF CONTENTS

Index of Plates

Index of Figures

VOLUME 2 MAPPING

Index of Figures

VOLUME 3 APPENDICES

Index of Appendices

1 INTRODUCTION

Grid25 is EirGrid's strategy to develop and upgrade the electricity transmission network from now until 2025. The Grid West project is the largest Grid25 project in the West, initially accounting for an estimated €240m of the investment earmarked for the region. By connecting the electricity generated by the region's huge renewable energy resources, the Grid West project will facilitate significant job creation and investment. It will contribute to national recovery and growth while at the same time allowing the region to attract inward investment which requires a strong reliable source of power.

This project will facilitate Ireland's national goal to achieve 40% of electricity consumption from renewable sources by 2020. These renewable resources include wind, wave and tidal energy. The existing transmission infrastructure in this region needs substantial investment to accommodate the West's increasing levels of renewable generation.

1.1 PURPOSE OF THIS REPORT

As part of the Grid25 strategy to develop the Irish electricity transmission network, EirGrid proposes to install a new high voltage electricity transmission line from the Bellacorick area of County Mayo to connect to the existing national grid, at either the existing Flagford substation in County Roscommon, or the existing Cashla substation in County Galway. Stage 1 of EirGrid's Project Development and Consultation Roadmap (Plate 1-1), entitled *Information Gathering* includes the route corridor and substation site identification process and concludes with the identification of feasible route corridors and substation site options.

The Lead Consultant's Stage 1 Report is the output of Stage 1, and it draws together work completed during Stage 1 of this project. It culminates in the identification of what is considered by EirGrid's Lead Consultant to comprise a least constrained route corridor, and least constrained substation site at the key nodal points of Bellacorick, Cashla and Flagford. 'Least constrained' in the context of this report should be considered to mean '*best fit'* from a technical and environmental perspective.

It presents and evaluates the information gathered to date, including the technical and environmental studies and the identification of environmental and other constraints in the identified study area. It sets out how these studies were used to support the identification of a number of feasible route corridor options and substation site options and ultimately, a least constrained route corridor and substation site option. The report includes details of the evaluation process, which has led to the least constrained corridor and substation site options in the view of the Lead Consultant. It also describes the public consultation which contributed to various elements of the Stage 1 work.

The purpose of the Lead Consultant's Stage 1 Report therefore, is:

- To present the relevant environmental and engineering constraints associated with route corridor and substation site identification;
- To develop feasible route corridor and substation site options;
- To identify a least constrained route corridor and substation site(s); and
- To describe the public consultation process in carrying out this work.

1.2 PROJECT DESCRIPTION

As noted in section 1.1 herein, EirGrid proposes to initially install one new high voltage electricity transmission circuit, from the Bellacorick area of County Mayo, to connect to the existing national grid, at either the existing Flagford substation in County Roscommon, or the existing Cashla substation in County Galway. In addition new 400kV substation infrastructure, which will be located at or close to the existing substations, will also be required at Bellacorick, and at either Cashla or Flagford. Based on the significant extent of the region's renewable energy potential, it may be the case that, in the longer term, a second circuit out of the Bellacorick area will be required; it may be assumed that any such additional circuit would connect to the other existing substation site option (either Cashla or Flagford subject to detailed technical studies). The timeline for development of any such second circuit, if required, is dependent on a number of factors, including the speed at which further renewable energy generation is developed in the region.

EirGrid's analysis of these requirements has to date highlighted that a new 400kV circuit, with an associated substation in the vicinity of the Bellacorick area, and extensions to the existing substations, at either Flagford or Cashla, will be required. The straight line distance from Bellacorick to both Cashla and Flagford is approximately 100km. A number of different technology options were considered as part of the EirGrid initial technical analysis. In accordance with the Grid25 strategy, and to provide the capacity and capability to maximise future development of the network, EirGrid concluded that the construction of a 400kV connection to a strong point on the national grid was preferred. It has also been determined that there were no significant technical considerations to differentiate between connection from Bellacorick to the existing Flagford substation, or alternatively, connection from Bellacorick to the existing Cashla substation. On that basis, it was considered that both options should be taken forward for consideration of which is best to serve the Gate 3[1] requirement, while recognising that any scenario of significant additional connection of renewables, beyond the Gate 3 horizon, is likely to require a second circuit out of the Bellacorick area.

[1] The Gate 3 Offer Project refers to the third round of connection offers that are currently being issued to generators under the Group Processing Approach (GPA).

1.3 PROJECT NEED AND JUSTIFICATION

This project contributes towards Ireland's national goal of achieving 40% of electricity consumption from renewable sources by 2020. The West of Ireland and County Mayo in particular, has significant potential for the development of renewable generation. These renewable resources include wind and wave energy. The System Operators[2] have issued connection offers to connect 647MW of wind energy, under the Gate 3 Group Processing Approach (GPA)[3], to a number of wind farm developments in the Bellacorick area. The existing transmission infrastructure in this region consists predominantly of 110kV circuits, and is not currently capable of carrying the renewable energy which is coming on stream. Consequently it needs substantial development to accommodate the Gate 3 projects, and to prudently provide capacity for other renewable energy projects.

The project has been concepted as a single circuit 400kV transmission line, connecting a new 400/110kV substation in the Bellacorick area, to a sufficiently strong point on the Irish grid. This has been identified as being a connection to the existing 220kV network at either Cashla or Flagford. Further details of the technical justification and requirements of this project are set out in chapter 3 of this report. However the concept for the Grid West project has been developed so as to meet the need for the current Gate 3 offers issued by the System Operators, to provide for future potential grid connection requirements in Mayo, and to meet the strategic development needs of the transmission grid in the area.

By connecting the renewable electricity generated by the region's renewable energy resources to the nearest strong points, of either Cashla or Flagford substation, the Grid West project will enable and facilitate significant job creation and investment. It will reduce Ireland's dependence on imported fossil fuels, improve the balance of payments, reduce our carbon emissions and will contribute to Ireland's ability to export renewable energy to the UK and European grid. It will contribute to national recovery and growth, while at the same time allowing the region to attract inward investment, particularly for projects which require a strong, reliable source of power.

The Grid West project is proposed to meet the development needs of the transmission system, which is a complex and dynamic system, allowing the country to meet its requirements and obligations for generation of electricity from renewable sources. Its primary purpose is as part of the solution to allow the connection of the approximately 647MW of Gate 3 wind generation, referred to above, and proposed in the County Mayo area around Bellacorick. However, it is also an enabling project for the region, and the project will form part of the national electrical grid. It is necessary to transmit renewable energy from the West of Ireland, as well as meeting the long term electricity needs of consumers and promoting development in the region.

[2] In Ireland, the System Operators consist of EirGrid, the Transmission System Operator and ESB Networks, as Distribution System Operator.
[3] The Group Processing Approach (as directed by the Commission for Energy Regulation (CER) is where applications are processed in batches; these batches are commonly referred to as 'Gates'.

1.4 EIRGRID'S OBLIGATIONS

EirGrid Plc ('EirGrid') is an independent, state owned company and is the statutory Transmission System Operator (TSO) in Ireland. EirGrid's statutory functions are a defining determinant of all that EirGrid undertakes, and should be kept in mind, as they impact on the objectives of the Grid West project. EirGrid's role includes:

- To operate a safe, reliable, economical and efficient national electricity grid;
- To plan and develop the grid infrastructure needed to support Ireland's economy;
- To supervise the security of the national grid;
- To schedule electricity generation with power generators and stations;
- To facilitate the integration of renewable electricity in Ireland; and
- Explore and develop opportunities for interconnection.

It is in this capacity that EirGrid is promoting the Grid West 400kV project.

1.5 GRID25

'*Grid25 – A Strategy for the Development of Ireland's Electricity Grid for a Sustainable and Competitive Future (2008)*' outlines EirGrid's high level strategy for upgrading Ireland's electricity network up to 2025, in response to the Irish Government's White Paper - '*Delivering a Sustainable Energy Future for Ireland'* (2007). Grid25 is EirGrid's programme to deliver the development of Ireland's transmission system. The programme aims to support economic growth and job creation, facilitate a reliable supply of electricity for all consumers, provide the infrastructure to enable Ireland to realise its renewable potential and achieve the challenging target of delivering 40% of electricity generated from renewable sources by 2020. Further details on this strategy are detailed in Chapter 2 of this report.

The Grid25 Implementation Programme 2011-2016[4] sets out a practical overview of the early stages of the Grid25 strategy for major investment in the transmission grid in order to meet the long term needs of the country. The Grid25 strategy (and the Implementation Programme) is consistent with the Government's renewable generation target of achieving 40% of electricity generated from renewable resources by 2020. This Implementation Programme underwent Strategic Environmental Assessment (SEA), in order to anticipate and avoid adverse impacts arising, and to provide a clear understanding of the likely environmental consequences of decisions arising from the Grid25 Implementation Programme.

[4] http://www.eirgrid.com/media/GRID25%20Implementation%20Programme.pdf

As part of this process, Strategic Environmental Constraints Mapping was prepared by EirGrid in order to provide relevant information on environmental constraints so that environmental issues could be taken into consideration from the earliest possible stages of strategic transmission reinforcement. For the purpose of the Grid25 Implementation Programme SEA, the country was divided into three sectors (taking into consideration combinations of the regions defined in the National Spatial Strategy (NSS):

- Sector 1 The Border and West Regions;
- Sector 2 The Midland, Mid East, South East and Greater Dublin Regions; and
- Sector 3 The Mid West and South West Regions.

The Grid West project is specifically identified in the Grid25 Implementation Programme as part of Sector 1.

1.6 CONTEXT WITHIN THE EIRGRID ROADMAP

The core process in delivering the Grid West project is the EirGrid Project Development & Consultation Roadmap, (the *Roadmap*[5]) which identifies the key stages of project development and aligns this with public and stakeholder consultation in order to ensure that the views of the public, stakeholders and all other interested parties are considered. Plate 1-1 graphically presents the Stages of this Roadmap. EirGrid seeks to follow a structured framework of project development, which provides for a clear and transparent process to the benefit of all stakeholders.

This Roadmap ensures that the approach taken for this project is to move through the project stages from information gathering (including seeking public input), to evaluation (with further consultation), before endorsing an emerging preferred corridor, and following further public input, moving to a specific project proposal. This Roadmap is common to all major Grid25 projects and its purpose is to assist the project team, working with the public and key stakeholders, to compile the most comprehensive information available in order to choose the best line route, leading to a workable statutory consent and ultimately a timely construction period.

[5] http://www.eirgridprojects.com/media/EirGrid%20Roadmap%20Brochure%20July%202012.pdf

Plate 1-1 EirGrid Project Development & Consultation Roadmap

1.6.1 Stage 1 Report within the Context of the EirGrid Roadmap

The Lead Consultant's Stage 1 Report is the output of Stage 1 and is the final report to be published in Stage 1 *Information Gathering*. It draws together work completed during Stage 1 of this project. It culminates in the identification of a least constrained route corridor and least constrained substation site(s), at the key nodal points of Bellacorick, Cashla and Flagford. The report includes details of the evaluation process which lead to the identification of a least constrained route corridor and substation site option(s), and it describes the public consultation which contributed to each part of the Stage 1 work.

A copy of the Stage 1 Report is made available to stakeholders (the public, statutory and non statutory agencies) in order to outline the approach to Stage 1 *Information Gathering* and to seek input on this work, so that any observations on the report can be taken into consideration in Stage 2 of the project. The project team is accordingly seeking views on all aspects of the Stage 1 Report.

2 STRATEGIC PLANNING CONTEXT

2.1 PLANNING AND DEVELOPMENT (STRATEGIC INFRASTRUCTURE) ACT (2006)

The relevant sections for electricity transmission infrastructure, (Sections 182A and 182B) of the Planning Act 2000 - 2012, came into force in January 2007. The Planning and Development (Strategic Infrastructure) Act, 2006 amends the principal Planning Act, the Planning and Development Act 2000, by providing an amended process of statutory consent for projects deemed to comprise Strategic Infrastructure Development.

The Planning and Development (Strategic Infrastructure) Act inserts into the Planning and Development Act, 2000 new sections (Section 182A and 182B) which require that applications for development concerning electricity transmission shall be made directly to An Bord Pleanála.

Section 182A (9) provides that the definition of '*transmission*' in relation to electricity in section 182A of the Planning and Development Acts 2000-2012:

> *'shall be construed in accordance with section 2(1) of the Electricity Regulation Act 1999 but, for the purposes of this section, the foregoing expression, in relation to electricity, shall also be construed as meaning the transport of electricity by means of ……. a high voltage line where the voltage would be 110 kilovolts or more.'*

2.2 NATIONAL POLICY

2.2.1 The Energy Policy Framework 2007 – 2020

The Department of Communications, Marine and Natural Resources (DCMNR[6]) produced a White Paper - '*Delivering a Sustainable Energy Future for Ireland'* (2007), which sets out the Government's Energy Policy Framework for the period 2007-2020, and which details future challenges as it sets out a framework for 2020. Amongst other matters, the White Paper seeks to expand the use of renewable energy and cut emissions of greenhouse gases. The key policy is to ensure a reliable and competitive energy supply.

The White Paper, noting Ireland's dependence on imported fuels, seeks to ensure security of energy supply, to promote sustainable energy and to enhance competitiveness of energy supply.

Section 3.1 of this White Paper states the need for quality energy infrastructure of sufficient capacity. We *'need robust … electricity networks and electricity generating capacity to ensure consistent supply'.* Immediate priority has been given to ensuring sustained investment in electricity networks while delivering enhanced levels of electricity interconnection.

[6] The DCMNR is now known as the Department of Communications, Energy and Natural Resources (DCENR)

The Government has committed itself to the following:

> *'We will ensure completion of the ongoing capital investment programme in transmission and distribution networks by 2010 and oversee further extensive investment in a programme expected to total €4.9bn up to 2013'.*
>
> *'We will, through EirGrid, publish a Grid Development Strategy in 2007 covering the period 2008-2025, which will set out the plans for the development of the transmission system over a 20 year horizon. The Strategy will take account of growing transmission demands given our economic growth as well as technology developments. It will be aligned to and facilitate greater certainty in relation to generation plant location, the growth of renewables, interconnection and the development of the all-island energy market framework as well as spatial strategy and regional development objectives' (section 3.2.3).*

In addition the White Paper envisages substantial investment in electricity transmission (section 3.5.1) '*We will ensure through EirGrid's Grid Development Strategy 2007-2025 and in light of the All-Island Grid Study the necessary action to ensure that electricity transmission and distribution networks can accommodate, in an optimally economic and technical way, our targets for renewable generation for the island to 2020 and beyond' (section 3.5.2).*

The White Paper also sets the target of 33% of electricity to be produced from renewable generation by 2020. This has subsequently been increased to 40%[7].

2.2.2 The National Climate Change Strategy 2007 – 2012

In order to reduce the contribution of power generation to Ireland's greenhouse gas emissions, a national target has been set. By 2020, 40% (previously 33%) of electricity consumed will be generated by renewable sources. Ongoing investment in electricity transmission will '*continue to reduce losses of electricity*' and support the 2020 target.

2.2.3 National Renewable Energy Action Plan 2010

This Action Plan is required under Article 4 of Directive 2009/28/EC. The Directive establishes the basis for the achievement of the EU's 20% renewable energy target by 2020. Member States are required to adopt a National Renewable Energy Action Plan and submit this to the European Commission. The plan follows a common template agreed by the European Commission. It sets out the targets for the share of energy from renewable sources consumed in transport, electricity and heating and cooling in 2020, taking into account the effects of other policy measures relating to energy efficiency on final consumption of energy. Ireland's overall target is to achieve 16% of energy from renewable sources by 2020.

In Chapter 1, 'Summary of National Renewable Energy Policy', the Action Plan states that there has been significant growth in electricity from renewable sources in recent years. All key national entities

[7] This target increased to 40% in 2009 in the carbon budget.

(including the Energy Regulator, distribution and transmission system operators and the renewable energy sector) are '*working with the Government to deliver the 2020 target through grid connection and grid development strategies'*.

2.2.4 Strategy for Renewable Energy 2012-2020

The Strategy for Renewable Energy sets out goals with regard to expanding wind power, developing the bioenergy sector, fostering research and development in renewables, growing sustainable transport and building robust and efficient networks. Strategic Goal No. 5 is to: '*Develop an intelligent, robust and cost efficient energy networks system'*. This includes the modernisation and expansion of the electricity grid and the cost effective delivery by EirGrid of their investment programmes in electricity transmission.

2.2.5 National Development Plan (NDP) 2007 -2013

As part of its 'roadmap' for Ireland's future, the NDP sets out an overall energy programme and a strategic energy infrastructure sub-programme.

The energy investment needs over the period of the plan include interconnection, market integration, network extension and storage.

An investment of €8.5 billion in energy is envisaged including the investment of €1.2 billion in a '*Strategic Energy Infrastructure Sub-Programme*' (pg. 137). '*Investments of over €1.2 billion in the life of the NDP in this area are required in the short to medium term to bring strategic energy infrastructure up-to-date and foster continued economic and regional development'.* (pg.138).

With regard to EirGrid, it states:

> *'During the period 2007-2013, the main focus of investment by EirGrid will entail improvement of the transmission network for electricity to accommodate increased usage and enhance security of supply, to allow increased connection of sustainable and renewable energy sources to the network and to support greater interconnection with Northern Ireland and Great Britain. Expenditure of some €770 million is envisaged on the transmission system over the period of the Plan'.* (pg. 141).

2.2.6 Government Policy statement on Strategic Importance of Transmission and other Energy Infrastructure, Department of Communications, Energy and Natural Resources (DCENR),

In July 2012 the DCENR published the Government Policy Statement, of which the key elements are as follows:

- The Government affirms the imperative need for development and renewal of our energy networks, in order to meet both economic and social policy goals. The planning process provides the necessary framework for ensuring that all necessary standards are met and that comprehensive statutory and non statutory consultation is built into the process;
- The Government acknowledges the need for social acceptance and the appropriateness of exploring ways of building community gain considerations into project planning and budgeting. Delivering long lasting benefits to communities is an important way of achieving public acceptability for infrastructure;

- The State network companies are mandated to plan their developments in a safe, efficient and economic manner. They are also required to address and mitigate human, environmental and landscape impacts, in delivering the best possible engineering solutions;
- The major investment underway in the high voltage electricity transmission system under EirGrid's Grid25 Programme, is the most important such investment in Ireland's transmission system for several generations; and
- While the Government does not seek to direct infrastructure developers to particular sites or routes or technologies, the Government endorses, supports and promotes the strategic programmes of the energy infrastructure providers, particularly EirGrid's Grid25 investment programme across the regions, and reaffirms that it is Government policy and in the national interest, not least in the current economic circumstances, that these investment programmes are delivered in the most cost efficient and timely way possible, on the basis of the best available knowledge and informed engagement on the impacts and the costs of different engineering solutions.

Planning authorities and An Bord Pleanála must have regard to this policy statement as and from the date of publication (18th July 2012).

2.2.7 Grid25

In 2008, EirGrid published '*Grid25: A Strategy for the Development of Ireland's Electricity Grid for a Sustainable and Competitive Future*[8], a strategy to upgrade and reinforce the national electricity transmission network up to the year 2025. This seeks to develop and strengthen the national electricity grid in order to meet future power demands and to facilitate new power generation. Generation will include renewable resources which are often in locations where there has previously been little or no power generation so that absence of transmission infrastructure is a serious impediment to development, necessitating significant reinforcement of the grid. The largest proportion of renewable development (35%) is expected to be in the North West Region (covering the counties of Galway, Mayo Sligo, Leitrim, Roscommon and Donegal). Grid reinforcement is also necessary to provide for industrial development and population growth in the regions.

It is expected that the capacity of the bulk transmission network (220kV and 400kV) will need to be doubled. The Grid25 strategy (The Strategy) seeks to facilitate an additional length of 20% of the transmission network over all voltage levels. The Strategy states that 400kV lines are preferred to 220kV lines because of their greater capacity; in that a 400kV line carries three times as much power as a 220kV line. The Strategy states that it is expected that up to €750 million will be invested in the grid in the north west region.

The Grid25 strategy states that in the Mayo/Galway area, there is expected to be 880MW of wind generation and 240MW of wave generation. Major developments for this area include:

[8] All of the figures quoted in this section of the Stage 1 Report, are taken from the Grid25 strategy document which may have been modified since the publication of this document.

'Major infrastructural development from Mayo to the main bulk transmission system in the eastern part of the region'.

The benefits of this and the other grid projects for the region are:

- The North West can become a net exporter of power to the rest of the island, reducing its reliance on generation from outside the region;
- Plans will facilitate the growth of renewable generation connections in the region; and
- The increased power supply will accommodate and help attract future industry.

2.2.8 The Grid25 Implementation Programme SEA

The Grid West project is specifically identified in the Grid25 Implementation Programme 2011-2016[9], which has been subject to Strategic Environmental Assessment (SEA).

The European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004 (SI No. 435 of 2004) as amended requires the carrying out of an environmental assessment for all plans and programmes:

a) Which are prepared for sectors including energy and which set the framework for future development consent of projects listed in Annexes I and II to the Environmental Impact Assessment Directive, or
b) Which are not directly connected with or necessary to the management of a European site but, either individually or in combination with other plans, are likely to have a significant effect on any such site.

EirGrid, as the competent authority with respect to the Implementation Programme for Grid25, carried out the required environmental assessment, and prepared an Environmental Report, containing the information specified in Schedule 2 of the Regulations, having consulted widely on the scope of the work.

An SEA Statement was prepared, summarising how environmental considerations have been integrated into the Implementation Programme, and the reasons for choosing the adopted programme over other alternatives detailed in the Environmental Report. A copy of the SEA Statement, together with the adopted Implementation Programme has been circulated to the relevant environmental authorities. A newspaper notice stating that a copy of the SEA Statement and Implementation Programme were available for inspection was published in national media in May 2012.

Work carried out on the Grid West project, to date in Stage 1, has had regard to the published Grid25 Implementation Programme SEA.

[9] http://www.eirgrid.com/media/GRID25%20Implementation%20Programme.pdf

2.3 REGIONAL PLANNING GUIDELINES

Regional planning guidelines set out the spatial planning objectives for their particular region, providing a framework for long term strategic development. The guidelines also ensure successful implementation of the National Spatial Strategy at regional, county and local level.

2.3.1 Western Regional Planning Guidelines 2010 – 2022

The Western Region includes the counties of Galway, Mayo and Roscommon. Chapter 5 of the Planning Guidelines deals with the Infrastructure Strategy for the region.

Section 5.5.1 specifically outlines the fundamental importance of electricity transmission and includes the following statements:

- The existing grid is not capable of transporting the energy generated from renewable sources and significant reinforcement is therefore required. The extension of a 220/440kV line from the south and east to Bellacorick, County Mayo is referred to as a possible development;
- In principle, planning authorities '*should consider and support where appropriate the provision of energy networks'*, provided that it can be demonstrated that it is required to facilitate significant economic or social infrastructure, the route has due consideration for impacts through environmental assessment, the design has the least impact on the environment without excessive cost, mitigation measures are included where impacts are identified and that it is consistent with international best practice regarding materials that will ensure a safe, high quality network; and
- A key requirement for the West Region is that grid investment must be guided by the need to remedy immediate deficiencies and also by an expected long term moderate growth in population and economic development.

The Planning Guidelines include the following relevant polices and objectives:

- Policy IP40 states that the proposal in Grid25 for additional investment in the West Region must be supported;
- Policy IP42 states that investment to upgrade the existing transmission and distribution network and to build new circuits must be supported;
- Objective IO50 specifically supports the Grid25 proposal to upgrade 700 kilometres of the existing network; and
- Objective IO49 supports the construction of new 110kV and higher lines, especially across West Galway and North Mayo.

2.3.2 Border Regional Planning Guidelines 2010 – 2022

The Border Region covers Sligo and Leitrim as well as the other border counties (Louth, Monaghan, Cavan and Donegal). Chapter 5 of the guidelines deals with the Infrastructure Strategy for the region.

Section 5.4.2 outlines the strategic importance of the electricity transmission network, referring to regional and local authorities as '*custodians over the grid'* both in terms of a national and regional asset.

Section 5.4.2.3 and 5.4.2.4 of the guidelines relate specifically to the Border Region and the existing electricity transmission network. It is stated that the electricity transmission infrastructure will need to be strengthened due to an increase in generation sources. This will involve a combination of upgrading and the building of new '*extra-high voltage'* infrastructure, as the system is nearly at full capacity.

Section 5.4.2.6 outlines future requirements and identifies key projects that are critical to the future development of the region.

Policy INFP23 stipulates that, in principle, development plans should facilitate the provision of energy networks, provided that it can be demonstrated that there has been due consideration for social, cultural and environmental impacts along the route where required, the design of infrastructure will minimise environmental impacts (including impacting upon human beings), the development is consistent with international best practice, undergrounding of lines is considered in the first instance and mitigation measures included where impact is inevitable.

2.4 COUNTY PLANS & STRATEGIES

2.4.1 Mayo County Development Plan 2008 -2014

The Mayo County Development Plan is the statutory development plan for the county of Mayo, including the existing substation site at Bellacorick, as well as a significant part of the study area.

Part 3.1.3 Transport and Public Infrastructure outlines the following policies:

- Policy TI-IC 1 requires major public and private utilities infrastructure to follow the line of existing infrastructure of a similar type, unless there are over-riding issues of public safety *etc*., in order to minimise impact on the landscape and natural environment;
- Policy TI-IC 3 aims to protect areas of high sensitivity identified in the *Landscape Appraisal of County Mayo* and other environmentally sensitive areas from large-scale visually intrusive energy infrastructure;
- Policy TI-E 1 will facilitate the provision of a high quality electricity infrastructure in the county whilst seeking to protect and maintain biodiversity, wildlife habitats, scenic amenities, including protected views, and nature conservation;

- Policy TI-E 3 seeks and will facilitate the extension of the national 220kV electricity network in Mayo; and
- Part 2.1.1.2 outlines an overall strategy for infrastructure and aims to '*ensure that the energy supply and distribution throughout Mayo is expanded and upgraded sufficiently to enable economic enterprise and other developments to locate in the county*'.

Renewable Energy Strategy for County Mayo 2011- 2022

Mayo County Council has prepared a Renewable Energy Strategy for the county. The strategy was prepared in the context of national and EU renewable energy targets.

The Strategy is explicit in its support for the development of energy infrastructure in the county.

Section 4 outlines the importance of EirGrid's upgrading of the National Grid. Grid25 is EirGrid's strategy for the development of the national electricity grid for a '*sustainable and competitive future*'. Mayo forms part of the '*North West Region*' in this plan – an area that has the largest expected regional distribution of renewable generation capacity.

The Renewable Energy Strategy for County Mayo states that this upgrading is '*imperative for the future development of energy production in Mayo*'. Inaction will result in, *inter alia*, an inability to meet new customer requirements and would have '*severe consequences on the ability of Ireland to meet its renewable energy targets and its long-term sustainable energy supplies*'.

Section 4.5 of the Strategy states that '*the potential for energy generation in the County is enormous*' but it will not be possible to utilise the county's natural resources for renewable energy (or to efficiently produce energy from conventional sources) without essential upgrades to the national grid. The Strategy states that '*it is reasonable to state that a 400kV line will be required to harness the County's natural resources and to achieve the policies and objectives of this Strategy*'. This would have less long term impact on the environment and local communities that constructing a multiplicity of 220kV lines. The section of the Strategy also states that '*securing the provision of a 400kV line and associated infrastructure in the County will be a priority for Mayo County Council*'.

2.4.2 Sligo County Development Plan 2011 – 2017

The Sligo County Development Plan is the statutory development plan for the county of Sligo including some of the northern part of the Grid West project study area.

Chapter 11 Energy and Telecommunications outlines the following:

- Policy SP EN-1 aims to support the sustainable infrastructural development of energy generation and transmission networks, to ensure the security of energy supply and provide for future needs;
- Objective SO-EN-1 stipulates that significant landscape views must be protected from the visual intrusion of large scale energy infrastructure;
- Section 11.1.1 maintains that electricity transmission development is critical to Sligo's ability to attract business and accommodate economic growth;
- Policy PE-EL 1 relates specifically to the provision of electricity and aims to facilitate the provision of new high voltage electricity infrastructure in County Sligo; and
- Policy PE-EL 2 supports the maintenance and upgrading of electricity infrastructure throughout the county.

2.4.3 Galway County Development Plan 2009 – 2015

The Galway County Development Plan is the statutory development plan for the county of Galway, including a large part of the study area including the existing Cashla substation, near Athenry.

Section 2 of the county development plan sets out a Spatial Planning Strategy for the county. This includes proposals for an *Eastern Strategic Corridor*[10]; an area with a high concentration of valuable infrastructure. One of its objectives is to facilitate the upgrading and increase of such facilities. Overhead powerlines '*will be considered'* and the corridor will '*support activities which would not be appropriate in proximity to centres of population or sensitive environments'*.

Section 7 Infrastructure considers the following energy infrastructure requirements:

- Policy IS32 states that the local authority will '*support the infrastructural renewal and development of electricity networks in the county*', including the overhead infrastructure required to provide the networks; and
- Objective IS24 states that the '*planning authority shall seek to reserve a strategic corridor free from conflicting or inappropriate development (Map IS2) for the purposes of providing necessary overhead electrical supply and distribution infrastructure between Galway and Screeb and other strategic infrastructure elements of the Grid Development Strategy'.*

County Development Plan 2009-2015, Variation No. 2

The Council has adopted a variation to the county development plan (Variation No. 2, adopted on 26/9/2011) to incorporate the provisions of the County Galway Wind Energy Strategy 2011-2016. (The Wind Energy Strategy is discussed below). The amendments to the plan provide for the development of wind and other renewable energy infrastructure.

Objectives incorporated into the plan include Objective IS24 which states that '*The planning authority shall seek to reserve a strategic corridor free from conflicting or inappropriate development as shown on Map IS2 for the purposes of providing necessary overhead electrical supply and distribution infrastructure between Galway and Screeb and other strategic infrastructure elements of the Grid Development Strategy'.* The said map (IS2) shows a 220kV power line running northwards from the vicinity of Cashla.

With regard to applications for transmission lines the plan states:

> *'Electricity Transmission lines are an essential and inevitable element in providing the necessary energy for economic and social progress. The development of electricity transmission lines shall be subject to the following:*
>
> 1. *Landscape Sensitivity: Transmission lines should where possible avoid landscapes, which have sensitivity ratings Class 5 – Unique or Class 4 – Special, where they do not already traverse such area.*

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[10] The corridor is only defined in 'indicative terms' in the Galway County Development Plan but includes the lands within 2km of the Galway to Dublin Railway.

2. *Amenity Impacts: New transmission lines should have regard to existing residential amenity and environmental designations and should mitigate against any significant diminution of views of special amenity value.*
3. *Applications: Applications for new transmission lines shall be accompanied by a demand schedule'.*

County Galway Wind Energy Strategy 2011 - 2016

Galway County Council has prepared a Wind Energy Strategy for the county. The strategy provides strategic direction to encourage renewable energy and to guide the siting and design of wind energy developments in appropriate locations within the county. This document has been informed by local, regional, national, EU and international agreements, policy and legislation in relation to climate change, energy security and renewable energy.

Specific objectives include:

- Work towards a target of 500MW of wind energy in County Galway, to enable Galway to make the initial steps toward a low carbon economy by 2020. This target will enable Galway to generate the equivalent of over 70% of its electricity needs from wind energy; and
- Support a plan led approach to wind energy development in County Galway predicated on the optimal harnessing of the county's wind energy resource, and at a minimum requiring that 40% of Galway's electricity needs can be met from renewable energy sources, including wind farms.

The relevant documents that informed this strategy include the following:

- Renewable Energy Directive EU Directive 2009/28/EC, which made legally binding targets for electricity to be generated from renewable energy generation by 2020; and
- The Government White Paper on Delivering a Sustainable Future Solution for Ireland (2007), which set a target to have 33% of electricity come from renewable sources by 2020 (this target increased to 40% in 2009 in the carbon budget).

2.4.4 Roscommon County Development Plan 2008 – 2014

The Roscommon County Development Plan is the statutory development plan for the county of Roscommon, including much of the eastern part of the study area and including the existing Flagford substation.

Chapter 3, section 3.11.2 Electricity states the following:

> '*It is critical that adequate capacity, in terms of both energy and energy infrastructure, is available within the county to support its development. The growth of the national economy has placed extra strain on the national electricity generating capacity. This plan will aspire to create sustainable communities which in turn require investment in electricity infrastructure including networks and generating stations'*.

The local authority also acknowledges the need to increase existing transmission lines within the county to at least 220kV and to 400kV in the longer term. They also recognise that the development of secure and reliable electricity transmission infrastructure is vital for economic development. Relevant policies and objectives include the following:

- Policy 75 aims to support the statutory providers of the national grid infrastructure by safeguarding such strategic corridors from encroachment by other developments that might compromise the provision of electricity networks where strategic route corridors have been identified;
- Policy 76 aims to promote and facilitate the doubling of the transmission voltage where required, in order to reduce power wastage by 75%; and
- Objectives 68 – 72 all aim to facilitate and promote high voltage electricity infrastructure within County Roscommon, to work in collaboration with EirGrid and actively promote the Government's White Paper 'Delivering a Sustainable Energy Future for Ireland, Energy Policy Framework 2007-2020', including the delivery of electricity over an efficient network.

County Development Plan 2008-2014, Variation No. 2

The Council has adopted (22/10/12) the above Variation to the county development plan which covers a number of matters including energy and transmission. It provides, inter alia, for the amendment of section 3.11.2 of the plan. This includes support for the upgrading of electricity transmission infrastructure.

It supports the provision of new energy networks provided:

- *'The development is required in order to facilitate the provision or retention of significant economic or social infrastructure;*
- *The route proposed has been identified with due consideration for social, economic, environmental and cultural impacts through relevant environmental assessment;*
- *The design is such that will achieve least environmental impact consistent with not incurring excessive cost;*
- *Where impacts are identified mitigation features have been included; and*
- *Where it can be shown the proposed development is consistent with international best practice with regard to the materials and technologies that will ensure a safe, secure, reliable, economic and efficient high quality network'.*

The following objectives and policies are also stated:

- *'Support the use of the existing and necessary upgrades of the electricity grid to facilitate the production of electricity from renewable sources. (RPG Objective IO53);*
- *Support the additional investment in County Roscommon as proposed in EirGrid's Grid25 Strategy. (RPG Policy IP40*); and
- *Support the construction of new 110kV and higher lines. Such proposals must take account of various EU designations and relevant environmental assessment in its design and construction and significant impacts on Natura 2000 sites must be avoided through the 'Appropriate Assessment' process.* (RPG Objective IO49)'.

Roscommon Wind Energy Strategy

The Roscommon Wind Energy Strategy is still in its predraft stage. In its absence the following most recent information is relevant:

The '*Strategic Issues Paper'* for 2014-2020 county development plan (published in June 2012) states the following under the heading Energy: '*With rising oil prices and the need to adopt more environmentally sustainable practices, renewable energy sources will become increasingly important. Some alternative sources of power include hydroelectric, solar, wind power as well as biomass power'*.

2.4.5 Leitrim County Development Plan 2009-2015

The Leitrim County Development Plan is the statutory development plan for the county of Leitrim, part of which is included in the study area's north eastern section.

Section 2.10.04 outlines the planning authority's support for new electricity supply infrastructure, including high voltage transformer stations and new power lines, stating that this is required to reinforce the transmission network to cope with growing electricity demand from existing and new customers. Such infrastructure is also:

- '*recognised as a key factor in supporting economic development and attracting investment to the area'.*

The authority's preferred option for high voltage lines (220kV and above) is that they are placed underground. Applications for the erection of high tension lines must take residential amenity into consideration.

The authority will be guided by the Landscape Character Assessment (LCA's) in determining the acceptability of proposed transmission lines in sensitive landscapes.

2.5 CONCLUSION ON PLANNING CONTEXT

The Grid West project will reinforce the electricity grid in the West of Ireland, providing the necessary high quality transmission infrastructure for industrial and employment growth, as well as facilitating the development of renewable energy sources in the region.

It is the adopted policy of the Government to improve facilities for the transmission of electricity by investing in the national grid. This is expressed in energy documents such as the Government's White Paper and in the National Development Plan (NDP).

Detailed proposals are set out in EirGrid's Grid25 strategy including the provision of major new infrastructure connecting Mayo to the existing high voltage national grid. This is necessary to provide for the future demands of industry and population growth in the area. It is policy to expand the use of renewable energy sources which also requires investment in the grid.

Such improvements are also supported by regional planning guidelines and county development plans in the area. The Western Regional Planning Guidelines specifically refer to improvements to the grid to Bellacorick, by the provision of either a 220kV or 400kV transmission line. The Mayo Renewable Energy Strategy notes that improvements to the grid are essential for the development of renewable energy sources in the area.

In short, adopted policy at national, regional and county level is strongly supportive of the principle of improved grid infrastructure in the Grid West study area

3 TECHNICAL FOUNDING REPORTS

This chapter should be read in conjunction with Volume 3 Appendix 3.1 'Grid West Initial Technical Studies', Appendix 3.2 'Technical Foundation Report' and Appendix 3.3 'Technical Report on Electromagnetic Fields'

3.1 GRID WEST INITIAL TECHNICAL STUDIES

Having identified the need for the Grid West project, and having established that the extension and reinforcement of the national grid in the West of Ireland is generally in accordance with the principles of national, regional and county development plans, the first stage of the project was for EirGrid to undertake a high level technical study to identify how this need could best be met. The outcome of this study, entitled 'Grid West Initial Technical Studies' is included in Volume 3 Appendix 3.1.

The Grid West Initial Technical Studies, considered three main aspects of the project:

1. Assessment of network capability;
2. Connection and termination options; and
3. Technology and voltage options.

The three aspects are all integrally linked and should not be considered independently, or sequentially. The key findings of the report are summarised herein.

3.1.1 Assessment of Network Capability

Network capability refers to the capacity of electrical infrastructure to transfer power, without adversely affecting its ability to function as required. As such, any modification to the grid must ensure that the network capability is sufficient for the modification.

The Commission for Energy Regulation's (CER) most recent group processing approach, which is referred to as Gate 3, considers the connection of a total of approximately 4,000MW[11] of wind generation to the Irish Grid. A significant proportion of this total, amounting to 647MW, is located in the area around the existing Bellacorick 110kV[12] substation in north west County Mayo. The studies on the network capability found that the existing 110kV network (with reinforcements) in this area could accept up to 170MW of this 647MW, with some reinforcement, but it could not accommodate the entire amount. Therefore, it was identified that a new extra high voltage circuit (EHV)[13] circuit would be required, in order to allow the balance to be connected to the grid. It was further found that connecting the full 647MW on a single circuit could introduce considerable operational risk, as a single event could disconnect this full amount from the system. The preferred approach was therefore to split the generation, with 170MW on the 110kV network (which drives further reinforcement of the 110kV network) and the balance to be transferred on an EHV circuit to the existing EHV electrical transmission

[11] MW = Megawatt, millions of watts, where a watt is the measure of electrical energy
[12] kV = Thousands of Volts, where a volt is the measure of electrical potential
[13] The Grid West Initial Technical Studies defines EHV as the voltages of 220kV and 400kV used in Ireland

network. This approach also offers flexibility to allow the system to expand in the future, if necessary, given the potential for renewable energy generation in the region.

It is noted that Mayo County Council has developed a Renewable Energy Strategy, which is anticipated to stimulate additional renewable energy projects (for example in areas of biomass, ocean energy, pumped storage and further wind generation) seeking to connect to the electricity transmission network.

The Grid West Initial Technical Studies noted that a number of technology options were available and identified a number of potential locations on the grid where the EHV circuit would terminate; these were then studied further.

3.1.2 Connection and Termination Options

It is clear that one grid connection or nodal point of the new link is required to be in the vicinity of the existing Bellacorick substation, as the primary objective of the project is to connect wind generation in this area onto the electricity transmission network. The other nodal point needs to be on the existing EHV electrical transmission network.

In its technical studies, EirGrid considered a number of network connection options. The impact of the injection of up to 477MW on the network around each possible nodal point was examined. This included consideration of operational risk to the wider network, as a single event, such as the loss of any circuit in the wider network would redirect power to other circuits with potential repercussions in the wider network. To mitigate this risk, in common with best practice, EirGrid adopts a principle known as the '*n-1 criterion'*, whereby the system is able to remain stable and operational with the loss of one key link. This principle is always applied by EirGrid (and other utilities internationally), and was applied throughout the network analysis of Grid West project.

Of the potential connection points examined, Flagford, County Roscommon and Cashla, County Galway both comprising of existing 220kV substations, emerged as the preferred connection termination points. One connection from the Bellacorick node[14], to either of these two nodal points, is required to accommodate Gate 3 commitments. However it was also determined that to provide additional capacity for further generation development in North West Mayo, beyond Gate 3, a second EHV circuit may be required in the future.

3.1.3 Technology and Voltage Options

The Grid West Initial Technical Studies considered a range of standard and non standard technologies and voltage levels for the connection to either Flagford or Cashla. The technology options were subject to technical and economic analysis, by EirGrid, as well as preliminary high level environmental scrutiny, and comparatively evaluated against the following criteria:

[14] Bellacorick node: The nodal point for the Grid West circuit in a suitable location in the vicinity of the existing Bellacorick substation where it is reasonably practical to connect the new wind generation projects.

- Provision of sufficient capacity for the connection of at least 477MW at Bellacorick;
- Facilitation of strategic development for longer term needs beyond Gate 3;
- Cost effectiveness;
- Operability; and
- Initial high level assessment of environmental impact.

The studies considered high voltage alternating current (HVAC) and high voltage direct current (HVDC) technologies including the option to use overhead lines (OHL) or underground cables (UGC) for each technology.

In the Grid West Initial Technical Studies EirGrid noted that in accordance with policy[15], overhead lines, rather than underground cable, would be the preferred technology for the HVAC solution. However this study did recognise that technical solutions should be revisited at Stage 1 of the route selection process. Both overhead and underground solutions were considered for HVDC.

Five solutions were identified as meeting the capacity requirements of the project:

1. Build a 220kV HVAC overhead single circuit from a new 220kV substation at Bellacorick to either of the existing substations at Flagford or Cashla;
2. Build a 220kV double circuit HVAC OHL from a new 220kV substation at Bellacorick to either of the existing substations at Flagford or Cashla;
3. Build a 400kV single circuit HVAC OHL from a new 400kV substation at Bellacorick to a new 400/220kV transformer connecting into either Flagford or Cashla 220kV substation;
4. Build a single overhead HVDC circuit from Bellacorick to either Flagford or Cashla with the associated converter stations at each end; and
5. Build a single underground HVDC circuit from Bellacorick to either Flagford or Cashla with the associated converter stations at each end.

The outcome of the evaluation was that a single 400kV HVAC OHL circuit solution, from Bellacorick, to either Cashla or Flagford, provides the best economic option from a long term perspective, and best meets the obligations of EirGrid as the TSO. This option amongst other factors, was significantly more efficient (i.e. requiring less energy to transport the electricity through the network, referred to as 'losses') than the next best (double circuit 220kV) option. It also offered greater capacity to facilitate expansion beyond the Gate 3 requirement, and was accordingly the recommended option to be taken forward in the Grid West project.

3.2 TECHNICAL ALTERNATIVES CONSIDERED

One of the first tasks of the project team was to revisit the technology to be utilised for the Grid West project, as indicated in the Grid West Initial Technical Studies. In considering these alternatives, the project team did not revisit the selection of Flagford and Cashla as the terminal nodes for the new

15 www.eirgrid.com/media/eirgridpolicy.pdf

transmission line, or the proposed voltage of 400kV[16] as this was considered to have been comprehensively addressed in the Grid West Initial Technical Studies.

The main objective of Stage 1 of the EirGrid Project Development and Consultation Roadmap (refer to Plate 1-1) is to identify the least constrained route corridor and substation site areas. In order to do this it was essential firstly to confirm the technology to be used, as the routing requirements, in particular, differ for the different technologies. For example, different routes would most likely be used for UGC compared to OHL. The project team therefore revisited the technology to be used for the Grid West project in detail in a Technical Foundation Report, which is described in more detail in section 3.3 herein.

3.3 THE TECHNICAL FOUNDATION REPORT

Developments in recent years in the transmission of electrical power now allow a number of different technologies to be considered for any transmission project. Historically, the majority of land based transmission projects have utilised conventional HVAC OHL lines, using steel lattice towers, and air insulated outdoor switchgear substations. However with the advent of newer technologies, the following alternatives were reviewed (similar to those reviewed in the Grid West Initial Technical Studies):

- High voltage alternating current overhead line (HVAC OHL);
- High voltage alternating current underground cable (HVAC UGC)[17];
- High voltage direct current overhead line (HVDC OHL);
- High voltage direct current underground cable (HVDC UGC); and
- Gas Insulated Switchgear (GIS) and Air Insulated Switchgear (AIS) substations.

The application of the above technologies for the Grid West project was considered in the Technical Foundation Report; this report is included as Volume 3 Appendix 3.2.

As noted above, two substation technologies have been considered for the Grid West project. Both technologies are commonly applied across the world; however AIS is the predominant technology used in the Irish national grid. A brief explanation of each the technologies is as follows:

- *Air Insulated Substation with gas Insulated or vacuum circuit breakers (AIS).* An AIS substation utilises air, which is a relatively poor insulator, to maintain electrical separation (insulation) to the earthed substation equipment. This requires insulation distances of four metres plus, usually achieved using steel supports, and post insulation, to mount the HV equipment. These large insulating distances lead to larger, more sparse substation layouts as shown in Plate 3-1.

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16 400kV applies only to the HVAC solution.

17 The report considered the different technologies as the primary solutions for the project but recognised that partial undergrounding of AC is an option to mitigate local constraints for overhead line technologies, without necessarily impacting the operation of the transmission line, provided the underground cable is not a significant proportion of the total length.

Plate 3-1 Typical AIS Substation

- *Gas Insulated Switchgear (GIS) substations* utilise SF_6 gas to insulate the high voltage components and conductors, reducing the electrical clearance distances dramatically, to the order of 100's of mm. This allows for a more compact design, leading to smaller substation footprint. It is normal for full GIS substations to be compact enough to be built in a building as shown below in Plate 3-2.

Plate 3-2 Typical GIS Substation

It is recognised in the energy industry that there is not a single technology, or mix of technologies appropriate for all projects and that the most appropriate technology must be considered for each project on its own merits.

The objective of the Technical Foundation Report was to review each of the above alternative technologies, identify the relative advantages and disadvantages of each and then assess these against the requirements of the Grid West project, in order to identify the preferred technology.

The project team has used an assessment method expanded upon the method used by EirGrid in the Grid West Initial Technical Studies as it was considered it would add to the robustness of the review. The report presented a multi criteria evaluation methodology of the different technical solutions that could be adopted for the Grid West project. This approach is similar to that used for the evaluation of environmental impact. In this assessment method a number of different evaluation criteria are identified, the impact of each of the criteria (set out below) for each of the technologies assessed and their impact analysed. The analysis was based on qualitative assessment with all criteria being of equal importance or merit. This technique allowed assessment of the different technologies across a range of potential impacts, and the identification of the technology with the least impact.

Eight criteria were adopted, following consultation with EirGrid.

1. ***Operability*:** whether the technology can be reasonably and practically applied and utilised post completion of construction of the project. There are a number of different technical considerations, including connection to and integration with the existing transmission network which need to be taken into account;
2. ***Maintainability***: how practical the maintenance of the circuit will be in regards to frequency, duration and ease;
3. ***Constructability*:** how practical the construction of the circuit will be;
4. ***Losses:*** all transmission systems have inherent losses relating to the required energy used to transmit the electricity through the network however these vary from technology to technology. Once lost this energy is no longer available to the end user. EirGrid has an obligation to ensure that electricity is transmitted in the most economically efficient manner, requiring that losses be minimised;
5. ***Future expansion and flexibility ('future proofing'):*** ensuring that the network can be easily upgraded in the future to accommodate changing needs such as the addition of more generation or the connection of new consumers, while remaining flexible to adapt to changing demands expected to be placed on the network;
6. ***Environmental impact*:** including a high level, general assessment of, amongst other factors, terrain, ecology, cultural heritage and visual impact;
7. ***Cost:*** It is commonly possible to engineer any solution if cost is not a consideration. However cost is one of the factors that must be considered in assessing any technical solution, as one of the EirGrid statutory obligations is to provide an economical transmission network to its users and customers; and
8. ***Risk to the successful implementation of the project*:** There are risks associated with the adoption of any of the technologies, with respect to obtaining planning consent and also risks to successful construction and operation, but the objective must be to minimise these risks.

The resultant summary analysis matrix is shown on Table 3-1. Details as to how the resulting impact was assessed, for each technology, against each criterion, are provided in the Technical Foundation Report.

Table 3-1 Evaluation of Technologies

Technology / Criterion	HVAC Overhead Line	HVAC Underground Cables*	HVDC Overhead Line	HVDC Underground Cable
Operability				
Constructability				
Maintainability				
Losses				
Future Expansion and Flexibility				
Environmental Impact				
Cost				
Risk[18]				

*Note: HVAC Undergrounding means for the total undergrounding of the line

Key	
Light Yellow	Preferred, very limited impact, no difficulty, fully acceptable
Green	Limited impact, limited difficulty, acceptable
Dark Green	Some impact some difficulty, limited acceptability
Aqua	High impact, difficult, poor acceptability
Dark Blue	Least preferred, major impact, high difficulty, unacceptable

Review of this matrix showed that HVAC OHL offered the most acceptable technical solution when assessed against the selection criteria adopted, and is thus the current preferred technology to be adopted for the Grid West project. The major advantages and disadvantages of the HVAC OHL technology are summarised in Table 3-2. This result validates the conclusion reached by EirGrid in its Grid West Initial Technical Studies.

[18] Risk Analysis is made against the mitigated risk e.g. for HVAC OHL it has been assumed that lower visual impact designs will be used

Table 3-2 Advantages and Disadvantages of Preferred Technology (HVAC OHL)

Criteria	Main Advantages and Disadvantages of the Preferred Technology (HVAC OHL)
Operability	Main advantages • AC technology is easy to integrate into the existing systems • No difficulties with frequency control, as part of synchronised AC system • Well proven technology proving a high level of reliability and availability • Modern protection systems can be included into the design allowing rapid fault clearance and fault location • The use of auto-reclose schemes allows rapid restoration of supplies following transient faults caused by lightning or contact with vegetation • Short repair times enable a higher level of confidence that '*n-1'* system conditions can be maintained • Does not impact on security of supply for technical reasons such as resonance, etc • Relatively easy to uprate or modify Notable disadvantage is that HVAC OHL is more exposed to lightning strikes
Maintainability	Main advantages • Well proven maintenance techniques with trained and experienced staff available • Rapid location of faults, allowing rapid repair • Visual inspection can be carried out from the ground or air • Self healing protection Notable disadvantages are that repairs have to be made while working at height and routine cutting of vegetation is required along the line route
Constructability	Main advantages • Modern construction and engineering techniques make construction in a variety of terrain types possible • Access is only required to tower sites (compared with underground circuit where continuous access along the route is required) • Towers are transported in relatively small, light sections, requiring smaller vehicles, facilitating access in difficult ground conditions Notable disadvantage is that transmission lines must be of sufficient height above ground to provide sufficient electrical clearance so as to allow people, animals and where appropriate, vehicles to pass safely underneath the line.
Losses[19]	Losses are of a similar magnitude to HVAC UGC; further details are provided in the Technical Foundation Report and are significantly less than for HVDC systems of this length
Future Expansion and Flexibility	Main advantages • Inherent 1,424MW capacity which exceeds the Grid West project requirement for 477MW, allows significant capacity for future development • Additional substation(s) can be introduced along the line of the route relatively easily • Uprating of line is possible as new conductor technologies become available There are no obvious disadvantages
Environmental Impact	Main advantages: • Ecology: Significantly less impact to habitats, greater flexibility in routing allows significant habitats to be avoided • Ecology: Habitat underneath the line is unaffected except at the tower locations. • Cultural heritage: Smaller footprint and greater flexibility in routing allows heritage sites to be avoided • Landscape: Landscape patterns continue relatively unbroken under the transmission line • Geology: Flexibility in routing and design and smaller footprint allows avoidance of areas of geological constraints • Water: Flexibility in routing and design and smaller footprint allows avoidance of areas where adverse impact on water resources would occur Notable disadvantages of HVAC OHL are that they can impact on bird flight paths and are highly visible
Cost	HVAC OHL has the lowest cost in comparison to the three other technologies
Risk	All technologies present a mix of consenting and implementation risk. However it is considered that all present a similar overall risk

[19] Energy lost during the transfer of power through the transmission network

The research and analysis also showed that, for the Grid West project, a total underground HVAC cable solution would be subject to significant constraints, particularly in respect of system operation and construction. It also showed that HVDC technology is not preferred, mainly because of greater operational difficulties, increased maintenance requirements, higher cost and limitations in future expansion and flexibility to adapt to any changing requirements.

With respect to substation technology, both air insulated switchgear (AIS) and gas insulated switchgear (GIS) are well proven technologies and have been implemented successfully in Ireland and around the world. Both technologies offer advantages, depending on the application and the selected substation site. The key disadvantage of AIS is the significantly larger footprint required, but this technology does have advantages over GIS in terms of cost, maintainability and future expansion. GIS has a clear advantage when there are space constraints. It is also housed in a building, which assists in reducing the visual impact. In the case of the Grid West project, the final selection of technology is likely to be influenced by the availability of land and ability to screen potential visual impact and will thus be determined during the development of the project. The Technical Foundation Report proposes that, given that the project is only in Stage 1 of EirGrid's Project Development & Consultation Roadmap, both technologies be taken forward into the substation site identification and evaluation process.

It is important that the selection of the preferred technology be made as early as practicable and appropriate in the project, as this enables the project to proceed to the next stages. In particular, the selection of the least constrained route corridor, which is the major activity in Stage 1, has been based on use of HVAC OHL technology as identified in the Technical Foundation Report. However, as with any development project, subsequent activities may require this analysis to be reviewed, if new information or factors arise.

3.4 TECHNICAL REPORT ON ELECTROMAGNETIC FIELDS

EirGrid views the protection of the health, safety and welfare of its staff and general public as a core company value and thereby ensures its projects are compliant with electromagnetic fields (EMF) exposure limits published by the International Commission on Non-Ionising Radiation Protection (ICNIRP). These guidelines are those most commonly recognised internationally, and are used as the basis for the European Council Recommendation[20].

There have been many thousands of research projects into the health effects of the electric and magnetic fields created by power lines. There have been some epidemiological studies that have suggested a weak link between electromagnetic fields and some cancers. However none of these studies has been able to demonstrate a causal link between the two. To date there has been no conclusive evidence that these cause any harmful effects to human health.

[20] European Council Recommendation 1999/519/EC on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)

EirGrid closely monitors all new developments and research in this area, and presents its current position on the subject in its information leaflet entitled '*EMF and You - General Information about Electric and Magnetic Fields in Ireland'*. The information leaflet was published in 2013.

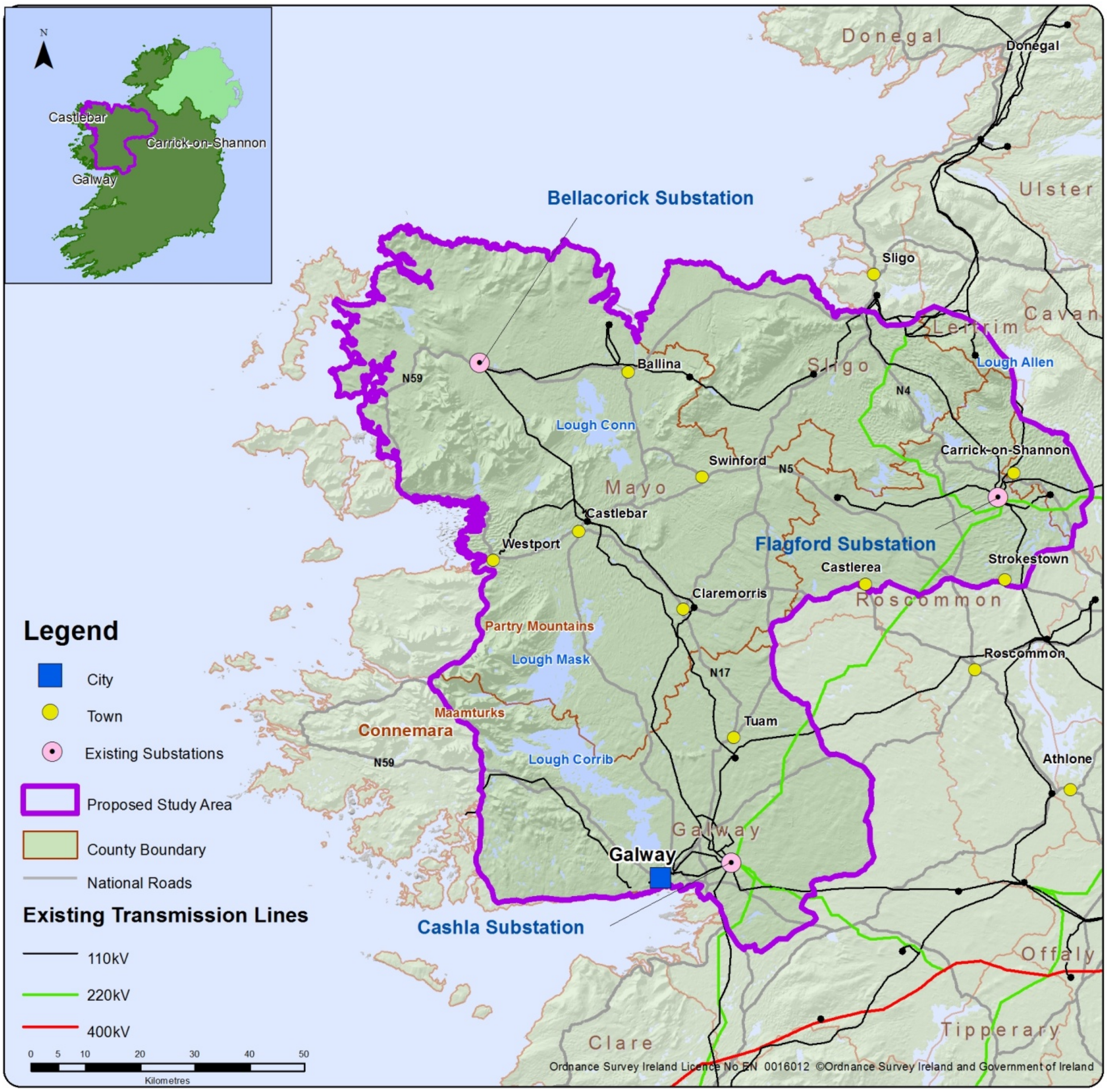
The project team undertook a review of recent research to establish whether any new developments would impact on the Grid West project. The findings of this review were submitted in a report entitled 'Technical Report on Electromagnetic Fields', a copy of which is included as Volume 3 Appendix 3.3 to this report. In summary, this research found that the current EirGrid designs for 400kV overhead lines complies with the European Council's guidelines for the limits of EMF exposure.

4 STUDY AREA

4.1 RATIONALE IN DEFINING THE STUDY AREA

This chapter of the report outlines the rationale for the Grid West project study area as shown in Figure 4-1. This map is also available in Volume 2 Figure 4-1 'Study Area' as an A0 drawing.

Figure 4-1 Grid West Study Area



At the outset of the project, it was recognised that the requirement was to develop a new high voltage electricity transmission circuit from the Bellacorick area of County Mayo to connect to the existing national grid, at either the existing Flagford substation in County Roscommon, or the existing Cashla substation in County Galway. In order to do this, the project team needed to identify route corridor and substation site options in which to site this transmission infrastructure.

It was considered that south Connemara, west of a line from Galway City, to Lough Corrib and Lough Mask, should be included within the study area, even though a route corridor through areas west of Lough Corrib would depart significantly from the most direct 'line-of-sight', or least distance, between Bellacorick and Cashla. In discussions on the study area boundary, it was recognised that many constraints, such as the Partry Mountains, the steep sided closed valleys of the Maamturks, blanket peat terrain, and environmentally designated areas would be present, such that they could combine to weigh against optimum route corridor options in this area.

Nevertheless, a precautionary principle was observed, so that the study area is not restricted by any preconceived assumptions in these respects at the outset of this project. This also permits the spatial constraint context of any potential route corridors to be readily understood in order to confirm no better options are available nearby.

Westport, Galway City and Castlerea are situated within the study area, thus ensuring the study area considers the constraints within all reasonable potential route corridors, as well as ensuring that the general public have an opportunity to take part in the consultation process.

The furthest limits of east Galway and the part of County Roscommon south of a line from Castlerea to Strokestown are not included within the study area because, given the defined end nodes for this project, it is considered that none of the route corridors from Bellacorick to Flagford or Bellacorick to Cashla would reasonably extend so far into the south east from the direct 'line-of-sight' or shortest distances between these defined end nodes.

Areas north east of Lough Allen have been omitted from the study area because it was considered that a potential Bellacorick to Flagford line would not be routed so far north east of the existing Flagford substation as it would mean an unreasonably long deviation in the direct route corridor. Similarly, a route corridor between Galway and Carrick on Shannon has been excluded from the study area, reflecting the nature of the Grid West project as a new circuit between Bellacorick, and either the existing Cashla or Flagford substations.

4.2 CONSULTATION ON THE STUDY AREA

The EirGrid Project Development and Consultation Roadmap (as outlined on Plate 1-1) sets out the key stages of the project and the necessity for ongoing public and stakeholder consultation at each stage of the project. This section outlines details of the public consultation process, at the very outset of the project, directly following the launch and publication of the study area map. Full detail on the public consultation process is available in Volume 3 Appendix 4.1 'Report and Feedback on First Round of Public Consultation' as published on the project website www.eirgridprojects.com/projects/gridwest.

The first phase of consultation commenced following the launch of the project on 4th May 2012 by An Taoiseach Enda Kenny and Minister Pat Rabbitte TD at the National Museum of Ireland – Country Life, Turlough Park, County Mayo.

4.2.1 Communications Initiatives

A number of dedicated communication channels have been established to facilitate information sharing and feedback between the project team, key stakeholders and the general public, including:

- A project specific web page (www.eirgridprojects.com/projects/gridwest/) has been developed to facilitate widespread accessibility to project data and to facilitate the communication of information specific to the Grid West project. This project web page will be regularly updated as the project progresses;
- A dedicated lo-call number 1890 94 08 02, which is managed by members of the project team, and is available to the public from 9.00am to 5.30pm each day;
- A project email address, gridwest@eirgrid.com, was put in place to provide channels through which the public can engage with the project team, request information and provide feedback; and
- An Information Centre at Linenhall Street in Castlebar, which has been open since 11th June 2012, and which is staffed by dedicated project team members, two days a week.

The project team is also engaged on an ongoing basis with a wide variety of stakeholders on the Grid West project. These include Oireachtas members, county councils within the study area and relevant council officials, representative bodies throughout the study area including the Atlantic Coastal Energy Co-Op, the CEO of Galway Chamber, Mayo County Development Board, Chambers Ireland, IBEC and Fáilte Ireland.

4.2.2 First Round of Consultation

Open days were held at locations across the study area, from Thursday 6th June – Friday 15th June 2012, including in Bangor Erris and Ballina, County Mayo; Tuam, County Galway and Ballaghaderreen, County Roscommon. Each open day took place from 1.00pm – 8.00pm.

The open days were advertised in local media and a radio announcement, advising of the open days, was also broadcast in the week prior to each open day.

Posters on the open days were also provided to Country Librarians in Mayo, Galway, Sligo and Roscommon for distribution to local libraries.

Local public representatives were contacted, via email and phone, to invite them to attend the series of open days.

A project specific Information Brochure was developed (as appended to in Volume 3 Appendix 4.1) with an outline of the preliminary study area, which was distributed to all those who attended an open day, and which was available to download from the project website.

4.2.3 Feedback Received

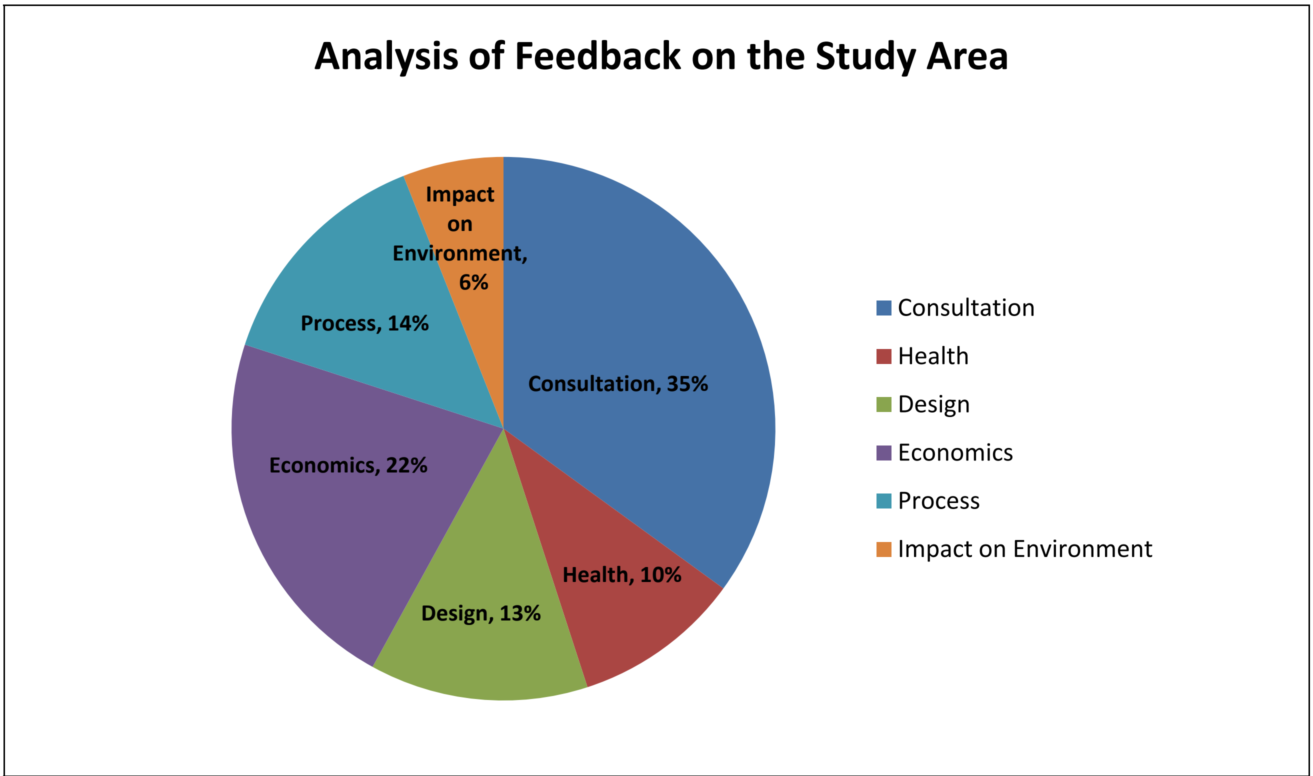
Some 105 stakeholders provided feedback in the form of comments, observations and queries on specific issues. It is appropriate to note in the context of the launch and presentation of the proposed study area, there is significant recognition of the need for infrastructural development to exploit the western region's natural resources and to sustain and facilitate job creation. Full detail on feedback received is available in Volume 3 Appendix 4.1 'Report and Feedback on First Round of Public Consultation' as published on the project website www.eirgridprojects.com/projects/gridwest.

The feedback received can be categorised under six broad themes:

- ***Consultation:*** the need for early, on-going and broadly based consultation;
- ***Health:*** queries related to the perceived health impacts of electricity transmission lines;
- ***Design:*** design issues around underground/overground line technology and, structural design;
- ***Economics:*** the economic context of the project – jobs, renewable development, investment and industry;
- ***Process:*** the processes and timelines which are to be followed; and
- ***Impact on Environment:*** queries about the potential impact of the project on the environment, ecology and heritage.

Figure 4-2 reflects the frequency of each theme which arose in engagements with stakeholders.

Figure 4-2 Analysis of Feedback on the Study Area



Responses received from stakeholders, including members of the public, assisted in confirming the boundaries and extent of the project study area.

5 CONSTRAINTS

5.1 CONSTRAINT THEMES

Following the identification of the study area, environmental and other constraints were identified and assessed. The project team has also had regard to the approach to constraints analysis adopted by the National Roads Authority (NRA) in its 2010 Project Management Guidelines, publicly available at www.nra.ie. Accordingly, for the purpose of this Constraints section of the Stage 1 Report, the key environmental constraints are summarised under the following headings:

Natural Constraints (naturally occurring landscapes and features)

- Ecology
- Landscape
- Geology
- Water

Artificial Constraints (forming part of the built environment)

- Settlements
- Cultural Heritage
- Utilities & Infrastructure

5.2 CONSTRAINTS MAPPING

Each individual constraint layer is separately illustrated in the suite of constraints maps, where they are seen in the context of the study area and the existing substation sites.

The following is a list of the Constraints Mapping, developed for the Constraints Report and presented in Volume 2 of the Constraints Report.

- Figure 5.1 Study Area Map;
- Figure 6.1 Constraints within the Study Area Map;
- Figure 7.1 Ecology Constraints Map;
- Figure 8.1 Landscape Constraints Map;
- Figure 9.1 Geology Constraints Map;
- Figure 10.1 Water Constraints Map;
- Figure 11.1 Cultural Heritage Constraints Map;
- Figure 12.1 Population Density Map;
- Figure 13.1 Utilities & Infrastructure Constraints Map; and
- Figure 14.1 Engineering Constraints Map.

Refer to Volume 2 Figure 5.1 'Constraints within the Study Area' as an A0 drawing, which highlights all constraints that were detailed in the Constraints Report on one composite map. This tends to overwhelm the map from a visibility viewpoint, but it shows nonetheless how little of the study area is completely free of one kind of constraint or another.

5.3 CONSTRAINTS REPORT

The purpose of the Constraints Report was to identify key environmental and other constraints, within the defined study area, which may influence the identification of potential route corridors and substation site options, and ultimately an indicative line route, along which the proposed transmission line will be sited. The Constraints Report and Constraints Mapping was published on the EirGrid website on http://www.eirgridprojects.com/projects/gridwest/constraintsreport/#d.en.10716

A 'constraint' incorporates two strands: it includes factors which could comprise potential obstacles in the identification of substation locations, route corridors and line routes, and might best be avoided where possible or appropriate; it also includes considerations which will assist in the design of the project. Constraints are identified in order to ensure a comprehensive understanding of the characteristics of the study area.

The Constraints Report was compiled based on desktop studies, site visits and consultation with a number of strategic stakeholders and with members of the public. It includes considerations of ecology, landscape, geology, water, cultural heritage, settlements, utilities & infrastructure and engineering constraints; all of which are factors which may influence the development of a transmission line. The constraints described in that report are based upon a review of local, regional and national datasets.

5.3.1 Ecology

It is clear from the Constraints Report, and the accompanying mapping, that the study area has a large number of important ecological sites and receptors. A fundamental strategy of '*impact avoidance'* has been adopted and prioritised, where possible, with respect to all statutorily designated sites, in particular Natura 2000 sites (Special Areas of Conservation and Special Protection Areas), Ballycroy National Park, Natural Heritage Areas, designated freshwater pearl mussel catchments (in rivers protected as Special Areas of Conservation) and lakes.

In addition, it is also recommended that other features of ecological significance detailed in the Constraints Report should be avoided, as much as possible, at the corridor identification stage or, alternatively, that these features would be fully considered at a more localised scale at later stages in the project i.e. Stage 2 *Evaluate Options*, based on more detailed studies. Other important ecological receptors include proposed Natural Heritage Areas, other (non designated) freshwater pearl mussel catchments, fens, turloughs, bogs, wet heath, semi natural woodland, wintering bird sites and semi natural grassland. This approach was adopted, given the importance of such areas in a national context and the commitments of the *National Biodiversity Plan (2011-2016)* which includes conservation of ecosystems, habitats and species, particularly high value habitats.

5.3.2 Landscape

The main international, national and county level landscape designations have been identified and mapped. In the absence of finalised national guidelines, each local authority uses its own terminology to describe parts of the landscape considered to be of significant aesthetic or recreational value on a county scale. This desktop study has been supplemented by a site visit which verified the key constraints and ascertained the characteristics of the wider landscape. The most important constraints are those of international (such as candidate World Heritage Sites) and national significance. The other constraints vary in their importance, and in the nature of their sensitivity.

5.3.3 Soils & Geology

The most relevant geological constraints within the study area have been identified and mapped. Irish Geological Heritage Sites (proposed Natural Heritage Areas and County Geological Sites) have been avoided, where possible, and areas of peat, bedrock outcrop and karstified rock, are also avoided, where possible. In addition, the project team have also sought to reduce the potential for unfavourable construction conditions, in areas of steep topography, and to reduce the requirement for specialised geotechnical input at the construction design phase.

Additional studies and site assessments have been carried out as the project has progressed, recognising that geological features are often quite localised in extent and significance, and can be more effectively considered at later stages of the project, when decisions are made with regard to the line design.

5.3.4 Water

The most relevant water related constraints within the study area for this stage of the project have been identified and mapped. It was recommended that larger lakes are avoided, where possible, and that floodplains in the vicinity of rivers are also avoided. In addition, it was recommended to avoid areas where there is a high occurrence of turloughs, as well as estuarine and coastal areas. Major rivers may be a physical constraint, but where there is a requirement to cross rivers, it was recognised that best practice would need to be incorporated into project design and construction, so as to minimise pollution risks, particularly for freshwater pearl mussel catchments.

Additional studies and site assessments will be carried out as the project progresses. In addition, more specific information on water features, including water quality baseline studies and water status under the Water Framework Directive may influence the selection of the indicative line route for the proposed transmission line.

5.3.5 Cultural Heritage

From the Constraints Report, it is clear that the study area has a rich and varied archaeological and historical past, with multi period monuments, ranging from humble sites of local interest, to large complexes of international significance. All of the features, from a prehistoric megalith, to a 19^{th} century gate pier, have varying degrees of statutory protection, but the primary principle should be their preservation *in situ.* Given the nature of the project, and the relative flexibility in designing transmission lines, this initial goal is achievable, thus the emphasis has been on reducing any potential impacts from the proposed development on the settings of monuments, structures and areas of cultural heritage significance.

5.3.6 Settlements

The study area includes within it, a wide range of settlements, one national Gateway centre (Galway City) and three designated Hubs (Castlebar, Ballina and Tuam). There are otherwise a wide range of smaller towns and villages, but generally the population density of this part of Ireland is relatively low and well below the national average.

Some rural areas have seen significant levels of development including extensive ‘one-off’ housing. These may present significant difficulties for the delineation of any route corridors. There is a band of higher density development, in a north south direction through the centre of the study area, from Ballina towards Galway. Generally densities are lower on the western and eastern parts of the study area and generally lower in the vicinity of the existing Flagford substation, than in the vicinity of the existing Cashla substation.

5.3.7 Utilities and Infrastructure

All of the known utilities and infrastructure within the study area have been identified and mapped. The identified utilities and infrastructure are a constraint in that the route of any proposed corridor must take due consideration of the location of any existing utilities and infrastructure. In addition, the utilities and infrastructure identified will have an impact on the location of the new Bellacorick substation site. This substation location has been further influenced by the location of wind farm generators near Bellacorick, which will require connections to the new substation at Bellacorick.

5.3.8 Engineering Considerations

Based on studies carried out to date, high voltage alternating current, overhead line technology is the preferred technology for the Grid West project. The engineering design will be undertaken in accordance with international best practice.

5.3.9 Conclusion

The Constraints Report identified the key environmental and other constraints within the defined study area. It was the basis on which the second round of public consultation was conducted, and it was the basis on which the identification of both substation site options and potential route corridor options has been conducted.

5.4 CONSULTATION AND FEEDBACK ON THE CONSTRAINTS MAPPING AND THE CONSTRAINTS REPORT

The second round of public consultation took place over a period of four weeks from August 21st 2012 to September 21st 2012. All material was made available on the project website at www.eirgridprojects.com/projects/gridwest and also for public viewing at the Information Centre in Castlebar. Full detail on the public consultation process is available in Volume 3 Appendix 5.1 'Report and Feedback on Second Round of Public Consultation'.

5.4.1 Communications Initiatives

EirGrid undertook a series of communications initiatives to extensively promote details of the Constraints Report and to seek feedback from the general public on all aspects of the report, and any additional information forthcoming relevant to the process, as follows:

- Updating of the Grid West project website on 21st August 2012 with full details of the second round of public consultation and the proposed open days;
- Publication of a second Information Brochure, outlining details of the project, the *Constraints Report* and the welcoming of feedback from the general public along with details of how feedback could be submitted;
- Development and publication of a *Guide to Constraints Report*, which was made available to the general public at the open days and at the Information Centre, and on request;
- Separately publishing and making available the *Executive Summary of the Constraints Report*, also available at open days and at the Information Centre in Castlebar, which provided an accessible overview to the Constraints Report;
- Promotion, via local radio and papers, of the commencement of the second round of consultation;
- Issue of a press release, to local media, with full details of the second round of consultation and tailored to individual regions with details of relevant open days in their county / local area;
- Media notification to local media inviting them to attend the open day in their local area and direct contact with individual journalists to brief them on detail of the Constraints Report and proposed open days;
- Radio interviews with local radio, conducted in and around the open days;
- Distribution of posters advertising the open days, to local libraries, via country librarians and also the direct postering in towns where open days were scheduled to take place;
- The establishment of a registered text service, 51444, for updates on the Grid West project;
- The issue of 269 letters and 147 emails to:
    - national elected representatives;
    - national elected representatives;
    - county councillors;
    - members of the general public who had previously engaged with the project;
    - community groups; and
    - business associations, providing them with details of the information brochure and forthcoming round of open days.
- The issue of an email to the Mayo and Galway County Community Forum, distributed on behalf of the project, to all community groups within their areas, and an email to the Leitrim

Development Company, circulated to all their members; and

- The issue of a follow up press release, and photography from the open days, with reminders for people to engage with the project using the various channels of communications.

Dedicated channels of consultation, open since the launch of the project, were available including the Information Centre at Linenhall Street, Castlebar, lo-call telephone number (1890 94 08 02), email address (gridwest@eirgrid.com), and project website (www.eirgridprojects.com/projects/gridwest).

5.4.2 Second Round of Consultation

A series of five open days were held across the region, from the 28th August to 5th September 2012.

Two open days were held in Mayo and one each in Leitrim, Sligo and Galway. The open days took place from 1.00pm – 8.00pm, to allow as many people as possible to attend. A total of 135 individuals attended over the course of the five open days. Members of the project team were on hand to greet members of the public at each day, and take them through details of the project and the Constraints Report and address any issues raised by the attendees and record feedback. On average, 12 to 15 Grid West project personnel were made available at each open day. These included environmental and engineering specialists, ensuring that where specific environmental queries were raised, a specialist was available to address these.

The open days took place at:

- Kiltane GAA Club, Belmullet, County Mayo - Tuesday 28th August 2012;
- Teach Laighne, Tubbercurry, County Sligo - Wednesday 29th August 2012;
- Landmark Hotel, Carrick-on-Shannon, County Leitrim - Thursday 29th August 2012;
- McWilliam Park Hotel, Claremorris, County Mayo - Tuesday 4th September 2012; and
- Raheen Woods Hotel, Athenry, County Galway - Wednesday 5th September 2012.

Project information was presented via display boards, which were set up at each of the open day locations. Members of the public were guided through these by members of the project team. These comprised:

- An overview of the general transmission network;
- A project Study Area Map;
- Key benefits from the project;
- Composite map with details of all the constraints captured;
- Population Density Map;
- Landscape Map;
- Ecology Map;
- Cultural Heritage Map; and
- Utilities and Infrastructure Map.

All of the constraints maps were available for viewing at each open day. Laptops were also available to the general public, who wished to view an interactive mapping programme, or to zoom in on detail in a particular area, or townland.

Available to the public were; the Information Brochure, Guide to the Constraints Report and an Executive Summary of the Constraints Report. Full copies of the Constraints Report, the EMF Brochure, and EirGrid's Approach to the Development of Electricity Transmission Lines Brochure were also available.

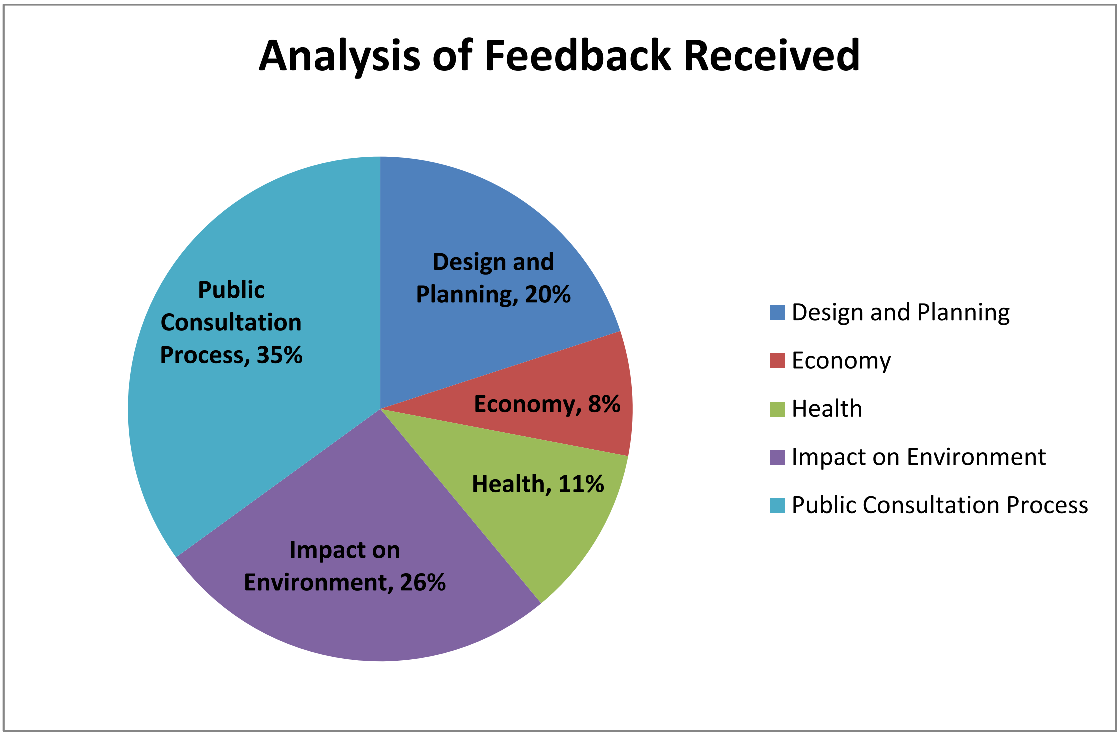
5.4.3 Feedback Received

Stakeholders provided feedback in the form of comments, observations and queries on specific issues. The general feedback received can be categorised under five broad themes, summarised below. Full detail on all feedback received is available in Volume 3 Appendix 5.1 'Report and Feedback on Second Round of Public Consultation' as published on the project website.

- ***Public Consultation Process***: The importance of comprehensive public consultation;
- ***Impact on the Environment:*** Comments on the potential impact on environment, ecology and heritage;
- ***Design and Planning:*** Structural design and queries relating to technology, substations and future developments;
- ***Health:*** Questions regarding perceived health effects in relation to electricity transmission lines; and
- ***Economy:*** The economic benefit of the project – jobs, renewable development, inward investment to the region.

Figure 5-1 Analysis of Feedback Received reflects the frequency of each theme which arose in engagements with stakeholders.

Figure 5-1 Analysis of Feedback on the Constraints Report and Mapping



5.5 RESPONSE TO CONSULTATION ON CONSTRAINTS REPORT

Following the publication of the Constraints Report on 21st August 2012, a focused period of four weeks to 21st September 2012 was allocated for the gathering of information and feedback from the general public, local interest groups, and both statutory and non statutory consultees. Any subsequent information gathered, since then, has nonetheless been included as part of the overall planning and evaluations process.

Examples of some issues raised by the general public, which were subsequently taken further into account by the project team include:

- The scenic beauty of Ballycroy National Park;
- Presence of a helicopter pad at Dooncarton Radar Station;
- The potential of heritage sites, including burial sites, around the Kiltane area;
- Whooper Swans near Turloughmore, Galway; and
- Local walkways were noted as significant, including a local walk between Drumsna and Jamestown, the Trollope Trail and the Foxford Way and Loop Walks around Callow Lake, and also mountain biking trails, particularly one west of Killagh.

6 ROUTE CORRIDOR OPTIONS

This chapter should be read in conjunction with Volume 3 Appendix 6.1 'Route Corridor and Substation Site Identification and Description' and Volume 3 Appendix 6.2 'Route Corridor Evaluation Report'.

6.1 ROUTE CORRIDOR IDENTIFICATION PROCESS

The project team identified potential route corridor options using elements of the Delphi process, which provides a structured approach to developing consensus. It was first developed by the Rand Corporation in the 1960's for forecasting, and has been used extensively in a variety of fields since. The traditional Delphi Process makes use of a panel of experienced specialists, selected in the areas of expertise required. The principle is that well informed individuals, using their insights and experience, when brought together in a panel which is chaired and facilitated, are better equipped to reach a workable outcome, so that the project team work collectively.

The essence of the Delphi process is the structuring of the group communication process, aimed at producing detailed critical examination and discussion. In the 'modified Delphi process' used by the project team in generating route corridor options the project team applied the process in a workshop format, rather than by relying on exchanged questionnaires as used in the original process.

The adopted process is based on the application of the expertise of project specialists in the following areas:

- Engineering;
- Ecology;
- Landscape;
- Cultural heritage;
- Geology;
- Water;
- Settlements; and
- Utilities & Infrastructure.

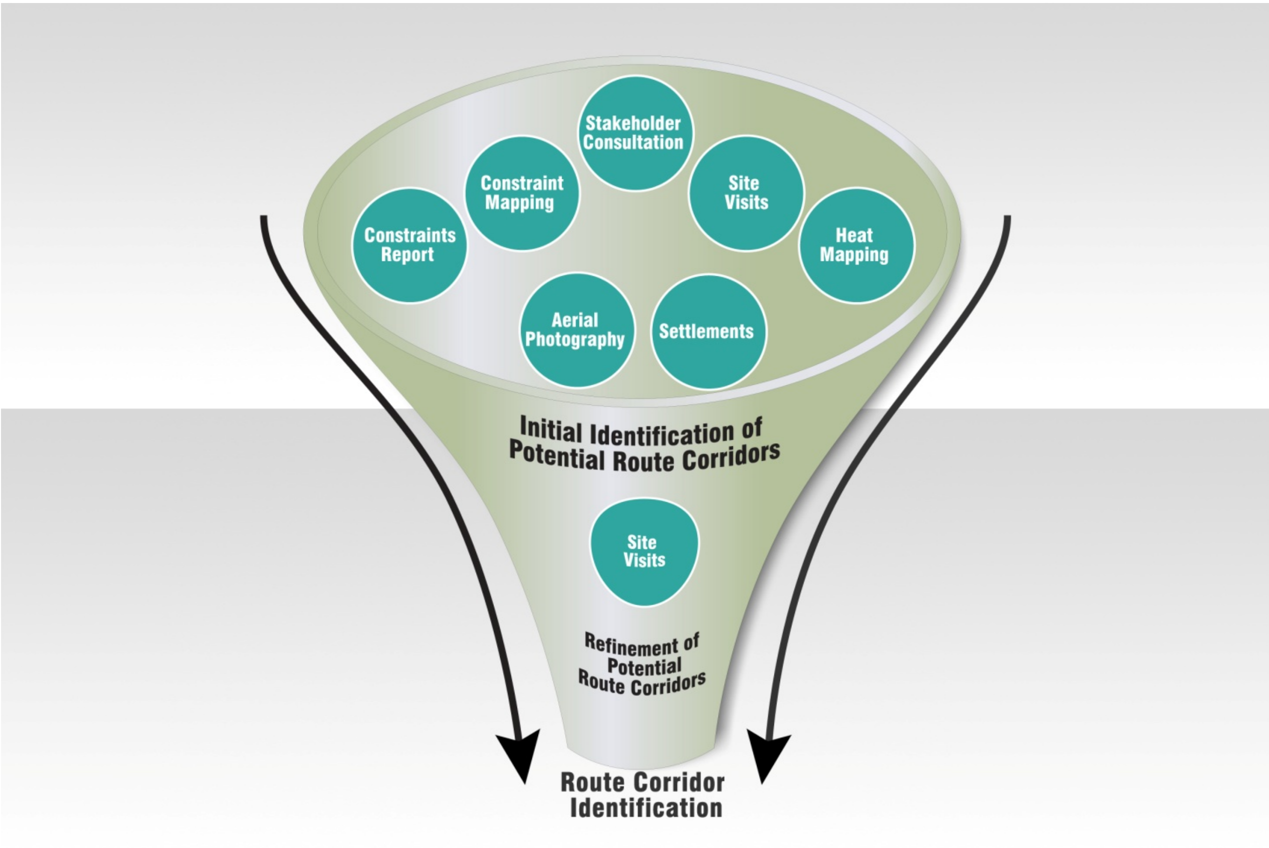
Each specialist was requested to identify their own route corridor options, independent from collaboration with other specialists, as an opening position, with least impact in their view, from their own specialist perspective. These would however be informed, by the mapping of the entire set of the constraints in the study area. The constraints were presented in the Constraints Report which had been collectively generated and agreed by the project team, and brought to public consultation.

The specialists presented their initial independent suggestions at a workshop, with the preferred position of each specialist subject to discussion and challenge. Over time the process of corridor identification was brought to an agreed outcome, by consensus in an iterative fashion with required refinements discussed and agreed between the specialists. This allows each voice to be heard, and consensus to be reached, but it is designed to limit the risk of '*group think*', by requiring independently generated route corridor options to be brought to the table in the first instance. The fundamental characteristics of the Delphi process, whereby independent opening positions are brought to a workshop and different viewpoints are brought to an agreed position by a facilitating chair, are valuable, and were used in the identification of the route corridor options for the Grid West project.

This process was supported by *ARC GIS spatial analysis*[21] techniques. Spatial analysis is an approach to analysing geographic data, based on geographic information systems (GIS). As the name implies, it allows analysis of information in a spatial or geographical context, it is outlined in greater detail in section 6.1.3 of this chapter. This spatial analysis technique produces a heat map, which identified the relative degree or density of constraints across the study area.

The project team also reviewed the EirGrid SEA Environmental Report of the Grid25 Implementation Programme, prior to developing the Grid West project approach to identification and evaluation of route corridors. The project team had regard to this report, in the development and application of the methodology for route corridor identification used for the Grid West project. The overall route corridor identification process used is summarised schematically in Plate 6-1.

Plate 6-1 Route Corridor Identification Process



[21] ArcGIS Spatial Analyst provides a range of spatial modelling and analysis tools. Using ArcGIS Spatial Analyst, one can create, query, map, and analyse cell-based raster data; query information across multiple data layers and fully integrate cell-based raster data with traditional vector data sources.

6.1.1 Constraints Report and Mapping

The starting point for the identification of potential route corridors is the constraints mapping and associated Constraints Report for the Grid West project.[22] The key environmental constraints maps are summarised under the following headings; Ecology, Landscape, Geology, Water, Settlements, Cultural Heritage and Utilities & Infrastructure. These constraints were the key factors in influencing the identification of the route corridor options.

Using the created GIS constraints mapping, as detailed above (but before development of full heat mapping), the project team first determined those 'key sensitive areas' where it is desirable to avoid locating route corridors, as the first step in a strategy grounded on the fundamental principle of impact avoidance. This process helps to define less constrained areas, which forms the basis for the future route corridor selection process. The identification of 'white space', or least constrained areas, is a basic principle in the development of route corridors options.

6.1.2 Specialists' Initial Identification of Corridors

Following the preparation of the constraints mapping, and the mapping of the key sensitive areas, the specialists were requested to identify a number of potential route corridor options, from their own specialist perspective. They were asked to do so, considering the key sensitive area constraints, and the constraints mapping, particularly taking into account the constraints imposed by their own specialism. The specialists were tasked with identifying route corridor options in those previously identified least constrained areas (white space), where possible. As outlined above, this work was initially carried out by each specialist working independently of all other specialists.

Under the modified Delphi process, route corridor identification was initiated with each of the specialists in isolation, each nonetheless had sight of all the constraints mapping, but without any route corridors shown. This meant that they were identifying potentially feasible route corridors, from their own specialist perspective, but without any conditioning by any other specialist at that point. This allowed for an informed selection by each of the specialists concerned, in advance of a workshop discussion, where any element of group conditioning of initial positions, is deliberately avoided.

6.1.3 Preparation of Heat Mapping

On the Grid West project the primary basis of identifying route corridor options is founded upon the expertise and experience of the specialists in the project team. In the Grid West study area, as detailed in the Constraints Report, there are more than 80 identified constraints layers, of different importance across the study area, and many of which overlap.

The project team identified the need for a visualisation support, and investigated the application of a GIS tool, *ArcGIS Spatial Analyst*, which acted as a '*decision support tool*' to support the specialists in their route corridor selection process. This process produced a *'heat map'* which identified the relative degree or density of constraints across the study area. This '*heat map'* was produced in parallel with the first iteration of route corridor identification. The heat map included the categorisation of constraints into primary, secondary and other constrained areas, as defined below, to allow the specialists to

[22] http://www.eirgridprojects.com/projects/gridwest/constraintsreport/#d.en.10716

understand the extent, degree of accumulation, and relative impact of various constraints on the route corridors.

For the Grid West project, the ARCGIS Spatial Analyst support tool allowed the project team to generate a heat map illustrating the relative degree of constraints between the three nodal end points (or substations). For the purpose of heat mapping all constraints were categorised by agreement into three groups (Primary Constraints, Secondary Constraints and Other Constraints).

- Primary Constraints are those constraints which should be avoided. Examples include population centres, Natura 2000 sites, National Monuments. If it is possible to locate corridors away from Primary Constraints, then this is a priority design objective.
- Secondary Constraints should be avoided, where possible. Mitigation measures should be considered, if unavoidable. Examples include Sites & Monuments Records (SMR's), river crossings.
- Other Constraints which should be taken into account, which cumulatively can influence route corridor identification, but individually do not influence route corridor identification. Examples include gas pipelines, railway lines. These are primarily considered at detailed line design stage.

Each of those constraint layers had buffer zones[23] assigned by each specialist, appropriately sized, having regard to the impact they were seeking to avoid. These buffer zones allowed the area potentially impacted by the constraint to be mapped, for example, a scenic view point carries a buffer zone assigned, to include the area seen from the view point.

The three groups of layers were assigned a nominal value, only for collective spatial analysis purposes. Primary constraints were assigned a value of 50, secondary constraints a value of 10 and other constraints were given a value of 2.

The resulting Heat Map for the study area is shown in Figure 6-1 'Heat Mapping of the Study Area' herein. This map is also available in Volume 2 Figure 6.1 'Heat Mapping of the Study Area' as an A0 drawing.

6.1.4 Other Considerations

As detailed above, the approach taken for the Grid West project is that the primary basis of identifying route corridor options should be founded upon the expertise and experience of the specialists on the project team, with the ARCGIS Spatial Analyst used as a supportive tool. However other tools which were used to identify route corridors include:

- Aerial photography; and
- Geodirectory (one off housing / ribbon development).

Aerial photography was used as a verification tool during the site visits, for example it allowed the project team to check land use type, and verify amenity areas (i.e. playing pitches) and to corroborate

[23] Buffer Zone: is a zone around a map feature measured in units of distance. These buffer zones are to allow the area potentially impacted by the constraint to be meaningfully mapped, for example a scenic view point carries a buffer zone assigned, to include the area seen from the view point. However, it should not be taken as being the actual extent of influence of that feature – this can only be confirmed by more detailed environmental assessment.

other datasets, in that it verified building type, which had been identified by the geodirectory database. It also allowed the project team to assess the extent of features, such as widths of rivers.

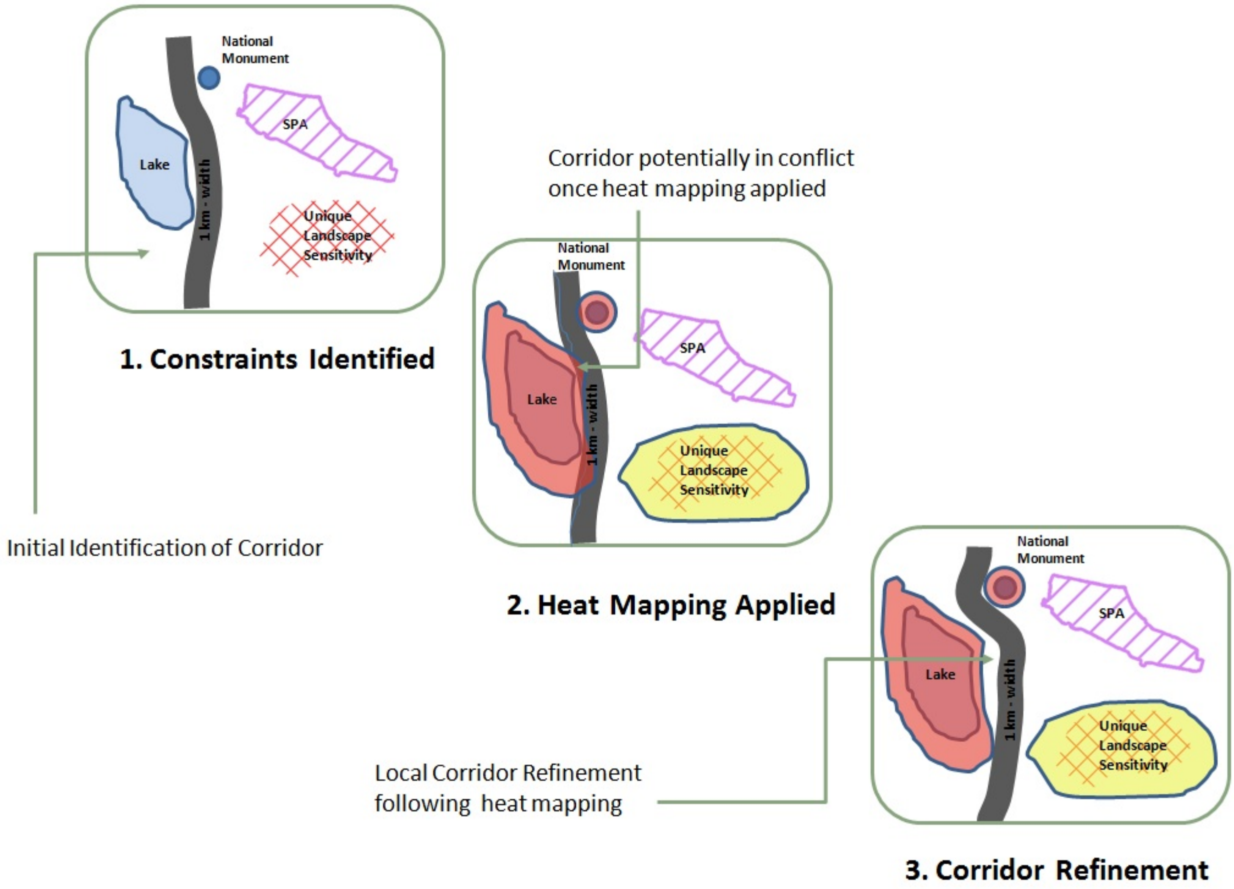
The geodirectory database was used to identify all 'one off' housing and ribbon development, which was not captured in the Constraints Mapping. This allowed the project team to consider clusters of dwellings when identifying route corridor options.

6.1.5 Refining Route Corridors

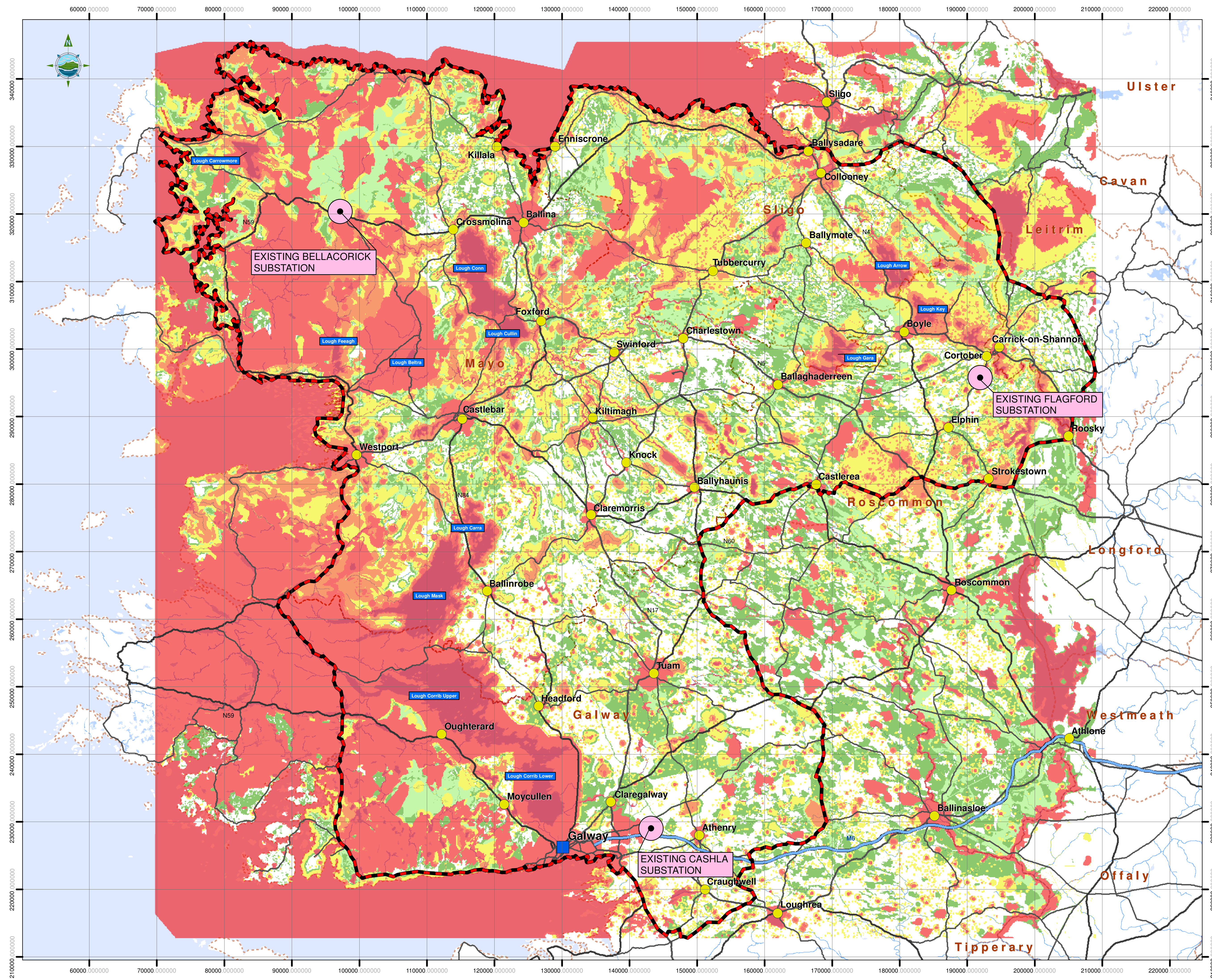
The refinement of route corridors is an iterative process, with initially identified corridors being refined following review of heat mapping, initial site visits, input from stakeholder consultation and specialist input.

The identified route corridors were taken to the next stage of verification, which involved detailed site visits including reviewing aerial photography and more detailed topographical data. The purpose of these site visits was to supplement mapping, verify the information gathered during the desktop study including the heat mapping and ultimately refine and confirm the potential route corridor options. Refinements to the route corridor options included ensuring greater distance to houses, specifically to take account of linear residential development along county roads, refinements to avoid higher ground, and avoiding other physical, cultural or community land use features not heretofore captured on mapping. In addition to this, the key specialists completed and updated site visits, in order to review and validate refined corridors, in relation to their particular constraints. Refer to Plate 6-2 which details the Route Corridor Refinement Process.

Plate 6-2 Route Corridor Refinement Process



The final refined potential route corridor options are shown, against the geography of the study area, and superimposed on the Heat Mapping, in Figure 6-2 'Heat Mapping of the Study Area with Route Corridor Options'. This map is also available in Volume 2 Figure 6.2 'Heat Mapping of the Study Area with Route Corridor Options' as an A0 drawing.



Proposed Study Area
City
Town
County Boundary
Motorway
National Roads
Regional Road
River
Lakes
Substation Site Locations

HEAT MAP

Value

- 2
- 3-9
- 9-19
- 19-49
- 49-380

0 2.5 5 10 15 20
Kilometres

NOTES

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3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Issue	Date	Description	By	Chkd.
A	22-02-13	ISSUED	G.F	M.H.

Client: EIRGRID

Project: THE GRID WEST PROJECT

Title: HEAT MAP OF THE STUDY AREA

Scale @ A3: 1:500,000

Prepared by: G.Fil | Checked: M.Hogan | Date: February 2013

Project Director: M.Garrick

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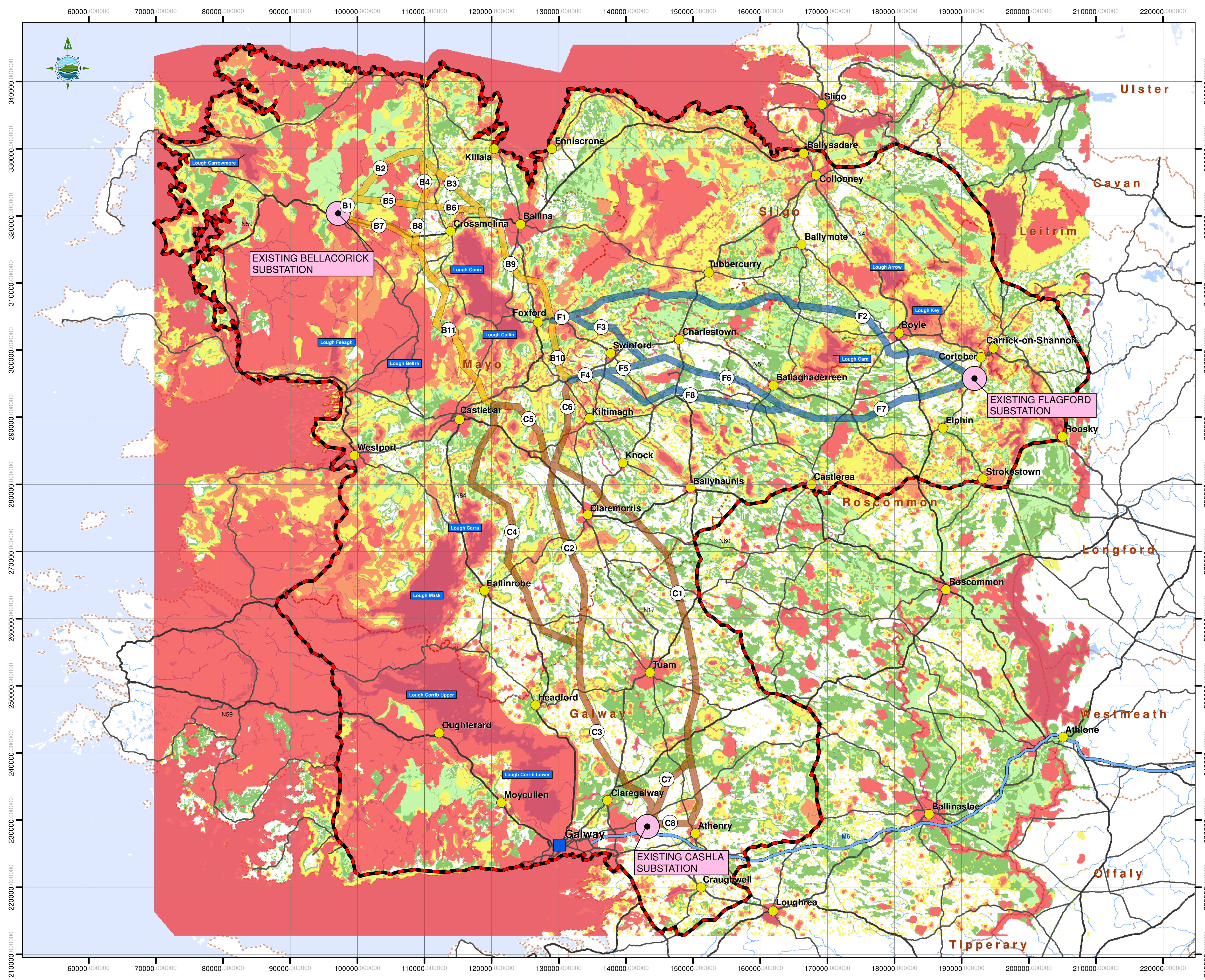
Figure 6-1 | A



Proposed Study Area
City
Town
County Boundary
Motorway
National Roads
Regional Road
River
Lakes
Substation Site Locations

Identified Corridors

- B1 Bellacorick Route Corridor Options i.e.B1
- C1 Cashla Route Corridor Options i.e. C1
- F1 Flagford Route Corridor Options i.e. F1

HEAT MAP

Value

- 2
- 3-9
- 9-19
- 19-49
- 49-380

0 2.5 5 10 15 20 Kilometres

NOTES

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Issue	Date	Description	By	Chkd.
A	22-02-13	ISSUED	G.F	M.H.

Client: EIRGRID

Project: THE GRID WEST PROJECT

Title: HEAT MAPPING OF THE STUDY AREA WITH ROUTE CORRIDOR OPTIONS

Scale @ A3: 1:500,000

Prepared by:	Checked:	Date:
G.Fil	M.Hogan	February 2013

Project Director: M.Garrick

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Figure 6-2 A

6.2 DESCRIPTION OF ROUTE CORRIDOR OPTIONS

6.2.1 Introduction

Following the identification of the initial route corridor options as outlined in section 6.1 of this chapter, a number of refined potential route corridor[24] options were identified in which to site a 400kV transmission line. In total 16 route corridor options have been identified. The refined route corridors are all of a notional width of 1km, this is in order to facilitate a robust comparative analysis, and they are envisaged to be of adequate width in which to subsequently identify a line route.

These route corridor options have been divided into three representative locational 'groups'; the Bellacorick route corridors, the Cashla route corridors and the Flagford route corridors. This grouping facilitates combining route corridor sections, so that the least constrained route corridor option from Bellacorick (to the north) could link with the least constrained route corridor options to Flagford (to the east) or to Cashla (to the south). These route corridor options (or sections of corridors) are categorised as follows:

- Route corridors associated with Bellacorick substation, have a prefix B, i.e. B1, B2 etc;
- Route corridors associated with Flagford substation, have a prefix F i.e. F1, F2 etc; and
- Route corridors associated with Cashla substation, have a prefix C i.e. C1, C2 etc.

The route corridor options associated with the Bellacorick group of route corridor can be linked to the route corridor options associated with either the Flagford or Cashla group of route corridor options.

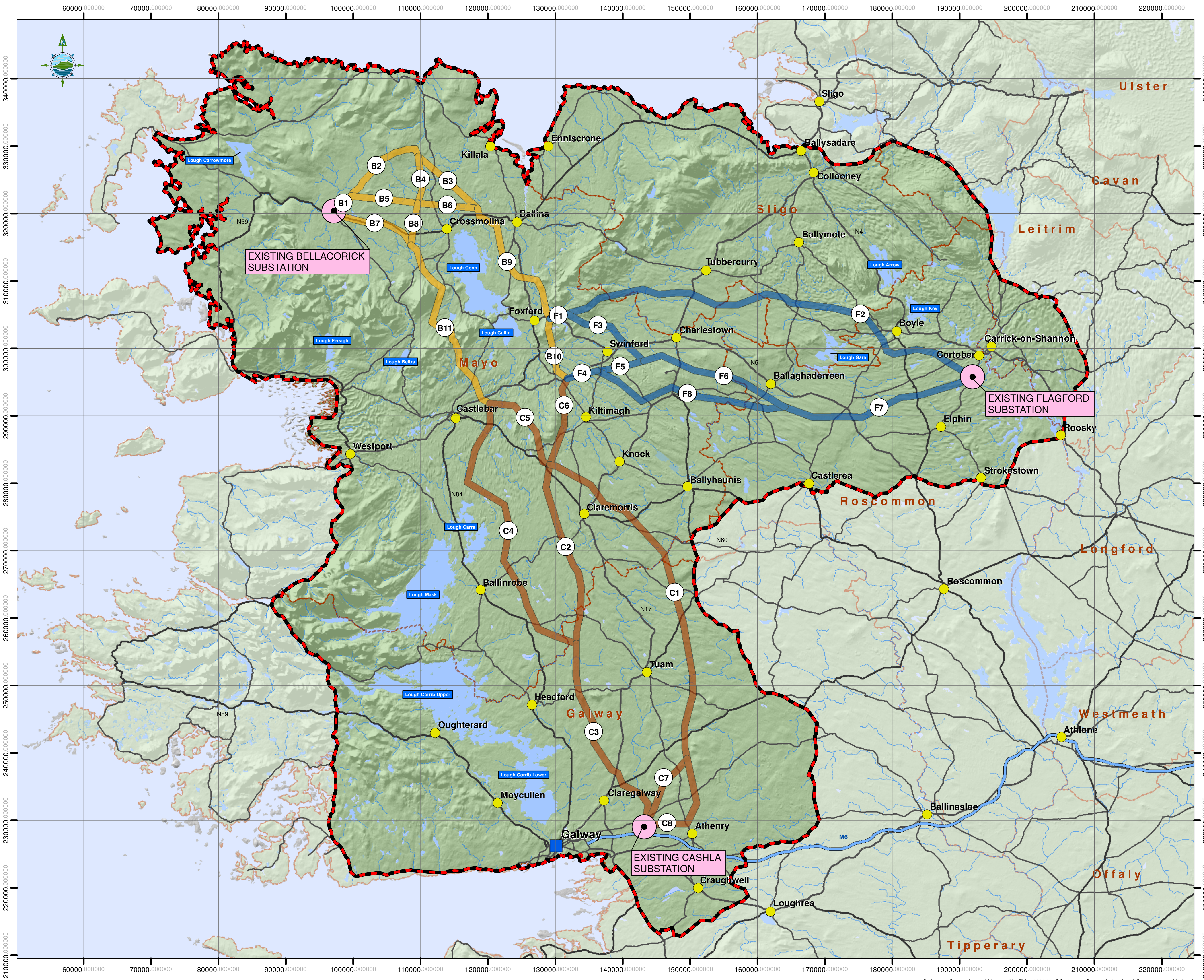
Refer to Figure 6-3 'Potential Route Corridor Options' herein.

Composite route corridor options are described by adding the relevant sections of each of the identified corridors, for example, B1/B2/B3/B9 makes up one composite route corridor. Refer to Table 6-1 for a list of composite route corridor options.

Table 6-1 List of Composite Route Corridor Options

Bellacorick	Cashla	Flagford
B1/B2/B3/B9	B10/ C6/C1/C7	F1/F2
B1/B2/B4/B8/B11	B10/ C6/C1/C8	F1/F3/F6/F7
B1/B5/B6/B9	C5/C1/C8	B10/ F4/F5/F6/F7
B7/B11	C5/C2/C3	B10/ F4/F8/F7
B1/B5/B8/B11	C5/C1/C7	
	B10/ C6/C2/C3	
	C4/C3	

[24] Potential Route Corridor is a linear band of land, of a notional 1km in width, between the nodal substations, routed so as to avoid as many environmental, technical and other constraints as possible, and within which a high voltage line route can later be positioned. In areas where there are white spaces/ least constrained areas, length of corridor was considered.



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Proposed Study Area
City
Town
County Boundary
Motorway
National Roads
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River
Lakes
Substation Site Locations

Identified Corridors

B1 Bellacorick Route Corridor Options i.e.B1
C1 Cashla Route Corridor Options i.e. C1
F1 Flagford Route Corridor Options i.e. F1

0 2.5 5 10 15 20
Kilometres

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A	22-02-13	ISSUED	G.F	M.H.
Issue	Date	Description	By	Chkd.

Client: EIRGRID

Project:

THE GRID WEST PROJECT

Title:

POTENTIAL ROUTE CORRIDORS OPTIONS

Scale @ A3: 1:500,000

Prepared by: G.Fil
Checked: M.Hogan
Date: February 2013

Project Director: M.Garrick

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Figure 6-3

A

6.2.2 Description of Route Corridor Options

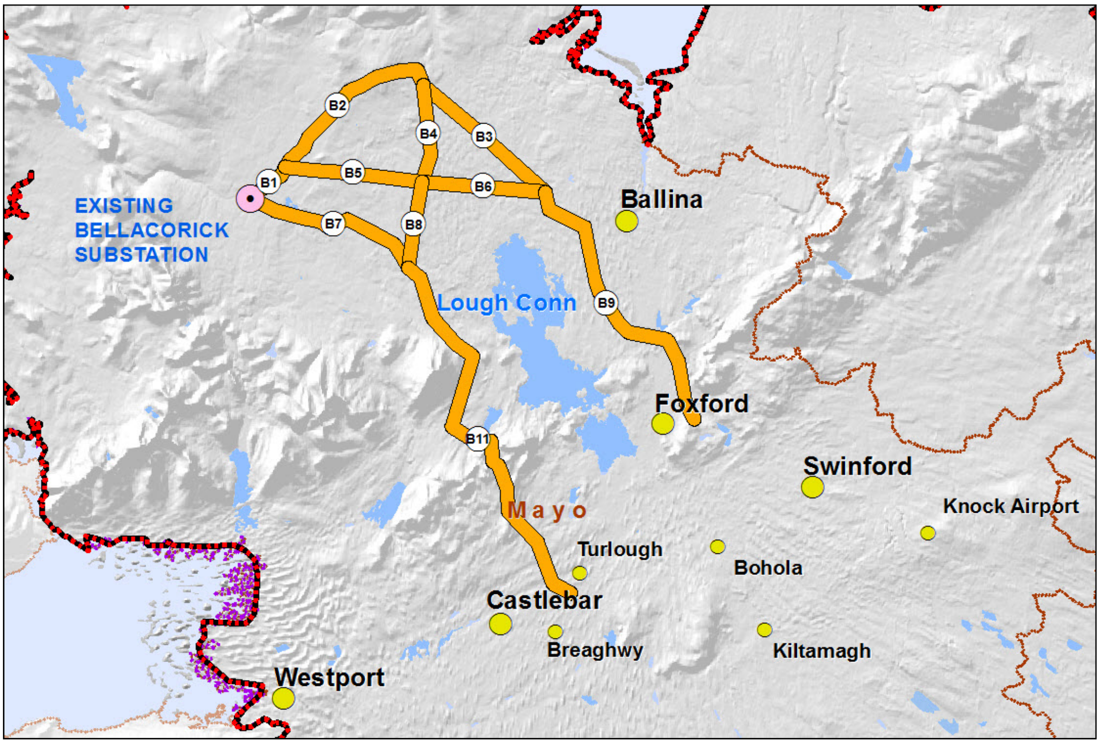
Table 6-1 lists of all identified route corridor options, with Figures 6-4 to Figure 6-6 depicting each route corridor option, combined within that locational group of the study area, e.g. figure 6-4 illustrates all route corridor options in the Bellacorick group of route corridors.

Note that there may be some instances where the linking of route corridors is not considered to be practical, for example linking a Bellacorick route corridor option to the west of Lough Conn, to a northern route corridor option towards Flagford, is not considered a reasonable link, due to the significant additional length of corridor required to connect both.

Route corridor section B10 is the southernmost Bellacorick route corridor, which may be included as part of three of the Cashla route corridor options and two of the Flagford route corridor options. It is, in essence, a link which is required to join certain Flagford and Cashla route corridor options, to the Bellacorick route corridor options.

6.2.3 Bellacorick Route Corridor Options B1, B2, B3, B4, B5, B6, B7, B8 & B9

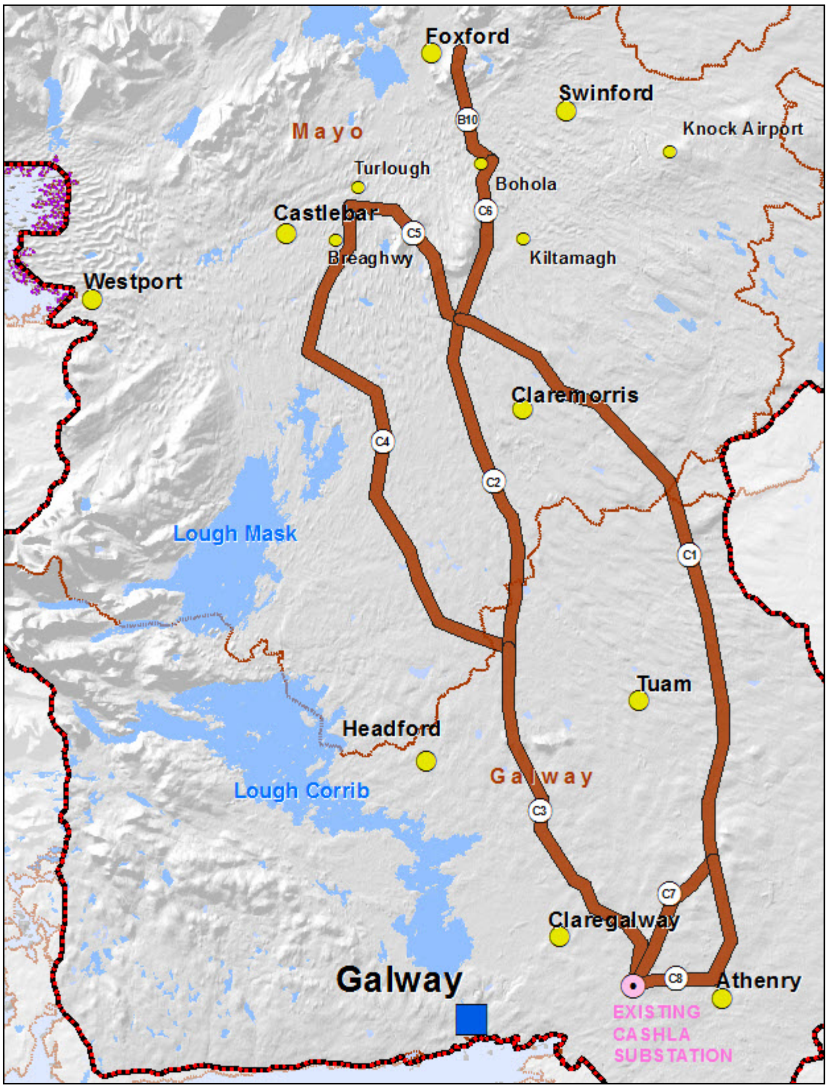
Figure 6-4 Route Corridor Options from Existing Bellacorick Substation Site



- Possible route corridor options include B1/B2/B3/B9, B1/B2/B4/B8/B11, B1/B5/B6/B9, B7/B11 and B1/B5/B8/B11;
- Note that all route corridor options emanate from the existing Bellacorick substation site, but these route corridors also accommodate the other potential substation location options within the Bellacorick substation study area;
- The B1/B2/B3/B9 and B1/B5/B6/B9 route corridor options run east of Lough Conn; and
- The B1/B2/B4/B8/B11, B7/B11 and B1/B5/B8/B11 route corridor options run west of Lough Conn.

6.2.4 Cashla Route Corridor Options C1, C2, C3, C4, C5, C6, C7, C8 & B10

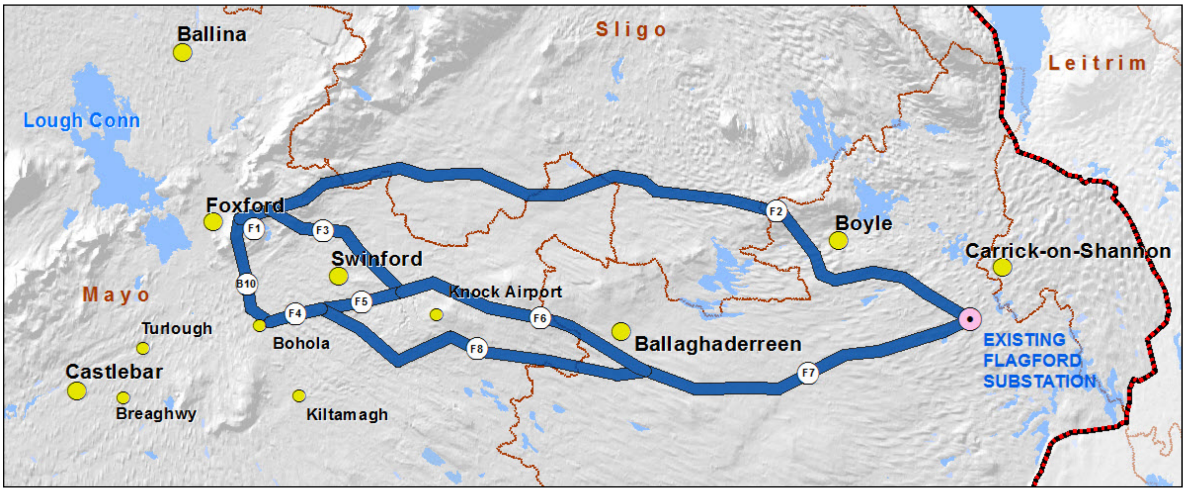
Figure 6-5 Route Corridor Options to the Existing Cashla Substation Site



- Possible route corridor options include B10/C6/C1/C7, B10/C6/C1/C8, C5/C1/C8, C5/C2/C3, C5/C1/C7, B10/C6/C2/C3 and C4/C3;
- Note that all route corridor options terminate at the existing Cashla substation site, but these route corridors also accommodate the other potential substation site area options within the Cashla substation study area;
- Route corridor sections C4 and C5 emanate from the west side of Lough Conn;
- Route corridor section B10 and C6 emanates from the east side of Lough Conn; and
- Route corridor section C1 is the most easterly route corridor option, while route corridor section C4 is the most westerly route corridor option.

6.2.5 Flagford Route Corridor Options F1, F2, F3, F4 & B10

Figure 6-6 Route Corridor Options to the Existing Flagford Substation Site



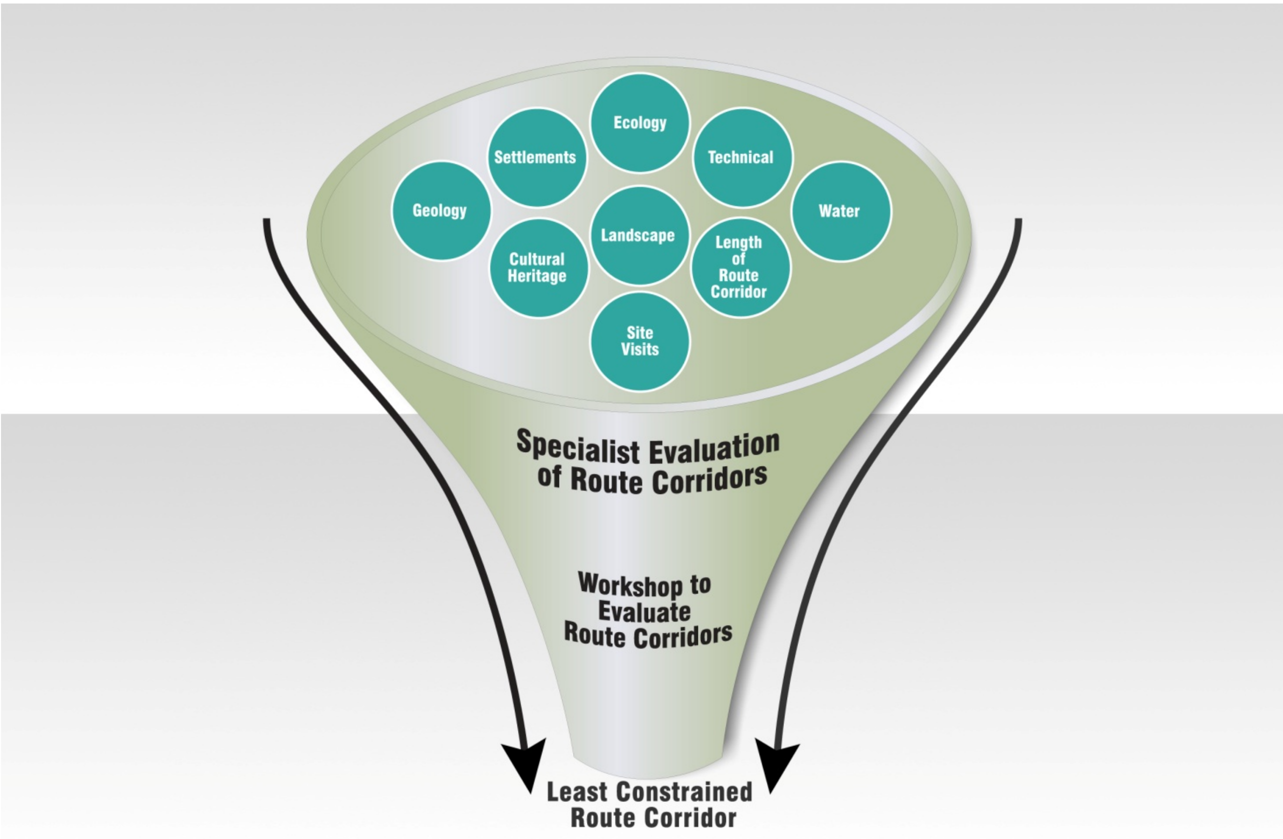
- Possible route corridor options include F1/F2, F1/F3/F6/F7, B10/F4/F5/F6/F7 and B10/F4/F8/F7;
- Note that all route corridor options terminate at the existing Flagford substation site, but these route corridors also accommodate the other potential substation site area options within the Flagford substation study area;
- Route corridor option F1/F2 is the most northerly of all the Flagford route corridor options; and
- All of the other route corridor options link with section F7 route corridor, south of the town of Ballaghaderreen.

6.3 EVALUATION OF ROUTE CORRIDOR OPTIONS

6.3.1 Introduction

This section sets out how the potential route corridor options (as identified in section 6.2 of this chapter) were evaluated and compared, in order to identify a least constrained route corridor option for the Bellacorick, Cashla and Flagford group of corridors. A least constrained route corridor option, associated with each of these groups, was identified, taking into account a set of comparative evaluation criteria. Plate 6-3 illustrates the Route Corridor Evaluation Process.

Plate 6-3 Route Corridor Evaluation Process



6.3.2 Route Corridor Evaluation Criteria

The project team identified a number of technical and environmental criteria which could comprise appraisal criteria for route corridor evaluation. These criteria derived from the professional expertise of the project team, the technical and environmental constraint assessments carried out in respect of the potential route corridors and from information elicited from informal and formal stakeholder and public consultation.

From this range of criteria, each specialist identified a set of key criteria which they considered would influence the evaluation of route corridors from their particular specialist perspective. Table 6-2 outlines the criteria which were agreed by the specialists to evaluate route corridor options.

Table 6-2 Criteria for Route Corridor Evaluation

Evaluation Criteria		
Ecology • Potential Impact on Designated Sites for Nature Conservation • Potential Impact on Wetlands • Potential Impact on Significant Bird Sites/Flightlines • Potential Impact on Fresh Water Pearl Mussel Waters • Potential Impact on Annex 1 Habitats/Annex 2 Species	**Settlements** • Number of dwellings within the 1km route corridor • Indicative population density within the 1km route corridor	**Technical** • Geotechnical (length over peat and karstified rock) • Implementation (e.g. the inherent difficulties associated with the route corridor and the relative ease of developing a 400kV line in the route corridor) • Access for Construction and Maintenance. • Impact of utilities & infrastructure crossings.
Landscape • Potential Impact on International and National Landscape Designations • Potential Impact on County Landscape Designations • Potential Impact on Significant Recreational Areas • Potential Impact on Significant Designed Landscape Features • Length of Corridor on Elevated Land in Relation to Key Receptors • Potential Impact on Landscape Character	**Cultural Heritage** • Potential Impact on Archaeological Sites • Potential Impact on Architectural Sites	**Length of Route Corridor** • The approximate length of an indicative line route within the route corridor
Geology • Potential Impact on Proposed Geological National Heritage Areas (NHA's) • Potential Impact on County Geological Sites (CGS)	**Water** • Potential Impact on River Crossings • Potential Impact on Lakes	

From the criteria which were identified, a number of criteria were considered generally 'Neutral' for the purpose of the comparative evaluation of route corridor options, in that the results are broadly the same for every route corridor option in the overall study area. These include those:

- For which it is reasonably assumed that mitigation measures can, and will, be implemented and which will therefore be the same, or similar, for each potential route corridor; and
- Issues more appropriately addressed during subsequent detailed route design, preparation of EIS and planning stages.

These issues relate to the following criteria:

- Safety and Construction;
- Other Technical Considerations;
- Air Quality;
- Electrical and Magnetic Fields; and
- Other Criteria.

Therefore, for the purpose of the comparative route corridor evaluation process, the 'Neutral' criteria have been omitted in order to focus on other criteria which may differentiate the route corridor options, and specifically on whether a particular route corridor option is 'more constrained' or 'less constrained' in respect of that particular criterion.

6.3.3 Environmental Overview and Comparison of Route Corridor Options

Each specialist provided a description of the route corridor options taking into account the relevant constraints and particularly the identified evaluation criteria which influenced the evaluation of route corridor options. This evaluation is divided into the three locational groups; Bellacorick, Cashla and Flagford route corridor options. This was completed for the following constraints:

- Settlements;
- Ecology;
- Landscape;
- Geology;
- Water;
- Cultural Heritage;
- Technical; and
- Length of Route Corridor.

6.3.4 Comparative Evaluation of Route Corridor Options

Following the appraisal of each route corridor option in relation to the evaluation criteria, each specialist considered whether a particular route corridor option is 'more constrained' or 'less constrained' (based on information and knowledge obtained to date), in respect of a particular criterion in comparison with another route corridor option of the same group e.g. the Bellacorick route corridor options are evaluated against each other.

This information then allowed for a comparative multi criteria evaluation of the route corridor options in order to identify a least constrained route corridor option to Bellacorick, Cashla and Flagford.

As stated herein, the potential route corridor options have been divided by means of representative locational 'groups' into the Bellacorick route corridors, the Cashla route corridors and the Flagford route corridors. Each specialist recorded, whether a corridor is 'more constrained' or 'less constrained' from their specialist perspective for each of these groups.

No quantitative or weighting system has been applied to the criteria in order to evaluate the route corridor options. It is a qualitative evaluation based on professional expertise and experience which is applied to each route corridor against the identified criteria, as set out in Table 6-2. This qualitative approach thus records whether in respect of a certain criterion, a corridor is 'more constrained' or 'less constrained', based on information and knowledge obtained to date. This evaluation demonstrates the clear, logical and transparent rationale for the conclusions reached.

When comparing one criterion against another, emphasis is also placed on the significance of the likely impact, and whether or not, potential impact can be mitigated. It is reasonable to consider that if there are likely to be long term adverse significant residual impacts which cannot be mitigated, with a particular criterion; these are deemed to be more sensitive than a potential impact which can be mitigated, when comparing route corridor options.

Consideration is also given as to whether the indicative line route within the 1km wide corridor can avoid a constraint at the line design stage e.g. for known cultural heritage sites and geological features.

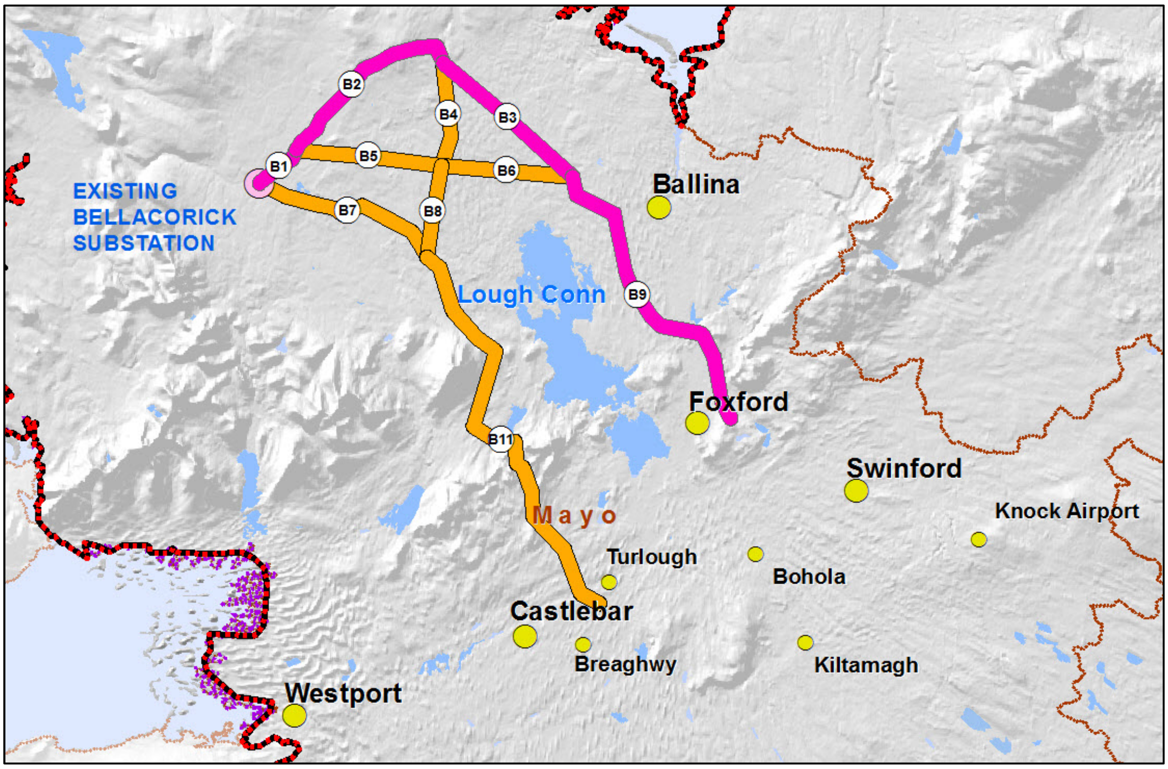
Finally, the length of route corridor (line route) has implications in terms of overall environmental impact and the costs associated with the Grid West project. As a broad baseline position, it is generally considered that the shortest line route will have the lowest environmental footprint, however this is not necessarily always the case. In addition, generally the cost of the line will be proportional to its length, although conditions on the route can have a major impact on the cost. For example, it may be more cost effective to route a line a long distance over good ground rather than to route a line over a shorter distance with poor ground conditions.

A least constrained route corridor option, associated with each of these groups, was identified taking into account the comparative evaluation criteria completed by each specialists. Volume 3 Appendix 6.3 'Route Corridor Evaluation Report', chapter 3, sets out matrices which captures the preference for one route corridor option, over another route corridor option, taking into account the balance of all criteria in accordance with the 'more constrained' or 'less constrained' evaluation method.

6.3.5 Bellacorick Route Corridor Options

Taking all constraints into account, the least constrained route corridor for the Bellacorick group of route corridor options is B1/B2/B3/B9. Figure 6-7 shows this least constrained Bellacorick route corridor option - B1/B2/B3/B9.

Figure 6-7 Least Constrained Bellacorick Route Corridor Option B1/B2/B3/B9



- In terms of potential impact on ***settlements*** i.e. the number of dwellings within a route corridor, B1/B2/B3/B9 is considered more constrained than any of the other route corridor options located to the west side of Lough Conn.
- In terms of ***ecological*** constraints, route corridors B1/B2/B3/B9, followed by B1/B2/B4/B8/B11, are considered less constrained route corridor options, as they avoid the Bellacorick Bog SAC complex. All other route corridors pass through the Bellacorick Bog SAC complex, carrying significant impediment under ecology in that they would likely cause a direct impact to Bellacorick Bog, specifically to the lowland blanket bog habitat, a qualifying feature of the site. Combinations of route corridors which include B1/B2/B3/B9 and B1/B2/B4/B8/B11, therefore, avoid impacts on the Bellacorick Bog SAC.
- In terms of ***landscape*** constraints, B1/B2/B3/B9 is considered less constrained than B1/B2/B4/B8/B11, B7/B11 and B1/B5/B8/B11. B1/B2/B3/B9 is slightly more constrained than route corridor B1/B5/B6/B9, as route corridor B1/B5/B6/B9 travels over a shorter distance of open bog landscape.
- In relation to ***cultural heritage*** constraints, route corridor option B1/B2/B3/B9 is considered a more constrained route corridor compared to the other route corridor options. However there will

be no direct impact on the cultural heritage resource as it will be possible to avoid all known cultural heritage sites during the line design stage.

- In terms of ***technical*** constraints, B1/B2/B3/B9 is considered less constrained than B1/B2/B4/B8/B11, B7/B11 and B1/B5/B8/B11, because these route corridors are routed down the west side of Lough Conn where difficult terrain and extended lengths of karstified rock, make implementation and access more difficult compared to options on the east side of Lough Conn. B1/B2/B3/B9 is also technically less constrained than route corridor B1/B5/B6/B9 as this corridor traverses a very short length of designated area where implementation and access is considered more difficult.
- The characteristics of route corridor options in the Bellacorick group of route corridors are broadly similar in terms of ***geology and water***, and are therefore considered non differentiating constraints in terms of evaluation.
- In terms of ***length of corridor*** B1/B2/B3/B9 is longer than B1/B5/B6/B9 and B7/B11, as it follows a north easterly direction from the existing Bellacorick substation in order to avoid impact on the Bellacorick Bog SAC complex. B1/B2/B3/B9 is similar in length to B1/B5/B8/B11, it is shorter than B1/B2/B4/B8/B11 by approximately 10km.

The evaluation of the Bellacorick group of route corridor options is presented schematically in a matrix format in Table 6-3. As shown in the matrix legend below, the more constrained route corridor options for each criterion are highlighted in dark blue, whilst the less constrained routes are highlighted in lighter colours toward yellow.

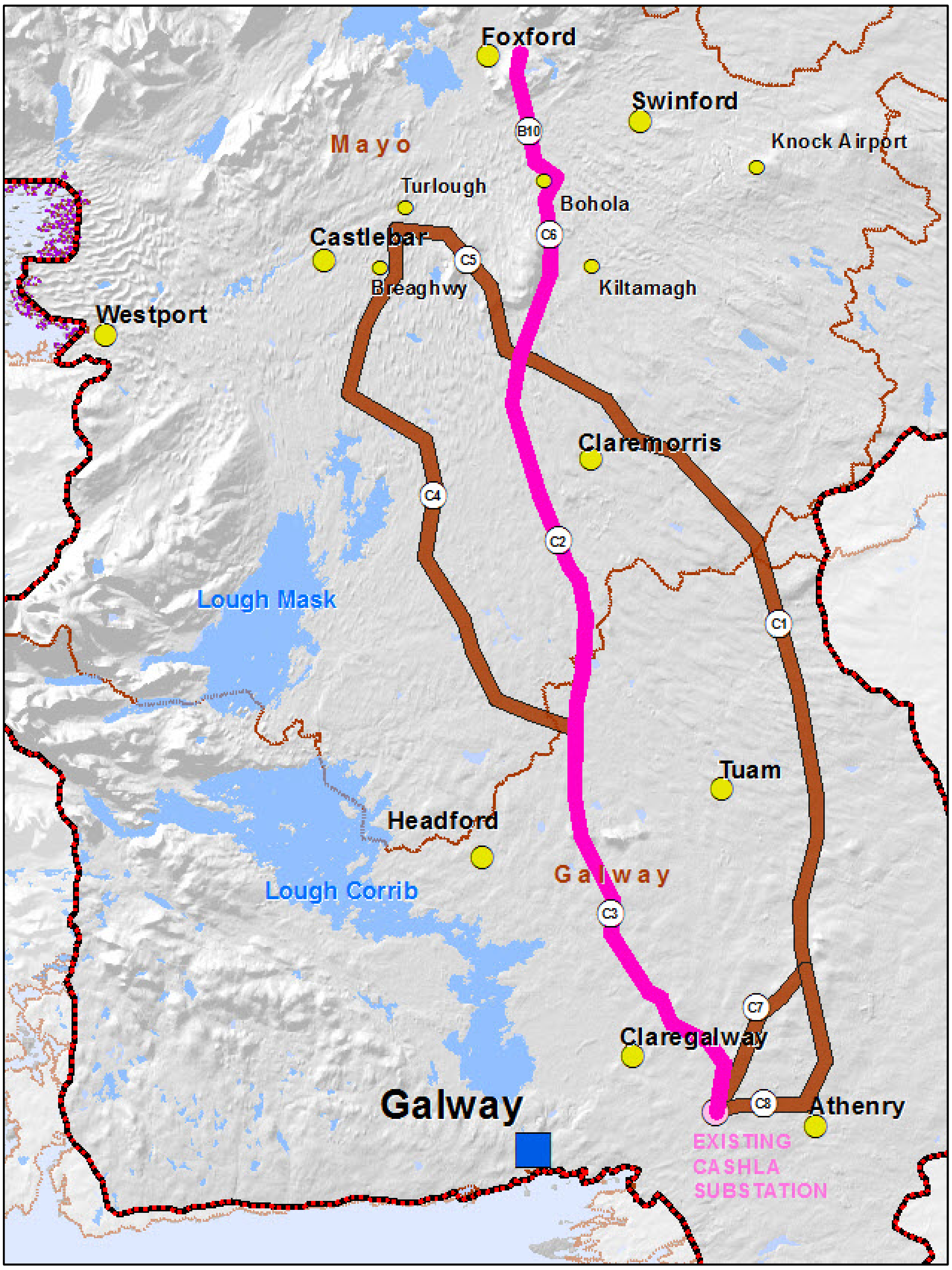
Table 6-3 Bellacorick Route Corridor Options Evaluation

Constraints	B1/B2/B3/B9	B1/B2/B4/B8/B11	B1/B5/B6/B9	B7/B11	B1/B5/B8/B11
Settlements					
Ecology					
Landscape					
Cultural Heritage					
Technical					
Geology					
Water					
Length of Line					

6.3.6 Cashla Route Corridors

Taking all constraints into account, the least constrained route corridor for the Cashla group of route corridor options are C5/C1/C7, followed by C5/C2/C3, and C5/C1/C8. However, it must be recognised that these particular combinations link to the Bellacorick route corridor options to the *west* side of Lough Conn, which are more constrained in the context of the Bellacorick group of route corridor options. Route corridor B10/C6/C2/C3, which links to the Bellacorick route corridor options to the *east* side of Lough Conn, is the next least constrained among the Cashla group of route corridor options. Figure 6-8 shows the least constrained Cashla route corridor option - B10/C6/C2/C3.

Figure 6-8 Least Constrained Cashla Route Corridor Option B10/C6/C2/C3



B10/C6/C2/C3 is less constrained than the other three Cashla route corridor options, which link to the east side of Lough Conn (namely C4/C3, B10/C6/C1/C7 and B10/C6/C1/C8), for the following reasons:

- In terms of potential impact on ***settlements,*** B10/C6/C2/C3 has fewer dwellings per kilometre compared to route corridor B10/C6/C1/C7 and B10/C6/C1/C8. Route corridor C4/C3 has fewer numbers of dwellings than the three other route corridor options.
- In terms of ***ecological*** constraints, B10/C6/C2/C3 is considered less constrained than C4/C3 but slightly more constrained than B10/C6/C1/C7 and B10/C6/C1/C8.
- In terms of ***landscape*** constraints, B10/C6/C2/C3 is considered similar in terms of constraints to route corridor options B10/C6/C1/C7 and B10/C6/C1/C8, this is because the B10 and C6 sections cross over a constrained area south of Foxford and higher ground south of Bohola. Route corridor C4/C3 is considered a more constrained route corridor option than all three other route corridor options.
- In terms of ***cultural heritage*** constraints, all four eastern Cashla route corridor options are considered more constrained, with C4/C3 being considered the most constrained of the Cashla group of route corridor options. However as noted previously there will be no direct impact on the cultural heritage resource as it will be possible to avoid all known cultural heritage sites during the line design stage.
- In terms of ***technical*** constraints B10/C6/C2/C3 is considered a less constrained route corridor option compared to all others, as it is the most direct route corridor, has good access and has a less number of implementation constraints.
- The characteristics of route corridor options in the Cashla group of route corridors are broadly similar in terms of ***geology and water*** and are therefore considered non differentiating constraints in terms of evaluation.
- In terms of ***length of corridor***, B10/C6/C2/C3 (82.3km) is shorter compared to B10/C6/C1/C7 (88.6km) and B10/C6/C1/C8 (93km). Route corridor C4/C3 is the shortest of the three route corridors at 76.2km.

The evaluation for the Cashla group of route corridor options is presented schematically in a matrix format, in Table 6-4.

Table 6-4 Cashla Route Corridor Options Evaluation

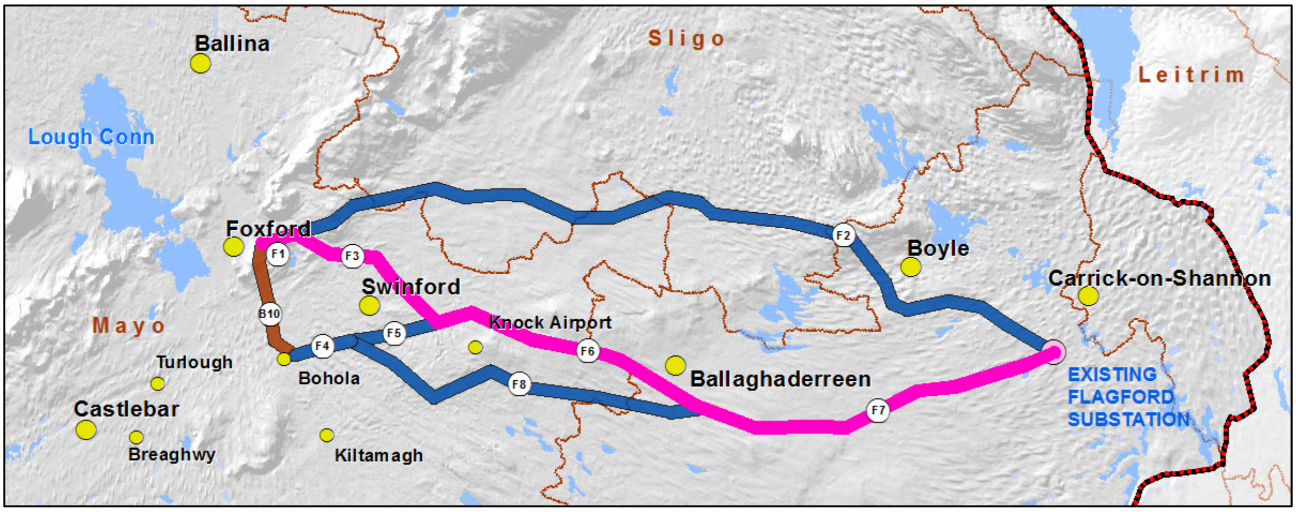
Constraints	B10/C6/C1/C7	B10/C6/C1/C8	C5/C1/C8	C5/C2/C3	C5/C1/C7	B10/C6/C2/C3	C4/C3
Settlements							
Ecology							
Landscape							
Cultural Heritage							
Technical							
Geology							
Water							
Length of Line							

more constrained ⟷ less constrained

6.3.7 Flagford Route Corridors

Taking all constraints into account the least constrained route corridor for the Flagford group of route corridor options is F1/F3/F6/F7 for the reasons outlined herein. Figure 6-9 shows the least constrained Flagford route corridor option - F1/F3/F6/F7.

Figure 6-9 Least Constrained Flagford Route Corridor Option F1/F3/F6/F7



- In terms of ***settlements,*** route corridor F1/F3/F6/F7 has fewer number of dwellings than route corridor B10/F4/F5/F6/F7 and B10/F4/F8/F7. Route corridor F1/F2 has fewer numbers of dwellings than the other three Flagford route corridor options.
- The characteristics of route corridor options in the Flagford group of route corridors are broadly similar in terms of **ecological** constraints and are therefore considered non differentiating constraints in terms of evaluation.
- In terms of landscape ***constraints,*** F1/F3/F6/F7 is considered a less constrained route corridor option compared to the other Flagford route corridors. This is principally due to the avoidance of upland areas between Lough Key and Lough Garra, higher ground south of Foxford, areas designated as sensitive in County Sligo and the foothills of the Ox Mountains.
- In terms of ***cultural heritage,*** F1/F3/F6/F7, F1/F2 and B10/F4/F5/F6/F7, are considered more constrained route corridor options than B10/F4/F8/F7. However, as noted previously, there will be no direct impact on the cultural heritage resource as it will be possible to avoid all known cultural heritage sites during the line design stage.
- In terms of ***technical*** constraints, F1/F3/F6/F7 is considered a less constrained route corridor compared to the other Flagford route corridors, as it is crosses over shorter lengths of blanket and cutover peat allowing for easier implementation.
- The characteristics of route corridor options in the Flagford group of route corridors are broadly similar in terms of ***geology and water*** and are therefore considered non differentiating constraints in terms of evaluation.
- In terms of ***length of corridor***, F1/F3/F6/F7 is the shortest route corridor option. However route corridor option F1/F2 is only 400m longer.

The evaluation of the Flagford group of route corridor options is presented schematically in a matrix format in Figure 6-5.

Table 6-5 Flagford Route Corridor Options Evaluation

Constraints	F1/F2	F1/F3/F6/F7	B10/F4/F5/F6/F7	B10/F4/F8/F7
Settlements				
Ecology				
Landscape				
Cultural Heritage				
Technical				
Geology				
Water				
Length of Line				

6.3.8 Comparative Analysis of Identified Least Constrained Route Corridor Options – Bellacorick to Flagford and Bellacorick to Cashla

This section considers the least constrained route corridor options for both Bellacorick to Flagford and Bellacorick to Cashla. The section should be read in conjunction with Table 6-6 which presents a schematic in matrix format for the least constrained route corridor options for both Cashla and Flagford.

When evaluating the least constrained route corridor option from Bellacorick to Flagford and the least constrained route corridor option from Bellacorick to Cashla, the project team are concerned more with differences between the least constrained Flagford and Cashla route corridors, as the least constrained Bellacorick route corridor option is common to both.

Therefore in Table 6-6 presented herein, the least constrained Bellacorick route corridor is not shown and the comparative analysis presented, is then between the least constrained Flagford and Cashla route corridor options.

Table 6-6 Least Constrained Cashla and Flagford Route Corridors

Constraints	Least Constrained Flagford Route Corridor	Least Constrained Cashla Route Corridor
	F1/F3/F6/F7	B10/C6/C2/C3
Settlements		
Ecology		
Landscape		
Cultural Heritage		
Technical		
Geology		
Water		
Length of Line		

In relation to each of the constraints the following main points should be considered:

- ***Settlements;*** Bellacorick to Flagford is considered less constrained than the Bellacorick to Cashla, as it has 0.3 dwellings per km less. The relevant details are presented in Table 6-7 below.

Table 6-7 Least Constrained Route Corridors - Bellacorick to Flagford/ Bellacorick to Cashla

	Bellacorick to Flagford Route Corridor Combinations (B-F)			Bellacorick to Cashla Route Corridor Combinations (B-C)		
	B1/B2/B3/B9 km	**F1/F3/F6/F7 km**	**Total km**	**B1/B2/B3/B9 km**	**B10/C6/C2/C3 km**	**Total km**
Length (km)	51.2	68.8	**120.0**	51.2	82.3	**133.5**
No. of Dwellings within each Corridor	434 *(8.5 per square km)*	637 *(9.3 per square km)*	**1,071** *(8.9 per square km)*	434 *(8.5 per square km)*	795 *(9.7 per square km)*	**1,229** *(9.2 per square km)*
Difference	**13.5km difference in B-C compared to B-F** **0.33 dwellings/km difference in B-C compared to B-F**					

- ***Ecology;*** the Flagford route is considered less constrained than the Cashla route as all ecological impacts along this route corridor can be minimised or avoided at line design stage.
- ***Landscape;*** the Flagford route is considered less constrained than the Cashla route as it avoids the key landscape sensitive areas, including the upland area between Lough Key and Lough Gara, the higher ground south of Foxford, areas designated as sensitive in County Sligo (as outlined in the Sligo County Development Plan 2011 – 2017) and the foothills of the Ox Mountains. The B10 section of the Cashla route corridor crosses over a constrained area, from a landscape perspective, south of Foxford.
- ***Cultural Heritage;*** the Flagford route is considered similarly constrained to the Cashla route.
- ***Technical;*** the Flagford route, is considered more constrained than the Cashla route, as it is required to cross more cutover and blanket peat which increases the difficulty of implementation and access for construction.
- ***Geology and Water*;** these constraints are not considered differentiating constraints in terms of evaluation.
- ***Length of route corridor;*** the Bellacorick to Flagford route is considered less constrained than the Bellacorick to Cashla route, as it is 13.5km shorter in length, which has implications for the extent of the environmental footprint potentially impacted, and also for the costs associated with the Grid West project.

From the above analysis, the least constrained route corridor option is from Bellacorick to Flagford, and is a combination of route corridor option B1/B2/B3/B9 from the Bellacorick group of route corridor options, together with F1/F3/F6/F7 from the Flagford group of route corridor options. Refer to Figure 8-1 ‘Route Corridor Options and Substation Study Areas with the Least Constrained Route Corridor Option’ which shows this least constrained route corridor option.

The next least constrained route corridor combination is from Bellacorick to Cashla, represented by a combination of route corridor option B1/B2/B3/B9 from the Bellacorick group of route corridor options, together with B10/C6/C2/C3 from the Cashla group of route corridor options.

7 SUBSTATION SITE OPTION IDENTIFICATION AND EVALUATION

This chapter should be read in conjunction with Volume 3 Appendix 6.1 'Route Corridor and Substation Site Identification and Description' and Volume 3 Appendix 7.1 'Substation Site Evaluation Report'.

It should be noted that in this section the following terminology is used:

- *Substation Site*: A generic term used in this report for an area of land with sufficient area to accommodate the projected ultimate development of the substation, sited so as to avoid as many environmental constraints as possible. At this stage in the project, specific substation sites have not been identified.
- *Substation Site Area:* A zone of land, typically of 1km in radius, sited so as to avoid as many environmental, technical and other constraints as possible, and within which a substation can later be positioned
- *Substation Location*: A zone of land, typically 1km in diameter, sited so as to avoid as many environmental constraints as possible, and within which a substation can later be positioned.

7.1 SUBSTATION SITE IDENTIFICATION PROCESS

The substation site identification process identified potential locations for both Air Insulated Switchgear (AIS) and Gas Insulated Switchgear (GIS) substations as described in chapter 3 of this report. The substation sites were identified in a process that involved three phases:

1. Preparatory work to establish study areas and the requirements at each node;
2. Initial desk based studies to identify potential substation sites in each study area using available mapping, the constraints mapping and the heat mapping; and
3. Refinement of the substation site selection by site visits, review by other specialists and comparison with the identified potential route corridor options.

The process applied to potential substation site identification was similar to that used for corridor identification, as illustrated in Plate 7-1 herein, and was done in parallel with, and informed by, the potential route corridor identification process.

7.1.1 Identification of Substation Study Area

The first step in the process to identify potential substation sites was to identify appropriate boundaries for study areas for each of the proposed new 400kV substation developments at each node.

The purpose of identifying a study area for each of the required substations was to define a reasonable and appropriate area at the outset of the substation site selection process, within which to identify potential substation sites.

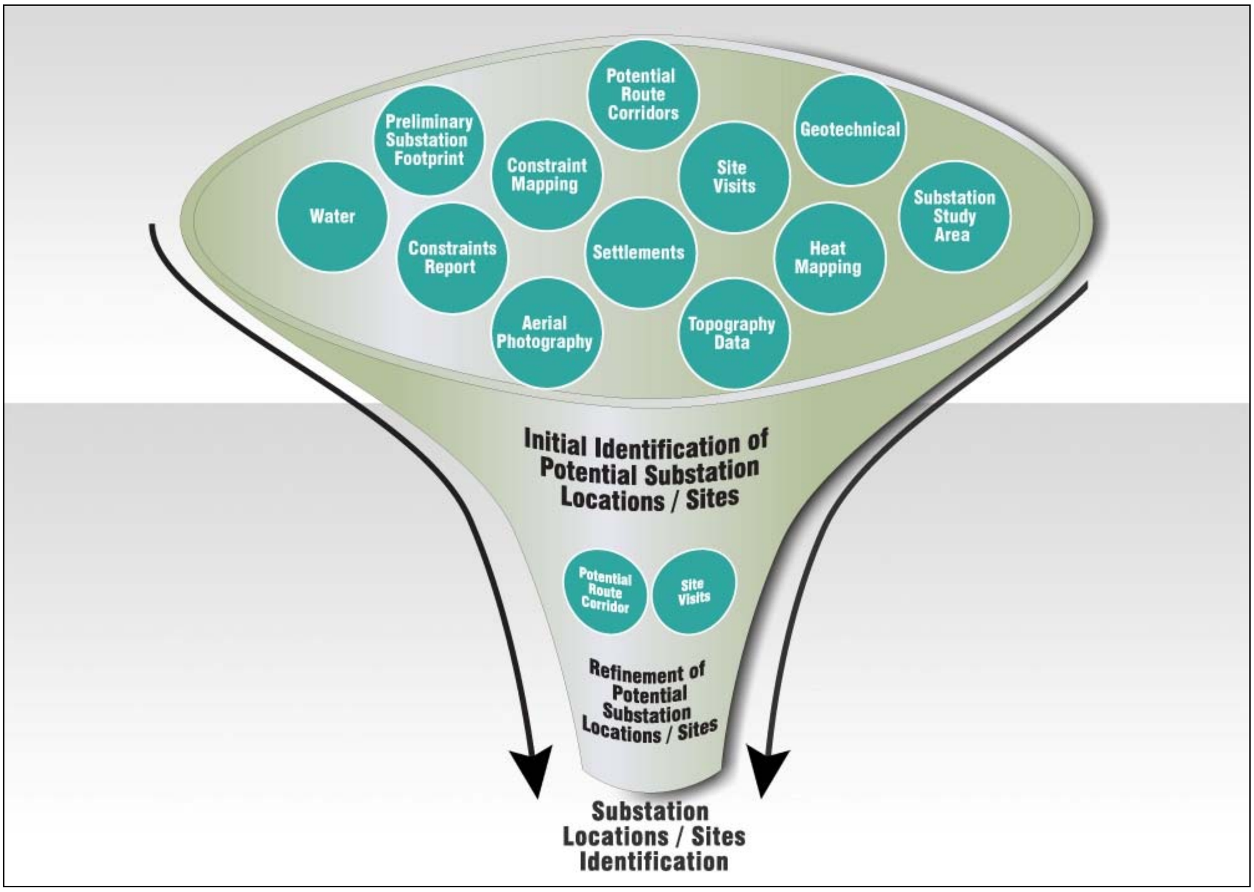
The nodes required were:

(a) A location for the new 400/110kV substation at Bellacorick, either adjacent to the existing substation or at a remote location taking into consideration environmentally designated areas and wind farm developments;

(b) A location for a 400kV substation at Cashla, either within, adjacent to or in close proximity to the existing Cashla 220/110kV substation; and

(c) A location for a 400kV substation either within, adjacent to or in close proximity to the existing Flagford 220/110kV substation.

Plate 7-1 Substation Site Identification Process



At the Bellacorick node, while there was a requirement for the new substation site to be connected to the existing Bellacorick 110/38kV substation, it was also a requirement that the new substation site should be sited so as to optimise the new connections required for these wind farms included in the Gate 3 process.

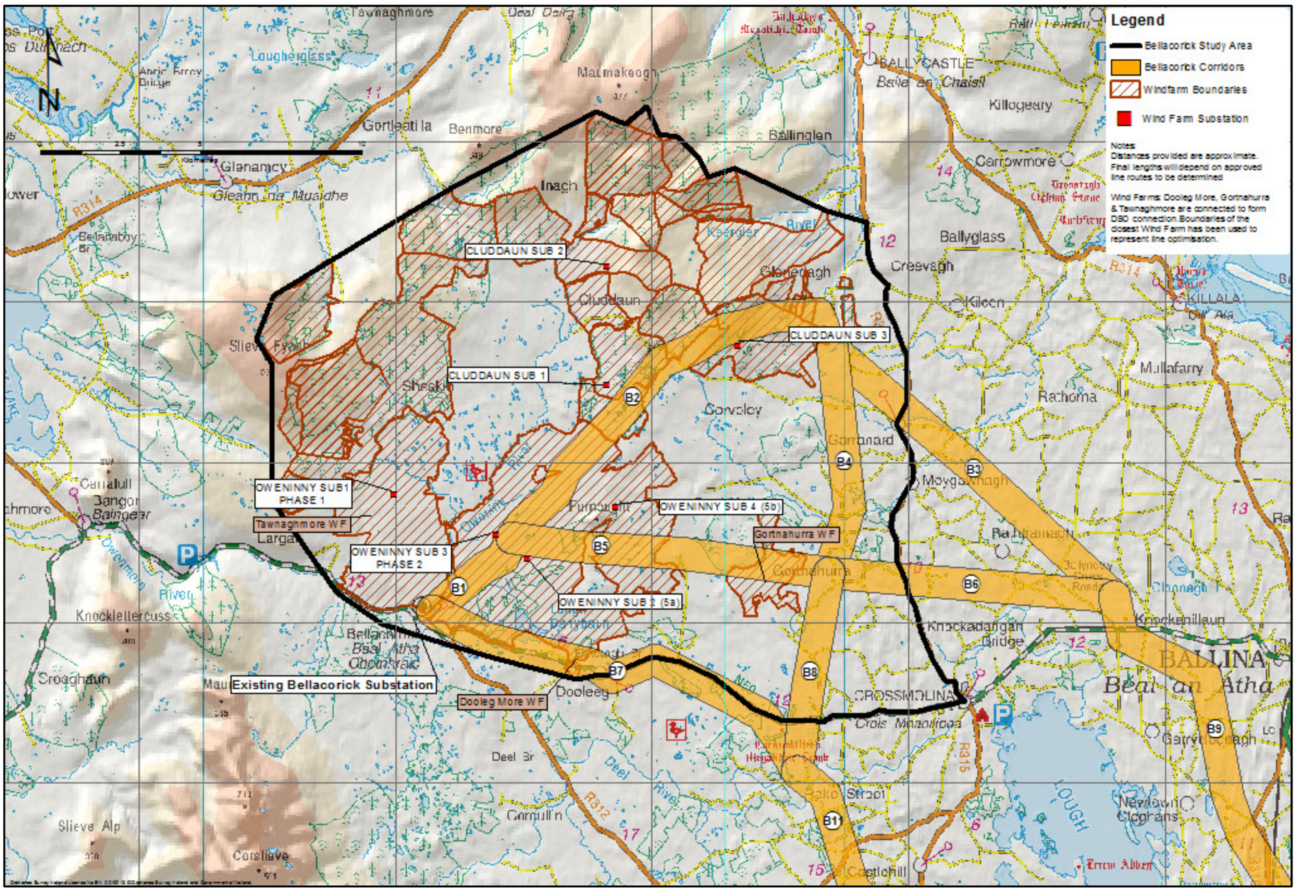
As the Grid West project will connect the new 400kV transmission line to the existing grid at either Cashla or Flagford, it was a requirement that the new substation site would preferably be located within or adjacent to the existing infrastructure at those sites or as close as possible to the existing substation site to limit the length of any interconnecting 220kV or 110kV transmission lines.

7.1.2 Selection of Substation Study Areas

The substation study areas proposed at the commencement of the substation site identification process endeavoured to optimise the site search, by limiting each substation study area, to an area expected to contain the most opportunity for a substation development, while meeting the requirements of the Grid West project.

Bellacorick Substation Study Area

Figure 7-1 Bellacorick Substation Site Study Area



Flagford and Cashla Substations Study Areas Figure 7-2 and Figure 7-3 herein show the study areas for Cashla and Flagford respectively. These areas are a circle of 1km radius, centred on the existing substation.

Figure 7-2 **Cashla Substation Study Area**

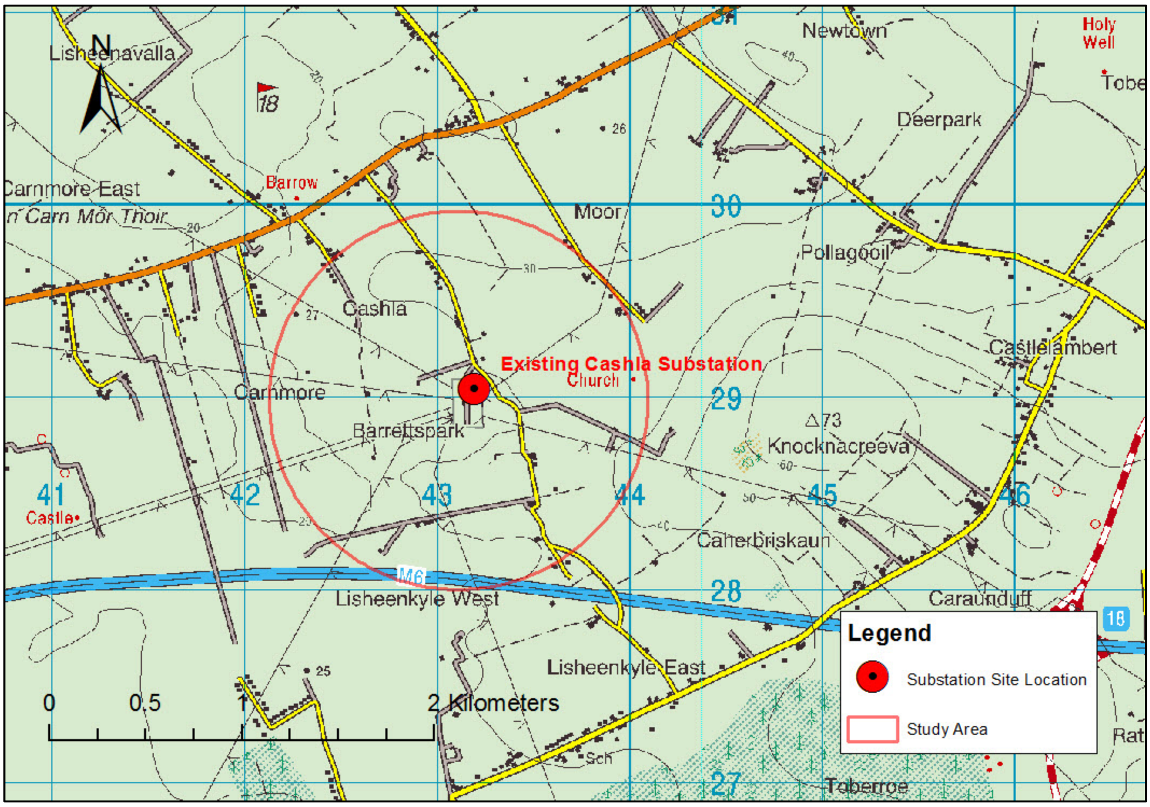
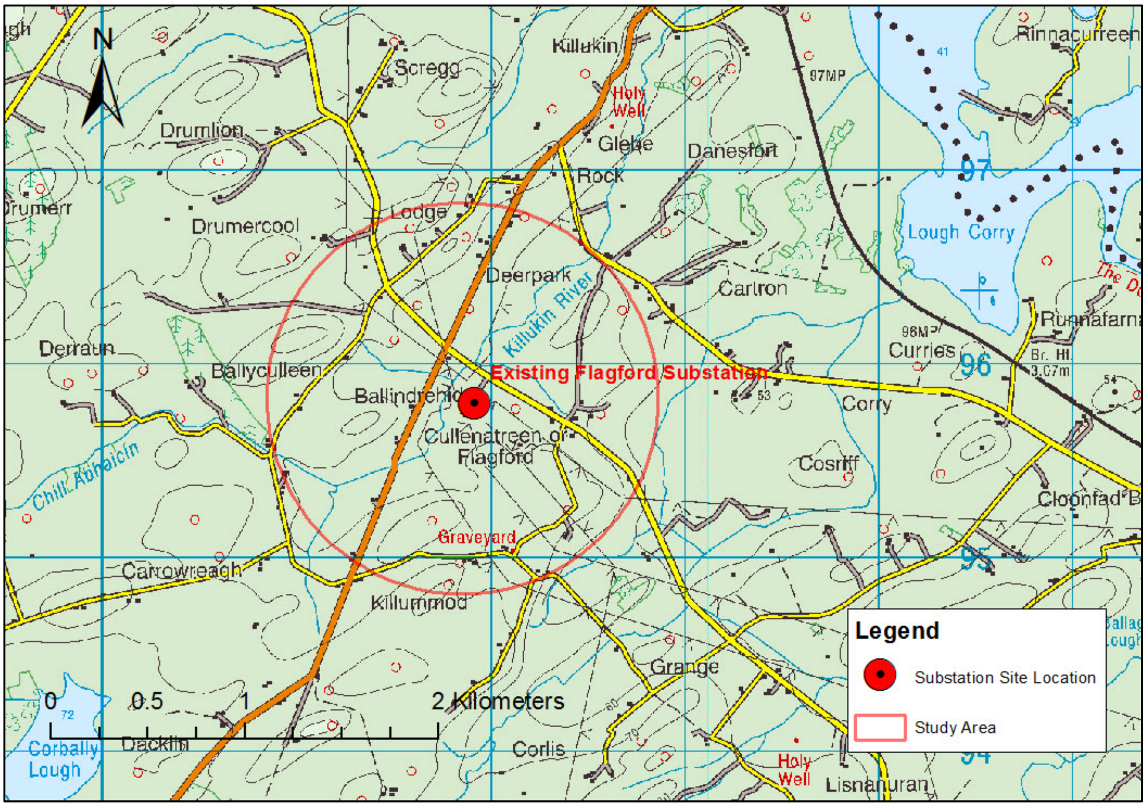


Figure 7-3 **Flagford Substation Site Study Area**



7.1.3 Development of Preliminary Substation Footprint

In order to inform the site selection process, an estimate of the area required for the anticipated final future substation configuration needed to be developed. It should be noted that the initial substation configuration being provided under the Grid West project will be a reduced configuration occupying a much smaller area than provided for in the areas identified in Table 7-1 herein.

Following discussions with EirGrid as to the potential final development requirements, the areas summarised in Table 7-1 herein were used to identify potential substation sites. Larger sites are required at remote locations because it is necessary to provide additional switchgear and associated equipment at the lower voltage (220kV and 110kV) to connect to the existing substation site.

Table 7-1 Summary of Areas Used for Substation Site Identification

	AIS	GIS
Bellacorick - Adjacent	435m x 260m	150m x 130m
Bellacorick - Remote	570m x 350m	150m x 130m
Flagford - Adjacent	320m x 180m	100m x 50m
Flagford - Remote	320m x 260m	100m x 100m
Cashla - Adjacent	320m x 180m	100m x 50m
Cashla - Remote	320m x 260m	100m x 100m

7.1.4 Initial identification of Indicative Substation Sites

The first stage in the process for the selection of indicative substation sites was to determine potential locations within the substation study areas. This involved a desk top review of the Geographic Information System (GIS) constraints mapping, heat mapping, publicly available bing aerial photography[25] and qualitative input by the project engineering specialist.

This initial study focused on key requirements as set out herein to determine a number of indicative substations sites. Where there was an area larger than that required for locating the substation with no apparent constraints, the whole area was presented as an indicative substation location. Specific sites were then determined during the refinement process, where appropriate.

At this stage, potential sites for both Air Insulated System (AIS) and Gas Insulated System (GIS) substations were identified, with neither technology being considered as preferred.

The initial substation site identification process was initiated once a preliminary set of route corridor options had been defined, but before any refinement of these route corridors took place. Thus the initial site identification process took these initial route corridors into account such that only substation sites that could be reasonably expected to link to a corridor were identified.

[25] http://www.bing.com/maps/

In the identification process, the size and nature of the substations and their equipment required that the substation sites be selected so as to minimise the impact of their construction on the environment, minimise the cost of construction and ensure that it was reasonably feasible to construct a substation at that site. Therefore the next step in the substation site identification process was to technically evaluate and assess each potential indicative substation site.

This was done by assessment against three main classifications, (i) general site selection considerations (ii) local constraints (iii) environmental constraints.

(i) General Considerations

The key general considerations taken into account in the initial site identification process included:

- **Overall system options and site selection:** In the development of system options, including new substations, consideration must be given to environmental issues from the earliest stage to balance the technical benefits and capital cost requirements for new developments against the consequential environmental effects, in order to keep adverse effects to a reasonably practicable minimum.
- **Amenity, cultural or scientific value of sites:** The siting of new electricity transmission substations, sealing end compounds and line entries should as far as reasonably practicable seek to avoid altogether, internationally and nationally designated areas of the highest amenity, cultural or scientific value by the overall planning of the system connections. Areas of local amenity value, important existing habitats and landscape features including ancient woodland, historic hedgerows, surface and ground water sources and nature conservation areas should be protected, as far as reasonably practicable.
- **Local context, land use and site planning:** The siting of substations, extensions and associated developments should take advantage of any screening provided by existing features and from the potential use of site layout and levels to keep intrusion into surrounding areas to a reasonably practicable minimum.
- **Design:** In the design of new substations or line entries, early consideration should be given to the options available for terminal towers, equipment, buildings and auxiliary development appropriate to individual locations, seeking to keep effects to a reasonably practicable minimum.

(ii) Local Constraints

The key local considerations taken into account in the initial site identification process included:

- **Location and ease of connection:** for the Bellacorick substation, the location of any proposed substation site ideally needed to be such that the connection to wind farms and existing stations could be easily made in a cost effective way, with least impact on the environment. For the Cashla and Flagford substations the considerations were similar, although the wind farm connections did not apply. The suitability of the sites for the connection of future transmission lines also needed to be considered. Although these were not known, the availability of potential route corridors could be assessed.
- **Existing Circuits:** The need to relocate existing circuits, and the possibility of any requirement to underground new and existing lines. For remote sites, the additional 110kV

circuit needed to connect the new substation to the existing 110/38kV Bellacorick substation or the additional 220kV circuit needed to connect the new substation to the existing 220/110kV substation at Flagford or Cashla were considered.

- **Geotechnical:** A high level review of available geotechnical mapping primarily to avoid areas of peat and karstified rock was considered.
- **Slope:** A review of topographical mapping as any site needed to be relatively flat to minimise civil engineering cost and construction impact.
- **Accessibility:** A site required roads suitable for the delivery of the expected loads of transformers and high voltage equipment.

(iii) Key Environmental Constraints

As part of the initial substation site identification process the Engineering Team used the constraints mapping and heat mapping within each substation study area to facilitate the identification of potential substation sites. Where possible, substation sites were selected that contained no constraints or, if this was not possible, the minimum degree of constraint (corresponding to green areas on the heat mapping).

This approach ensured that the substation sites identified avoided key sensitive areas and minimised potential environmental impact. These included areas identified as being highly constrained as indicated by the heat mapping and constraints mapping. Where practical, areas known to be at risk of flooding were also avoided.

In principle all the constraints identified for route corridor identification also applied to substation site selection, although only those constraints occurring within the respective substation study areas needed to be considered.

Following the identification of technically suitable substation sites, the other specialists in the team reviewed the proposed sites, offered comments and identified any locations which they believed should not be progressed or considered further. Their evaluation was based on the qualitative knowledge of each specialist of the substation sites in relation to their field of expertise.

As the engineering specialist had already considered the constraints mapping and heat mapping during the technical review, the other specialists' reviews at this stage focused on avoidance of localised constraints by more detailed searches of the constraints data. For example the specialists considered settlements, local historical monuments, local habitats such as rivers and streams or hedgerows and specific localised landscape considerations, including opportunities for screening.

7.1.5 Refinement of Substation Site Locations

Following identification of the initial set of potential substation sites, the next stage of the process was to refine the selection of these sites, using the same process, as for the route corridors.

This involved an iterative process of:

- Review against the route corridors;
- Review against heat mapping and constraints mapping;
- Site visits to confirm the desk based studies; and
- Substation site review by environmental specialists.

7.2 DESCRIPTION OF SUBSTATION LOCATION/SITE OPTIONS

7.2.1 General

As detailed in section 7.1 herein a number of potential substation sites were shortlisted for each of the Bellacorick, Cashla and Flagford nodes and then refined so as to be considered as reasonably robust substation locations to site a new 400kV substation. In the Bellacorick study area potential substation locations were identified, while in the Flagford and Cashla study areas potential substation site areas were identified.

In total 22 potential substation locations were identified, five potential substation locations for the Bellacorick node, 11 potential substation site areas were identified for the Cashla node and six potential substation site areas were identified for the Flagford node. These substation site options were categorised as follows:

- Those sites associated with the existing Bellacorick substation, have a prefix SB, i.e. SB1, SB2 etc;
- Those sites associated with the existing Flagford substation, have a prefix SF i.e. SF1, SF2 etc; and
- Those sites associated with existing Cashla substation, have a prefix SC i.e. SC1, SC2 etc.

Each of the substation sites linked to at least one of the refined route corridor options. However it was possible that not all the identified substation sites would be available once the least constrained route corridor had been identified. This was a factor in the evaluation of both the substation sites and the route corridors and required that the final evaluation be carried out concurrently.

All the substation sites identified to date have been identified by desk top studies and then visual site visits. No intrusive surveys have been undertaken to verify the suitability of the substation sites for the construction of a substation. In particular full geotechnical studies, including soil resistivity investigation will be needed to confirm the initial investigations, should a site be identified as the least constrained.

7.2.2 Bellacorick Node Substation Locations

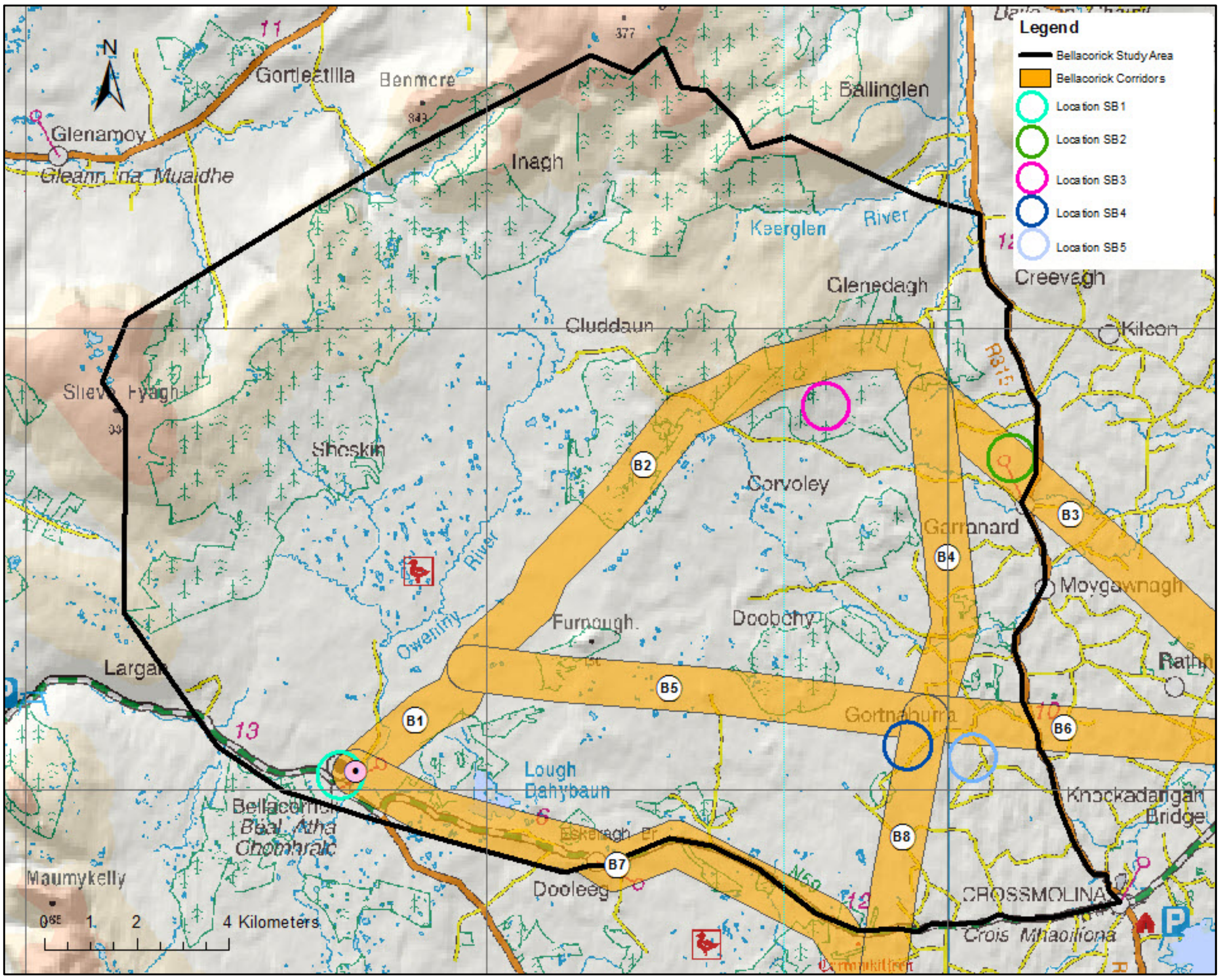
The Bellacorick area is heavily constrained by natural and environmental constraints. This restricted the number of route corridors that could be identified, which combined with the limited number of areas suitable for the siting of a substation location, meant that only a limited number of suitable locations for substations could be determined.

A total of five potential substation locations have been identified for the Bellacorick node. These are shown in Figure 7-4 of this report. Full details of the Bellacorick substation locations and evaluation of these locations are provided in Volume 3 Appendices 6.1 '*Route Corridor and Substation Site Identification and Description'* and Appendix 7.1 '*Substation Site Evaluation Report*', respectively.

The five locations can be summarised as follows as detailed in Figure 7-4 herein:

- Location SB1 (Light green circle): Extension to the existing Bellacorick 110/38 kV substation on the land previous used for the peat-fired power station;
- Location SB2 (Dark green circle): New Bellacorick 400/110kV location to north-east of the study area;
- Location SB3 (Red circle): New Bellacorick 400/110kV location to the north-east of the study area;
- Location SB4 (Dark blue circle): New Bellacorick 400/110kV location to the south-east of the study area; and
- Location SB5 (Light blue circle): New Bellacorick 400/110kV location to the south-east of the study area.

Figure 7-4 Potential Bellacorick Substation Locations



A brief description of each location is provided below.

Location SB1: Expansion of the Existing Bellacorick 110/38kV Substation

Location SB1 will require extending the existing 110/38kV substation at Bellacorick to the adjacent vacant ground previously occupied by the now demolished peat fired power plant where there is sufficient area to development either an AIS or GIS substation. The site is elevated above the surrounding peat complex and above the river which flanks the raised proposed substation location to the west and south. The precise position of the substation extension will be confirmed upon detailed site investigation of this brownfield site at design stage.

Due to the proposed sites position adjacent to the existing Bellacorick substation, the location offers the only Bellacorick substation option which does not require an additional 110kV line route to connect to the existing 110/38kV Bellacorick substation, but will require a link from the existing 110kV busbar[26], to the new 110kV busbar.

[26] Busbars and busbar sections, refers to the substation plant which joins multiple substation bays together. These would normal require extending if a substation is to be expanded or developed significantly

Location SB2: New Bellacorick 400/110kV Substation Location to the North East of Study Area
Location SB2 will require the development of a substation within the location to the north east of the study area. This location has been identified as being potentially suitable to locate the proposed 400/110kV AIS or GIS substation. The existing Bellacorick substation will be connected via a new 110kV transmission circuit. Initial investigations indicate that the location offers sufficient area, acceptable geotechnical conditions and limited constraints. It falls within proposed route corridor section B3.

Location SB3: New Bellacorick 400/110kV Substation Location to the North East of Study Area
Location SB3 will require a substation site be found within the location to the north east of the study area. Initial investigations indicate that this location offers an area with suitable geotechnical conditions and topography to facilitate the 400/110kV GIS substation and would be connected to the existing Bellacorick substation by a new 110kV transmission circuit. The location is positioned on the slope of a hill in an area of planted forestry and hence it is expected that earthworks and tree felling will be required to develop this site. The location offers natural visual screening and is not located close to known dwellings. However the location is within a potential wind farm boundary which would have an impact on the siting opportunities for the substation and/or wind turbines. The location is within the proposed corridor section B2.

Location SB4: New Bellacorick Substation 400/110kV Location to the South East of Study Area
Location SB4 will require the development of a substation within the location to the south east of the study area. Initial investigations indicate that the location offers a suitable area and geotechnical conditions to facilitate a new 400/110kV AIS or GIS substation. The substation could be connected to the existing 110kV substation via the proposed Grid West route corridors sections B5 and B7, which travel through a highly constrained area, including SPA. If a route corridor through this area is not obtainable, then an alternative route to the north along route corridor sections B2/B1 would be required. This adds considerable length to the connecting 110kV lines. The location is within the proposed route corridors sections B5 and B8.

Location SB5: New Bellacorick 400/110kV Substation Location to the South East of Study Area
Location SB5 will require the development of either an AIS or GIS substation within the location to the south east of the study area. From initial investigations the location has areas with suitable geotechnical conditions, a limited number of constraints and acceptable access roads. The location contains a number of dwellings and will require additional circuits to connect to the existing Bellacorick substation and the wind farm sites. The topography is varied across the location; however suitable sites for the substation appear to be available from the preliminary investigations. The location is within the proposed route corridor section B6.

7.2.3 Cashla Node Substation Site Options

The Cashla substation study area includes a 1km radius area from the existing substation. Apart from the area to the west, the study area has a limited number of constraints. Consideration did need to be given to the quarry site to the southwest, the M6 to the south and the proximity to residential dwellings in the study area.

The orientation of the existing substation and the connecting 220kV and 110kV transmission lines limited the future connection options to Cashla to the eastern, southern and northern substation boundaries. However it is envisioned that many of the potential sites for Cashla may need to incorporate undergrounding for the final approaches of the transmission lines into the substation.

Therefore two alternative approaches have been considered when assessing potential substation site areas near the existing Cashla substation:

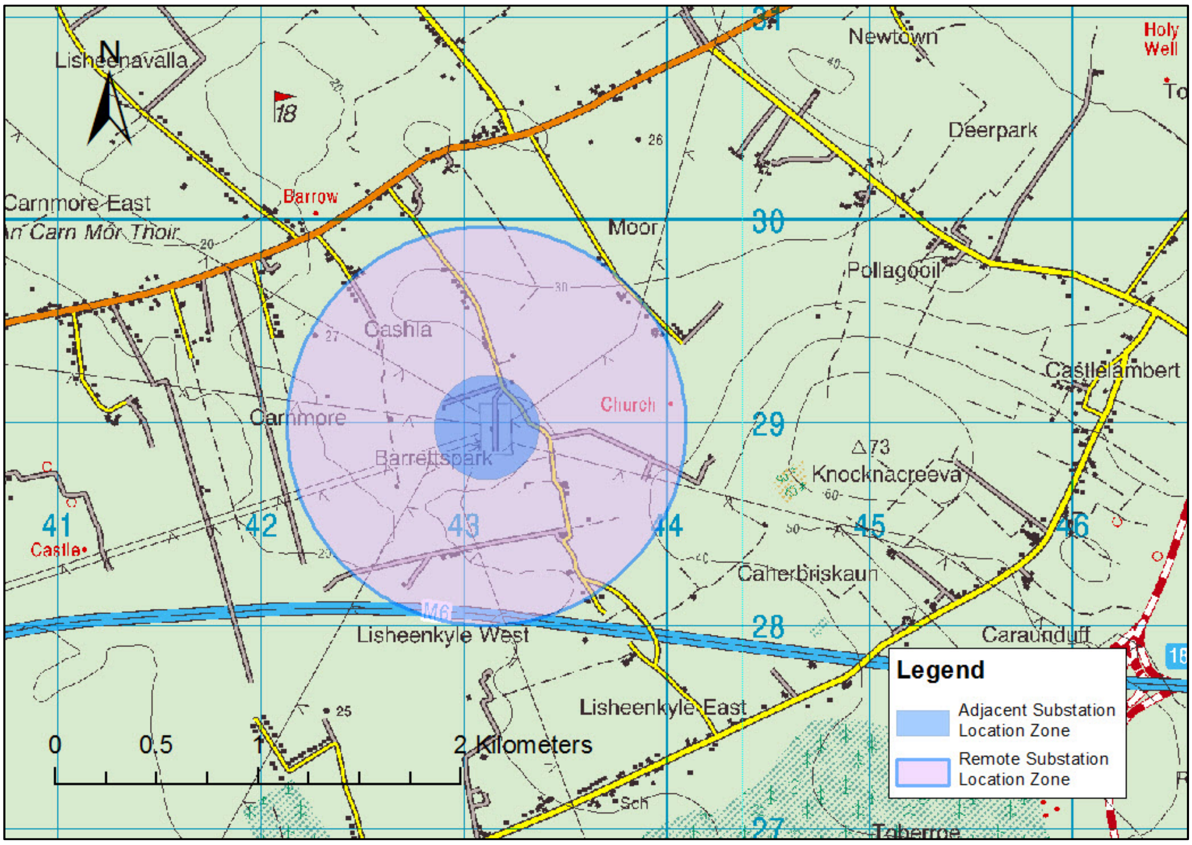
- ***Adjacent substation location zone***, where the new 400/220kV substation will be located adjacent to the existing substation and will be developed as an extension of this substation. Adjacent options would be preferred as they do not require the routing of additional circuits to connect to the existing substation and additional 220kV busbars with associated switchgear, therefore potentially being more compact and less costly. These options are also consistent with standard planning guidelines.
- ***Remote substation location zone***, where the new 400/220kV substation will be located at a site within the study area but remote from the existing substation. This option will require the development of a completely new substation including 220kV busbars and feeders and a connection via a 220kV circuits to the existing substation.

The Flagford and Cashla proposed substation sites are defined and evaluated in a provisional way as site areas. Prior to Stage 1 consultation, they are to be understood as located within the Adjacent Substation Location Zone or the Remote Substation Location Zones, in the zonal areas discussed, rather than being identified as a '*defined footprint*'. Precise positioning of a new substation expansion within these areas would follow the initial consultation with landowners and more detailed site and technical investigations.

These two options are illustrated in Figure 7-5 herein, where adjacent sites would be located within the inner zone and remote sites within the outer zone.

Within these zones a number of areas that met the basic requirements for a substation were identified as potential substation site areas. These areas are referred to as site areas in this report. A total of 11 potential substation site areas have been identified for the Cashla node, of which seven are located within the adjacent zone and the remaining four are remote. All of these site areas are considered as part of the substation evaluation in the event that an adjacent site cannot be found. Full details of the Cashla substation site areas and the evaluation of these sites is provided in Volume 3 Appendix 6.1 'Route Corridor and Substation Site Identification and Description' and Appendix 7.1 'Substation Site Evaluation Report', respectively.

Figure 7-5 Potential Cashla Substation Site Location Zones



A brief description of each site area is provided below.

Site Area SC1: Adjacent GIS Substation Site Area on the Northern Boundary

Site area SC1 is located directly adjacent to the northern boundary of the existing Cashla substation site on a section of land suitable for a new GIS substation. Underground cables to the 220kV busbars will be required to connect to the southern busbar section of the existing Cashla substation. The substation access road and other existing infrastructure located on the land would need to be relocated to allow construction of the new substation.

Site Area SC2: Adjacent GIS Substation Site Area on the South Boundary

This site area is adjacent to the southern boundary of the existing substation where there is sufficient land to develop a GIS substation. Initial investigations indicate that it offers suitable topography, a low concentration of constraints, suitable geotechnical conditions and facilitates connection to the existing substation. Underground cables to the 220kV busbars will be required to connect the northern busbar section of the existing Cashla substation.

Site Area SC3: Adjacent GIS Substation Site Area on the Northern Boundary across the Road

Site area SC3 is positioned along the northern boundary of the existing substation site on the other side of a local road. Initial investigations indicate that the substation site area of suitable size for the development of a GIS substation, with acceptable soil conditions and topography. Connection to the existing 220kV substation site will require underground cables, although it may be possible to connect the northern section of the existing busbar using an overhead connection across the road.

Site Area SC4: Adjacent GIS Substation Site Area on the Eastern Boundary

Site area SC4 is located adjacent to the eastern boundary of the existing substation. Initial investigations indicate that the site area offers a suitable area with acceptable ground conditions and topography to develop a GIS substation. The site area would connect directly to the existing 220kV busbars; however due to the position of the proposed substation between the two existing 220kV towers, the connection to Grid West 400kV transmission line may require an underground cable to reduce the number of 220kV line crossings.

Site Area SC5: Adjacent GIS Substation Site Area on the South Eastern Boundary

Site area SC5 is located adjacent to the south eastern boundary of the existing substation site. Initial investigations indicate that the site area offers suitable topography and geotechnical conditions to develop a GIS substation. The position facilitates the direct connection to the existing 220kV busbars and future lines approaching from the south; however it is expected that connection of the Grid West line and northern section of the existing 220kV busbar would be via underground cables.

Site Area SC6: Adjacent AIS Substation Site Area on the South Eastern Boundary

Site area SC6 proposes development of an AIS substation directly connected to the 220kV busbar of the existing substation. The proposed substation site area will extend the 220kV switchyard from the southern end of the existing yard then establish a 400 kV switchyard to the southeast.

Site Area SC7: Adjacent AIS Substation Site Area on the Eastern Boundary

Site area SC7 proposes development of an AIS substation to the east of the existing substation site. The proposed site area presents a number of technical challenges, including the need to underground all existing 220kV lines terminating at Cashla substation.

Site Area SC8: Remote GIS Substation Site Area to the North of the Existing Site

Site area SC8 is within the study area but remote from the existing Cashla substation to the north. Initial investigations indicate that this substation site area offers an area of land suitable for a GIS substation with suitable geotechnical conditions, topography and with no constraints present. Connecting the Grid West transmission line to the new substation would have limited impact to the existing electricity lines. This site area would facilitate connection to the Grid West line.

Site Area SC9: Remote GIS Substation Site Area to the South of the Existing Site

Site area SC9 is within the study area but remote from the existing Cashla substation. The site area is located to the south of the existing substation in an area that is clear of the quarry. Initial investigations indicate that the substation site area offers an area of land with suitable geotechnical conditions and topography sufficient to locate a GIS substation. This substation site area would not require the rerouting or undergrounding of the existing 220kV transmission lines connecting into Cashla.

Site Area SC10: Remote GIS Substation Site Area to the North East of the Existing Site

Site area SC10 is within the study area but remote from the existing Cashla substation where there is sufficient area to develop a GIS substation. The substation site area is located to the north east of the existing substation and offers similar conditions and advantages to site area SC8.

Site Area SC11: Remote GIS Substation Site Area to the North of the Existing Site

Site area SC11 is within the study area but remote from the existing Cashla substation site to the north of the existing factory complex where there is sufficient area to develop a GIS substation. This would allow the substation to be visual associated with the factory, reducing its visual impact. The connection of Grid West to the site area is expected to have limited impact on the existing electricity lines. However an underground 220kV cable connection would be required to the existing substation.

7.2.4 Flagford Node Substation Site Options

The Flagford study area includes a 1km radius area from the existing Flagford substation site. Heat mapping indicates that there are a number of localised constraints which will need to be considered, including a high concentration of constraints located to the south of the Flagford study area. Locations to the east of the study area have been avoided due to the additional route length required to connect the proposed 400kV connection and the presence of existing 220kV lines in the area.

The existing Flagford substation is restricted by the Killuken River to the west and the Culleenatreen road to the north east.

As for the Flagford substation, two alternative approaches have been considered when assessing potential substation sites near the existing Flagford substation:

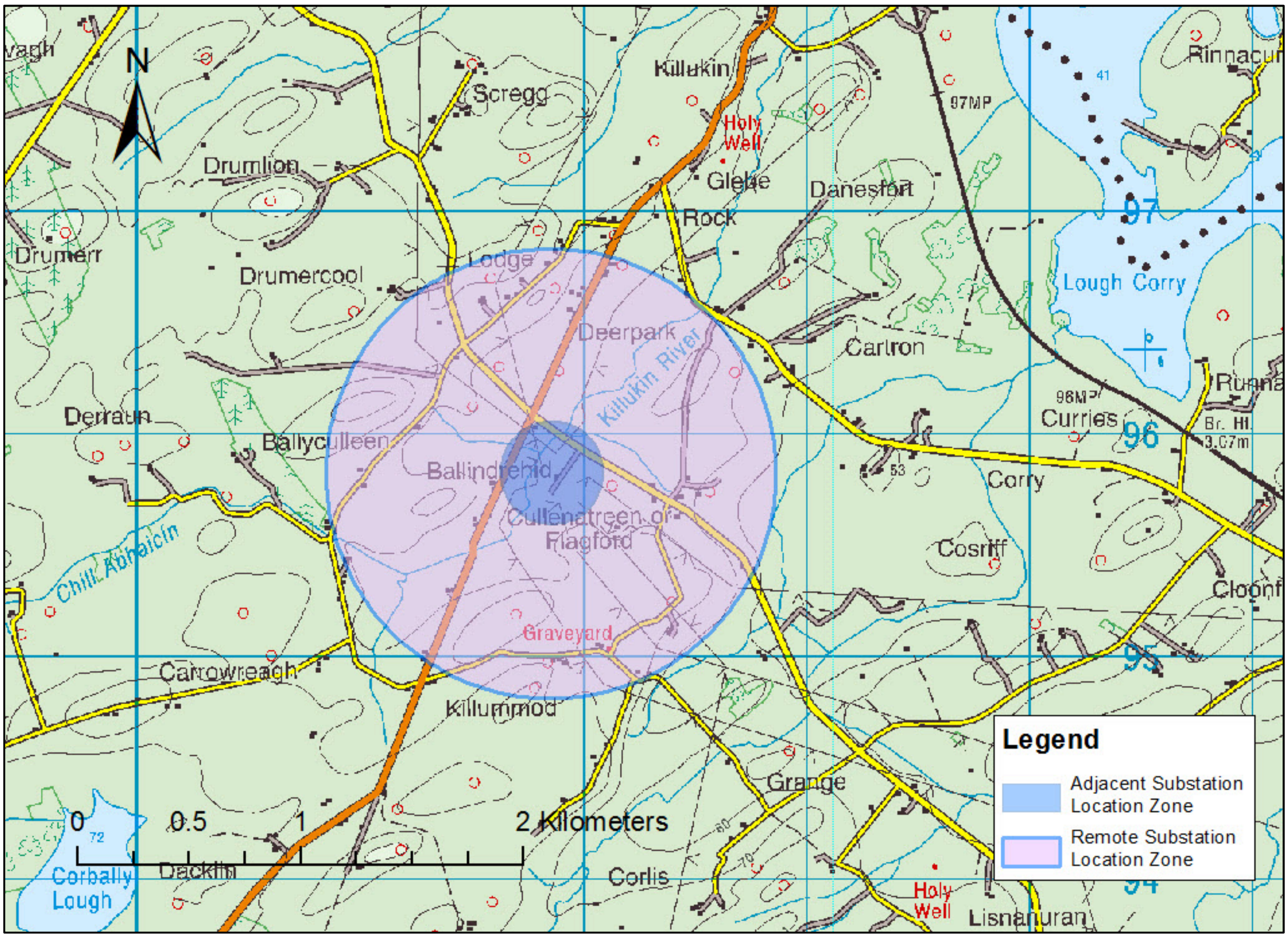
- ***Adjacent substation location zone***, where the new 400/220kV substation will be located adjacent to the existing substation and will be developed as an extension of this substation. This is the preferred option as it does not require the routing of an additional line to connect to the existing substation sites requires less switchgear and is therefore potentially lower cost and follows standard planning guidelines.
- ***Remote substation location zone,*** where the new 400/220kV substation will be located at a site within the study area but remote from the existing substation. This option will require the development of a complete new substation including 220kV busbars and feeders and a connection via a 220kV overhead line or lines to the existing substation.

These two options are illustrated in Figure 7-6 herein, where adjacent sites would be located within the inner zone and remote sites within the outer zone.

Within these zones a number of areas that met the basic requirements for a substation were identified as potential substation site areas. A total of six potential substation site areas have been identified for the Flagford node, of which four are located within the adjacent zone and the remaining two are remote. All of these site areas are considered as part of the substation evaluation in the event that an adjacent site cannot be found.

Full details of the Flagford substation site areas and the evaluation of these site areas is provided in Volume 3 Appendix 6.1 'Route Corridor and Substation Site Identification and Description' and Appendix 7.1 'Substation Site Evaluation Report', respectively.

Figure 7-6 Potential Flagford Substation Site Location Zones



A brief description of each site is provided herein.

Site Area SF1: Adjacent GIS Substation Site Area Option on the Northern boundary

Site area SF1 is situated across the local road from the northern boundary of the existing substation. Initial investigations indicate that the site area offers an area of land with acceptable geological and topographical conditions to develop a GIS substation. The connection to the existing substation northern busbar would be achieved via either overhead lines or underground cables. Connection to the southern busbars and possible future south approaching 400kV line will be made via underground cable.

Site Area SF2: Adjacent GIS Substation Site Option on the South Eastern Boundary

Site area SF2 is situated adjacent the southern boundary of the existing substation site between the existing 220kV towers. Initial investigations indicate that the site area offers an area of land with suitable topography and geotechnical soil to develop a GIS substation. The site area can be directly connected to the existing 220kV substation; however the impact on the existing 220kV lines and terminal towers will need to be assessed in detail.

Site Area SF3: Adjacent GIS Substation Site Area Option on the South Western Boundary

Site area SF3 is adjacent to the southern boundary of the existing substation. Initial investigations indicate that the site area offers an area of land with suitable topography and geotechnical soils to facilitate the development of a GIS substation. The connection to the southern 220kV busbar section can be made via overhead circuit; however the northern section of the 220kV busbars will need to be connected via underground cable.

Site Area SF4: Adjacent AIS Substation Site Area Option on the South Western Boundary

This site area proposes the construction of an AIS substation to the south west of the existing substation. The development is expected to have significant impact on the area due to the increased footprint and associated construction works required for an AIS substation.

Site Area SF5: Remote GIS Substation Site Area Option to the North of the Existing Site

Site area SF5 is within the study area but remote from the existing Flagford substation site. Initial investigations indicate that the site area offers an area of land with suitable geotechnical conditions and topography to locate a GIS substation. This site area has good access and minimal impact to existing electricity lines, if the Grid West line was to be routed in via route corridor section F2.

Site Area SF6: Remote AIS Substation Site Area Option to the North of the Existing Site

Site area SF6 proposes the development of an AIS substation in approximately the same location as SF5 GIS site area described above. The development is expected to have significant impact on the area due to the increased footprint and associated construction works required for an AIS substation.

7.3 SUBSTATION SITE EVALUATION

The evaluation of the potential locations and site areas identified above was based on a subjective evaluation of each site against a number of criteria, and discussed in brief within the following sections. A full description and results of this evaluation can be found in Volume 3 Appendix 7.1 'Substation Site Evaluation Report'.

7.3.1 Substation Evaluation Criteria

The substation site options have been evaluated against each of the substation site evaluation criteria summarised below. This evaluation has incorporated the expertise of each specialist to provide an evaluation as to the degree by which a site or location is constrained against each of the criteria.

As illustrated in Plate 7-2, the study area for the Bellacorick node was much larger than for the other two nodes, as it was not essential to locate the substation as close as possible to the existing Bellacorick 110/38kV substation. As one key purpose of this new substation is to facilitate connection to the Gate 3 wind farms in the area, it was considered that optimising the connections to these wind farms should be an important criterion. This was assessed by estimating the length of the 110kV connections required to each wind farm as described in more detail in Volume 3 Appendix 7.1 'Substation Site Evaluation Report'.

The following criteria were used to evaluate the substation locations/site areas:

- ***Proximity to existing substation*:** The substation location/site areas ease of connection to the existing substation with consideration to its complexity and distance;
- ***Impact on length of 110kV connections to wind farms (Bellacorick substation specific):*** The length of circuits required to connect the applicable Bellacorick wind farms;
- ***Topography:*** The substation location/site area selected should ideally be flat for ease of construction;
- ***Geotechnical conditions / subsoil:*** The substation location/site area soil conditions should endeavored to be firm and stable;
- ***Access - proximity to suitable public road:*** The location/site area should be furnished by a suitable public road for ease of construction;
- ***Routing of transmission lines to substation:*** The new substation location/site area should have suitable options for future connections while minimising the impact to existing ones;
- ***Proximity to houses/other occupied buildings:*** Where possible the substation location/site area should be removed from houses;
- ***Impact on local infrastructure:*** The construction and future operation and maintenance of the substation location/site area will impact the local infrastructure. This impact should be minimised or mitigated as far as possible;
- ***Location in relation to least constrained route corridor:*** The substation location/site area should allow connection to the least constrained corridor;
- ***Landscape and visual impact:*** Substation locations/site areas have the potential to impact negatively on the landscape in which they are implemented, therefore the potential at each substation site area to mitigate or absorb the proposed visual impact of the substation has been considered;

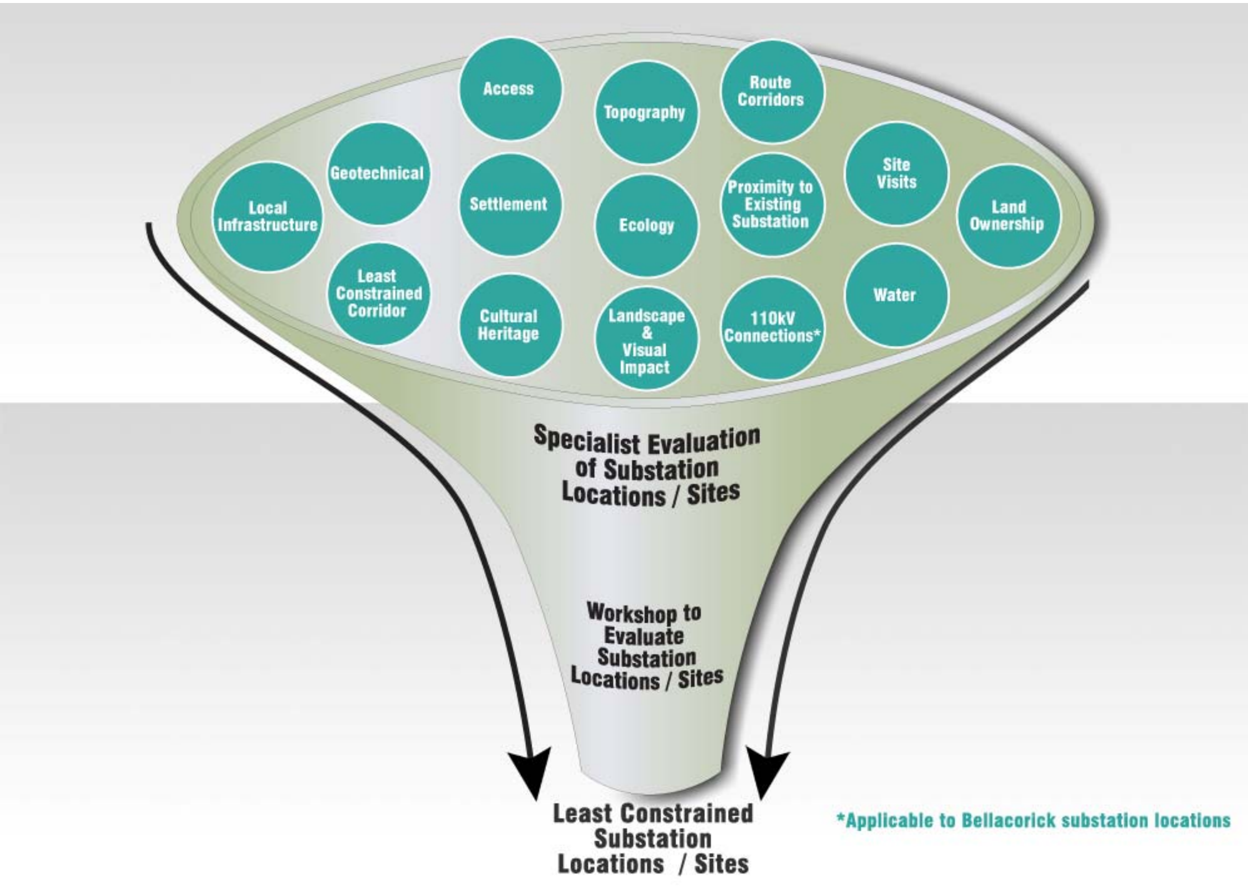
- ***Landownership:*** Landownership has been considered at a pre-feasibility level as it is advantageous to select substation location/site area which has a single land owner;
- ***Cultural Heritage:*** The location/site of the substation should endeavor to avoid or minimise the impact too, areas which include known cultural heritage sites; and
- ***Ecology:*** The location/site of the substation should endeavor to avoid or minimise the impact too, areas which include known designated sites.

7.3.2 Substation Evaluation Process

The project team identified a diverse range of issues which influence the evaluation of a substation site. These issues derived from the professional expertise of the project team, from internationally used guidance and from the technical and environmental constraint assessments carried out in respect of the substation locations/site areas. These issues were then set out as the evaluation criteria as documented in the Volume 3 Appendix 7.1 'Substation Site Evaluation Report'

The evaluation process is illustrated in Plate 7-2 herein.

Plate 7-2 Substation Evaluation Process



All substation site areas and locations investigated are considered to be technically feasible in that they were selected so as to:

- Provide sufficient area to facilitate the potential future substation requirements;
- Avoid major areas of blanket peat as indicated by available geotechnical mapping;
- Be located on suitable relatively flat topography;
- Avoid areas which have been subject to flooding; and
- Avoid areas of internationally or nationally recognised ecological and cultural heritage significance.

This first stage of the evaluation process reviewed and reconfirmed the suitability of the locations / site areas identified during the substation site identification process as discussed above.

It is important to understand that the selection of the least constrained substation site at each node is intrinsically linked to the identified least constrained route corridors and that it is not possible to determine a least constrained substation location/site area in isolation from the least constrained route corridor. The selection of the substation site has to follow the selection of the route corridor and thus the least constrained substation site has to be associated with the least constrained route corridor. However, it should be recognised that the least constrained route corridor as identified in chapter 6 of this report may not emerge as the preferred corridor for a variety of reasons and therefore it is important that all the various substation locations/site areas be evaluated so as to inform any future discussions.

Each site was visited and evaluated qualitatively by the technical, cultural heritage, landscape and ecological specialist against the criteria listed in section 7.3.1 of this chapter, from ‘less constrained’ to ‘more constrained’, the results of which were used to furnish a matrix for each node as seen in Table 7-2, Table 7-3 and Table 7-4 herein. The site visits made by the specialists during the identification process were an important element of this evaluation process.

The substation locations/site areas identified had initially been selected so as to minimise the environmental impact of the construction of a substation. In the evaluation process the specialists considered any localised constraints which would impact on the potential to locate the substation at each site. Where any such localised constraints were identified, the evaluation was amended accordingly.

7.3.3 Wind Farm Connection Distances

As indicated in section 7.3.1 of this chapter, the new substation at the Bellacorick node should facilitate connection to the Gate 3 wind farms in the area and that the total length of the 110kV connections to these wind farms should be optimised.

The approximate length of connections required to connect the Gate 3 wind farms to the new, substation were estimated, together with the length of the 110kV line required to connect to the existing Bellacorick 110/38kV substation. The assessment assumed that the proposed Grid West route corridors would be available and incorporated the latest publicly available planning proposals from the nominated wind farm developers. This information was combined with applicable constraints mapping so that indicative 110kV route lengths could be determined.

Since it is not possible to route a transmission line through an SAC when a viable alternative route is available, the route to SB4 is significantly longer than to SB2, since lines to SB4 would need to be routed north from this site on B4 and then to the west on B2 and B1. Routing 110kV circuits underground along the N59 in the B7 corridor, even if this were desirable, would also be longer.

Full details of this assessment are provided in Volume 3 Appendix 7.1 ‘Substation Site Evaluation Report’.

7.3.4 Substation Site Evaluation Matrices

The matrices presented herein represent the results of a qualitative evaluation by the specialists on the project team for each of the substation locations/ site areas. These should be read in conjunction with the evaluation criteria discussed in Section 7.3.1 of this chapter.

These have been produced as an indication of the relative merit associated with each substation site. It is recognised that each of the substation site location/area options evaluated herein could potentially be developed as a substation site, but the identification of the least constrained substation location/site area has to be linked to the identification of the least constrained route corridor.

7.3.5 Bellacorick Substation Evaluation

Table 7-2 Bellacorick Substation Location Evaluation Matrix

Evaluation Criteria	Bellacorick Proposed Substation Locations				
	SB1	SB2	SB3	SB4	SB5
Proximity to existing substation					
Impact on length of 110 kV line connections to Wind farms					
Topography					
Geotechnical conditions / subsoil					
Access proximity to suitable public roads					
Routing of transmission lines to substation					
Proximity to houses/other occupied buildings					
Impact on local infrastructure					
Proximity to least constrained route corridor					
Landscape and visual impact					
Landownership					
Cultural heritage constraints					
Ecological constraints					

In accordance with the evaluation criteria, as set out in Table 7-2 the least constrained substation location is SB1. This location has the advantages of being adjacent to the existing 110/38kV substation, on a site formerly used for a power station, with good road access.

The site is within the least constrained route corridor, B1/B2/B3/B9, which forms part of the least constrained corridor to either Flagford or Cashla. However the potential impact on the routing of the required 110kV lines and any future transmission lines is a factor in the evaluation, which could have implications that, if not accommodated by a degree of co-design, could limit the future development opportunities of the site. This location will only be suitable if a route for the 400kV line through the wind farm developments can be confirmed as acceptable under EirGrid's overhead line design standards.

Substation location SB2 is the next less constrained substation location, offering potentially good technical sites removed from major environmental constraints and is located within the least constrained route corridor, B1/B2/B3/B9. It is however a greenfield location compared to the already established land use at SB1. Its location to the east of the Bellacorick peat complex means that the Grid West 400kV line will be shorter and there will also be reasonable opportunities for the routing of future transmission lines to the north, south and east. This should be considered in conjunction with the additional 30km of 110kV lines connecting to the substation and the requirement for any future 110kV lines. The routing of the 110kV transmission lines to the existing Bellacorick substation and the Gate 3 wind farms connecting to the substation is also highly constrained and will need to be developed in coordination with the wind farm developers. Potentially significant cultural heritage sites have been identified within the area of location SB2. However it is likely that these can be avoided during final site selection.

Location SB3 is the next less constrained. It offers similar advantages to location SB2. However its position within a wind farm could present land acquisition difficulties as well as impose restrictions on the routing of future transmission lines.

Substation location SB4 is the next less constrained following SB1, SB2 and SB3. It offers a location with a limited number of technical and environmental constraints and provides reasonable opportunities for the routing of future transmission lines. However it does not fall within the least constrained route corridor option and due to its southern location, 110kV connections into Bellacorick and the wind farms will be more difficult and longer with the associated greater impact. Again coordination with the wind farm developers will be required.

Substation location SB5 is a more constrained within the Bellacorick substation study area. It offers similar advantages and disadvantages to SB4. However the location would also impact on a number of houses and two ringforts that been identified within the location SB5. These additional constraints have resulted in this site being ranked as more constrained.

It should be noted that substation site option evaluation at Bellacorick has been carried out on the environmental and technical constraints listed in the evaluation matrix, without embarking upon detailed site investigation either at the brownfield location adjacent to the existing substation or at the other locations, and without commencing any land acquisition discussions.

In this regard, it is emphasised that all substation location options remain active as alternatives, (subject to alignment with the least constrained route corridor) with respect to any other constraints emerging at detailed design stage.

7.3.6 Cashla Substation Evaluation

Table 7-3 Cashla Substation Site Evaluation Matrix

Evaluation Criteria	Cashla Substation Site Area Options								
	Adjacent Substation Location Zone					Remote Substation Location Zone			
	SC1	SC2	SC3	SC4	SC5	SC8	SC9	SC10	SC11
Proximity to existing substation									
Topography									
Geotechnical conditions / subsoil									
Access proximity to suitable public roads									
Routing of transmission lines to substation									
Proximity to houses/other occupied buildings									
Impact on local infrastructure									
Proximity to least constrained route corridor									
Landscape and visual impact									
Landownership									
Cultural heritage constraints									
Ecological constraints									

more constrained — less constrained

All Cashla substation site areas are located within the least constrained route corridor thus the effect of the least constrained route corridor has been considered as neutral in the evaluation.

As detailed in Table 7-3, the least constrained substation site area for Cashla is SC1. It is located within the adjacent substation location zone. It offers suitable technical and environmental conditions to facilitate the construction of a GIS substation, with the added advantage of being contained within the existing substation site.

SC2 and SC4 are the next less constrained substation site areas, again located within the adjacent substation location zone. They also offer suitable technical and environmental conditions to facilitate the construction of a GIS substation. These are directly adjacent to the existing substation but the land requirement is unlikely to be completely contained within the existing site boundary. Substations located on these sites may require an underground section to connect to the Grid West line approaching from the north.

SC3 and SC5 are the next less constrained of the adjacent site area options which also have suitable technical and environmental conditions to facilitate the construction of a GIS substation. These would require short connections. However the development of a new substation compound will increase the impact of the development.

Substation site area evaluation at Cashla has been carried out on the environmental and technical constraints listed in the evaluation matrix, without detailed site investigations or landowner consultations.

All site area options identified within the adjacent substation location zone at Cashla are feasible, and their ordering in terms of degree of constraint, is subject to review in the event that other constraints emerge related to ground conditions or land availability. All of the substation site area options remain active as alternatives with respect to any other constraints emerging at detailed line design stage.

SC8, SC9, SC10 and SC11 lie in the remote substation location zone, and are more constrained than the adjacent options as they required overhead lines or cable routes to connect to the existing site, a larger substation compound and additional access. Although site areas within the remote substation location zone (the outer circle) are technically feasible, and remain as alternative options, they would be considered 'in reserve' against the less constrained adjacent location zone options.

7.3.7 Flagford Substation Evaluation

Table 7-4 Flagford Substation Site Evaluation Matrix

Evaluation Criteria	Flagford Proposed Substation Site Areas			
	Adjacent Substation Location Zone Options			Remote Substation Location Zone Option
	SF1	SF2	SF3	SF5
Proximity to existing substation				
Topography				
Geotechnical conditions / subsoil				
Access proximity to suitable public roads				
Routing of transmission lines to substation				
Proximity to houses/other occupied buildings				
Impact on local infrastructure				
Landscape and visual impact				
Proximity to least constrained route corridor				
Landownership				
Cultural heritage constraints				
Ecological constraints				

more constrained ←→ less constrained

All Flagford substation site area options are located within the least constrained route corridor to Flagford and thus the effect of the least constrained route corridor has been considered as neutral in the evaluation matrix.

As evident in the evaluation matrix in Table 7-4 above, substation site area SF2 is considered the least constrained as it appears to have suitable technical and environmental conditions to facilitate the construction of a GIS substation, while being directly adjacent to the existing substation. There are a number of transmission lines on this side of the substation, which have been considered in the above evaluation. This also considers impact on existing infrastructure and neighbouring properties, of a substation site located in this area.

SF1 is the next less constrained adjacent site area, offering suitable technical and environmental conditions to facilitate the construction of a GIS substation. However the site area would be positioned within lands separated by a local road from the existing substation, which will require either an underground or overhead connection

Site area SF3, positioned within lands on the south western side of the substation, is the next less constrained site area. It is directly adjacent to the existing substation but its proximity to a cultural heritage sites and slightly more difficult approach for other transmission lines, ranks it lower than site areas SF2 or SF1.

SF5 is a more remote site area, which as for the Cashla remote site areas, is technically feasible but considered 'in reserve' and the associated impact of providing a line or corridor route and new substation site in the area of SF5 would only be fully assessed after all adjacent options have been dismissed.

It should be noted that all the site areas SF1, SF2 and SF3, located in the adjacent zone are relatively similar in ranking on the environmental and technical constraints listed in the evaluation matrix. This would be reviewed following site investigation and the outcome of any consultations with landowners.

All site area options at Flagford are feasible, and all of the substation site area options remain active as alternatives with respect to any other constraints emerging at detailed design stage. However those site areas located in the remote substation location zone would be considered in reserve to those in the adjacent substation location zone.

Chapter 8 of this Stage 1 Report discusses the bringing together of least constrained route corridors, with least constrained substation site area options, to achieve a least constrained combination at the substation nodal points.

8 LEAD CONSULTANT'S RECOMMENDATIONS

8.1 ALIGNING THE LEAST CONSTRAINED ROUTE CORRIDOR OPTION WITH THE LEAST CONSTRAINED SUBSTATION SITE AREA OPTION

It would be optimal if the least constrained route corridor option could also terminate at the least constrained substation site area option at each of the nodal points of Bellacorick, Cashla and Flagford. However, it must be recognised that the least constrained route corridor option, optimised over long lengths and under significant densities of constraints, has a degree of priority as it arrives at the area of the nodal substation.

At each of the nodal points of Bellacorick, Cashla and Flagford, it is again emphasised that evaluation has been carried out on the environmental and technical constraints listed in the evaluation matrix, as they are known at this stage. This is prior to site investigation at any of the locations, and prior to commencing any land acquisition discussions.

All substation site area options remain active as alternatives, with respect to any issues which may emerge as further constraints at detailed design stage.

On the basis of the above, the following sections outline the recommended alignments of the least constrained route corridors with substation site area options for the nodal points at Bellacorick, Cashla and Flagford.

Refer to Volume 2 Figure 8.1 'Route Corridor Options with Substation Study Area'.

8.1.1 Bellacorick Route Corridor and Substation Site Options

Substation site location SB1, the (expanded) existing substation site, is common to all route corridors as a terminal node. Substation site location SB2 is associated with the northern route corridor section B3, and substation site location SB3 is also associated with northern route corridor sections B2 and B3. Substation site locations SB4 and SB5, on the other hand, lie along corridor sections B5, B6 and B8.

This means that since the least constrained route corridor option into Bellacorick includes sections B1/B2/B3, then the substation site locations to be considered with this northern corridor section, effectively narrow to SB1, SB2 and SB3. The other two substation site area locations, SB4 and SB5 are tied primarily to route corridor options which include B6 as corridor sections.

In chapter 6 of this report, it has already been concluded that, under all the constraints, and particularly having regard to the planned wind farm developments along the route corridors, and the likely 110kV works associated with connecting them, the least constrained route corridor option is to route the proposed 400kV line along B1/B2/B3/B9 to the new substation site location SB1, adjacent to the existing Bellacorick substation. Development of additional demand for transmission capacity, from renewable energy projects beyond Gate 3, requiring a second 400kV line, could be accommodated in the future by constructing a larger substation to the east of the Bellacorick peat complex, and originating the second line from there as a nodal terminus. Precise positioning of that future substation would be determined when the need for it became established.

In summary, at Bellacorick, the least constrained route corridor option has been combined with the least constrained substation site locations. The joint optimisation of route corridor and substation site location at Bellacorick therefore achieves the optimal combined position.

Refer to Volume 2 Figure 8.2 ‘Bellacorick Route Corridor Options with Substation Study Area’ and Figure 8.3 ‘Bellacorick Route Corridor Options with Substation Study Area and Constraints’.

8.1.2 *Cashla Substation Route Corridor and Site Options*

The least constrained route corridor option to Cashla has been identified as B10/C6/C2/C3, and it approaches the Cashla substation study area from the north. This least constrained route corridor option optimally aligns with the least constrained GIS substation site area option, namely SC1, as a terminal point.

Refer to Volume 2 Figure 8.4 ‘Cashla Route Corridor Options with Substation Study Area’ and Figure 8.5 ‘Cashla Route Corridor Options with Substation Study Area and Constraints’.

8.1.3 *Flagford Substation Route Corridor and Site Options*

The least constrained route corridor option to Flagford has been identified as F1/F3/F6/F7, and it approaches the Flagford substation study area from a west, south west direction. Although substation location area option SF2, which is adjacent and to the south east of the existing Flagford substation, has been identified as the locally least constrained substation site area. Substation site area SF3 which is also adjacent to the Flagford substation, but to the south, provides the least impact with regard to connection to this least constrained route corridor, when the existing concentrations of 110kV lines to the west and the 220kV lines to the east of Flagford substation are considered. Therefore when identifying the Grid West least constrained combination of route corridor and substation solution the combination of route corridor F1/F3/F6/F7 and substation site area SF3 are considered to be the least constrained combination.

Refer to Volume 2 Figure 8.6 ‘Flagford Route Corridor Options with Substation Study Area’ and Figure 8.7 ‘Flagford Route Corridor Options with Substation Study Area and Constraints’.

8.2 RECOMMENDATIONS

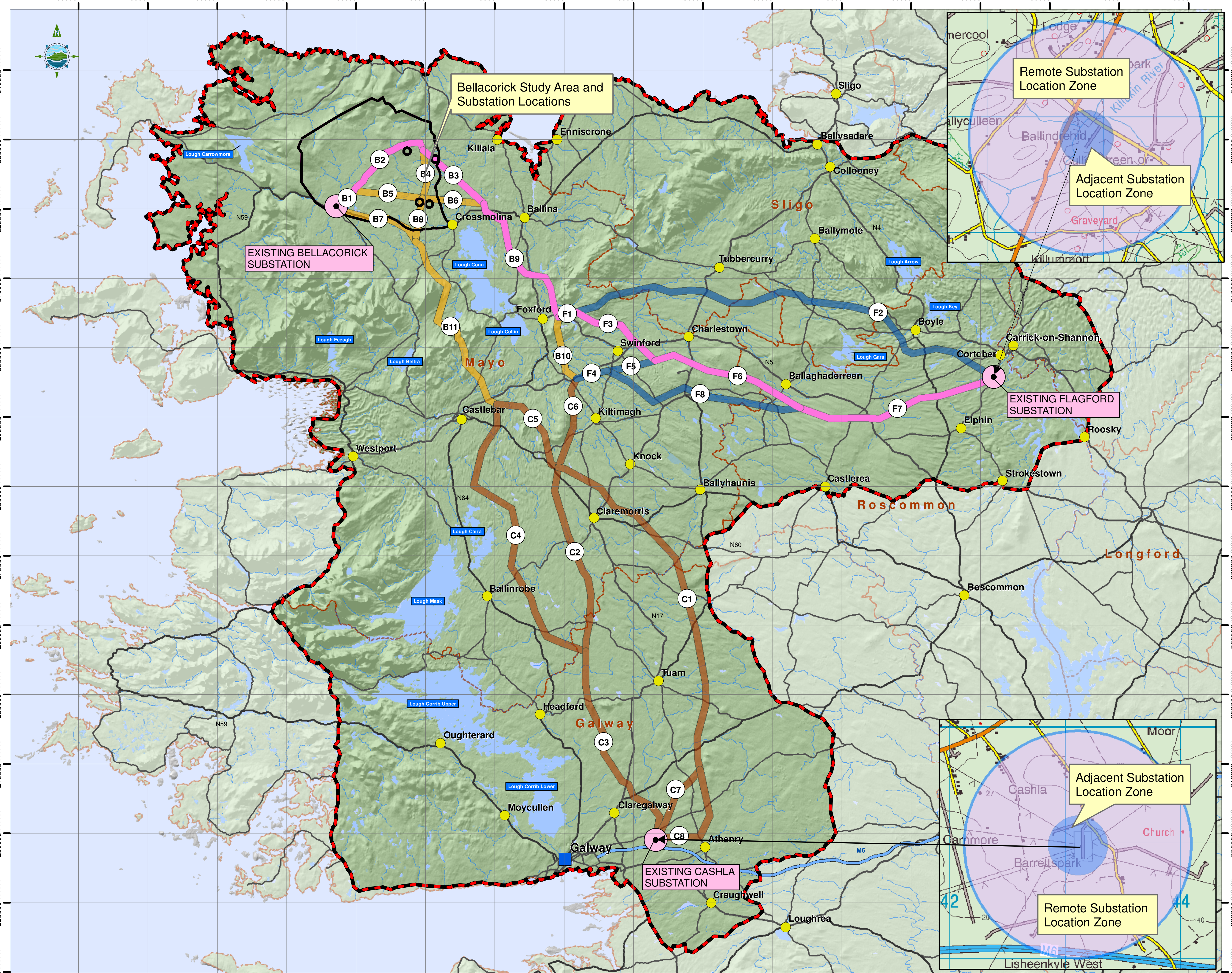
8.2.1 The Recommendations on Combined Least Constrained Route Corridors and Substation Sites

The Stage 1 Report has identified the route corridor option B1/B2/B3/B9/F1/F3/F6/F7, linking a 400kV substation extension at Bellacorick (SB1) to an extension of the existing Flagford station (SF3) as the least constrained option overall, in the view of the specialist team.

It has identified the next least constrained route corridor option as B1/B2/B3/B9/B10/C6/C2/C3 to Cashla, with the existing substation there extended as per substation site area option SC1.

It is now recommended that all route corridor options and substation site options, inclusive of the consultant's considered least constrained options, are brought before the public and stakeholders, to consult with them, and to take their views.

Refer to Figure 8-1 'Route Corridor Options and Substation Study Areas with the Least Constrained Route Corridor Option' herein and also detailed in A0 in Volume 2 Figure 8.8 'Route Corridor Options and Substation Study Areas with the Least Constrained Route Corridor Option'.



Proposed Study Area
City
Town
County Boundary
Motorway
National Roads
Regional Road
River
Lakes
Substation Site Locations
Bellacorick Study Area and Substations Location

Identified Corridors

Bellacorick Route Corridor Options
Cashla Route Corridor Options
Flagford Route Corridor Options
Least Constrained Corridor

0 2.5 5 10 15 20
Kilometres

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Issue	Date	Description	By	Chkd.
A	22-02-13	ISSUED	G.F	M.H.

Client: EIRGRID

Project: THE GRID WEST PROJECT

Title: ROUTE CORRIDOR OPTIONS AND SUBSTATION STUDY AREAS WITH THE LEAST CONSTRAINED ROUTE CORRIDOR OPTION

Scale @ A0: 1:500,000

Prepared by: G.Fil | Checked: M.Hogan | Date: February 2013

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Figure 8-1 A

GLOSSARY OF TERMS

Adjacent Substation Location Zone: is an area directly surrounding the existing substation site where development, for technical, environmental and planning purposes can be considered an extension of the existing site.

ArcGIS Spatial Analyst: provides a range of spatial modelling and analysis tools. Using ArcGIS Spatial Analyst, one can create, query, map, and analyse cell-based raster data; query information across multiple data layers and fully integrate cell-based raster data with traditional vector data sources.

Buffer Zone: is a zone around a map feature measured in units of distance. These buffer zones are to allow the area potentially impacted by the constraint to be meaningfully mapped, for example a scenic view point carries a buffer zone assigned, to include the area seen from the view point. However, it should not be taken as being the actual extent of influence of that feature – this can only be confirmed by more detailed environmental assessment.

Constraint: A constraint is any physical, environmental, topographical, socio-economic or other condition that may affect the location, development and other aspects of a proposal.

Other Constraint: constraints which should be taken into account which cumulatively can influence corridor selection but individually do not influence corridor selection. Examples include gas pipelines, railway lines.

Potential Route Corridor: A linear band of land, of a notional 1 km in width, between the nodal substations, routed so as to avoid as many environmental, technical and other constraints as possible, and within which a high voltage line route can later be positioned. In areas where there were white space / least constrained area, length of corridor was considered.

Primary Constraint: Constraints which should be avoided. Examples include population centres, Natura 2000 sites, National Monuments.

Remote Substation Location Zone: is an the area within the substation study area, that excludes the adjacent substation locational zone, where the development is considered for technical, environmental and planning purposes can be considered for a new substation site linked to the existing substation site.

Secondary Constraint: Constraints which should be avoided, where possible. Mitigation measures would be considered, if unavoidable. Examples include Sites & Monuments Records (SMR's), river crossings.

Strategic Environmental Assessment (SEA): Strategic Environmental Assessment (SEA) is the formal systematic evaluation of the likely significant environmental effects of implementing a plan or programme before a decision is made to adopt it.

Substation Location: A zone of land, typically 1 km in diameter, sited so as to avoid as many environmental constraints as possible, and within which a substation can later be positioned.

Substation Site Area: A zone of land, typically of 1 km in radius, sited so as to avoid as many environmental, technical and other constraints as possible, and within which a substation can later be positioned.

Substation Site: A generic term used in this report for an area of land with sufficient area to accommodate the projected ultimate development of the substation, sited so as to avoid as many environmental constraints as possible. At this stage in the project specific substation sites have not been identified.

ACRONYMS

AIS	Air Insulated Switchgear
BMW	Border, Midlands and Western Regions
CER	Commission for Energy Regulation
CGS	County Geological Sites
DCENR	Department of Communications, Energy and Natural Resources
DCMNR	Department of Communications, Marine and Natural Resources
EC	European Commission
EHV	Extra High Voltage
EIS	Environmental Impact Statement
EMF	Electromagnetic Fields
EU	European Union
GIS	Gas Insulated Switchgear
GIS	Geographic Information System
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
ICNIRP	International Commission on Non-Ionising Radiation Protection
IP	Implementation Programme
kV	Kilovolt
LCA	Landscape Character Assessments
LCA	Landscape Conservation Areas
MW	Megawatt
NDP	National Development Plan
NHA	Natural Heritage Area
NRA	National Roads Authority
NSS	National Spatial Strategy
OHL	Overhead Line
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SMR	Sites & Monuments Record
SPA	Special Protection Area
TSO	Transmission System Operator
UGC	Underground Cable

The Grid West Project

Lead Consultant's Stage 1 Report

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