# The Grid West Project

EirGrid

## Lead Consultant's Stage 1 Report

# Volume 3 Appendix 6.1

Route Corridor and Substation Site Identification and Description

March 2013

TOBIN Consulting Engineers

URS

DRURY

Patrick J. Tobin & Co. Ltd.

# REPORT

**PROJECT:** **Grid West Project**

**CLIENT:**

**EirGrid**
The Oval
160 Shelbourne Road
Ballsbridge
Dublin 4

**COMPANY:**

**TOBIN Consulting Engineers**
Block 10-4
Blanchardstown Corporate Park
Dublin 15

www.tobin.ie

## DOCUMENT AMENDMENT RECORD

**Client:** EirGrid PLC

**Project:** Grid West Project

**Title:** Appendix 6.1 Route Corridor and Substation Site Identification and Description Report

| PROJECT NUMBER: 6424 | | | | DOCUMENT REF: 6424 - A | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| A | Final Issued to Client | MH | 21/02/13 | DG | 21/02/13 | MFG | 21/02/13 |
| Revision | Description & Rationale | Originated | Date | Checked | Date | Authorised | Date |
| TOBIN Consulting Engineers | | | | | | | |

# TABLE OF CONTENTS

## TABLES



## FIGURES

## PLATES



## ANNEX

# 1. INTRODUCTION

## 1.1 THE PROJECT TEAM

The Consultants' team for the Grid West project comprises of TOBIN Consulting Engineers, URS and Drury Communications, with specialist input from Moore Group on cultural heritage and Stephen Dowds on planning. TOBIN act as Lead Consultants on the team, providing environmental, civil engineering, and project management services. URS provide specialist high voltage transmission system engineering services, and Drury Communications provide the communications services on the project.

## 1.2 CONTEXT WITHIN THE EIRGRID ROADMAP

The core process in delivering the Grid West project is the EirGrid Project Development & Consultation Roadmap, ('the *Roadmap*[1]),*'* 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 heard. Plate 1-1 illustrates graphically the sequential 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 a 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.

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

**Plate 1-1 EirGrid Project Development & Consultation Roadmap**


### *1.2.1 Route Corridor and Substation Site Identification and Description Report within the Context of the EirGrid Roadmap*

This Route Corridor and Substation Site Identification and Description Report is a deliverable of Stage 1 and is a constituent part of development of the Stage 1 Report. It sets out the steps in developing route corridor and substation site options, from the desk study level around constraint mapping, to refinement following site visits and specialist workshops. It presents the features and characteristics of each of the substation and corridor options between the key nodal points of Bellacorick, and both Cashla and Flagford.

That consultation builds on a sequence of consultative steps whereby the project team consulted stakeholders, initially on the Study Area in June 2012, and then again on the Constraints Report in August and September 2012.

# 2. METHODOLOGY FOR ROUTE CORRIDOR IDENTIFICATION

## 2.1 INTRODUCTION

The project requires the identification of suitable substation site options at Bellacorick, Cashla and Flagford, together with feasible route corridor options, from Bellacorick to Cashla, and from Bellacorick to Flagford, so that the least constrained substation site and route corridor options can be identified.

This stage of the project identifies potential indicative corridors and substation site locations, based on the results of the Constraints Report[2] and Mapping, the subsequent Heat Mapping of those constraints, the public and stakeholder inputs, the findings of the Technical Foundation Report[3], EirGrid SEA[4], EirGrid Grid25[5], and consideration of social, environmental and economic issues.

The Technical Foundation Report examines the different transmission line technologies that could be used for the Grid West project, it has been agreed that the Grid West project will be based on high voltage alternating current overhead line (HVAC OHL) technology.

Following the Open Days presenting the project study area, held in June 2012 (first round), and an additional series of Open Days (second round) held in August and September 2012 after the publication of the Constraints Report, any issues highlighted by stakeholders and the public were reviewed and taken into consideration in this report. The results of the consultation on the Constraints Report informed the identification of potential indicative corridors which in turn influenced potential substation site options. Confirming the feasibility of route corridors and substation site options is a linked process, where joint feasibility of combinations of sites and corridors is tested. The identification of potential indicative corridors and substation sites involved a combination of desk study and field survey to identify, map and describe potential route corridors and substation site options, accounting for areas of known or potential environmental value, and assessing the significance of the potential impacts of a transmission line within those corridors. In addition to the constraints mapping, potentially feasible substation sites were identified using various sources including aerial photography and site visits.

From the outset, the project team's strategy for the identification of route corridors has been 'impact avoidance by design'. The project team has aimed to minimise potential environmental impact in the development of route corridor options, by locating corridors away from highly constrained areas, to avoid potential impact on highly sensitive receptors, such as Sites of European Importance (Special Areas of Conservation (SACs), Special Protection Areas (SPAs)).

Given the nature and scale of the development and its receiving environment, it is not possible to fully avoid environmental impact, while at the same time designing a viable development. Where potential impact cannot be avoided, good design nonetheless seeks to position route corridors where such impact can be minimised.

[2] http://www.eirgridprojects.com/projects/gridwest/constraintsreport/#d.en.10716
[3] Refer to Volume 3, Appendix 3.2 of the Stage 1 Report
[4] Environmental Report for the Grid25 Implementation Programme 2011-2016, SEA
[5] http://www.eirgrid.com/media/Grid%2025.pdf

### 2.1.1 Delphi Process

For the identification of potential route corridors, TOBIN/URS adopted elements of the Delphi process. The Delphi process 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 essence of the Delphi process is the structuring of the group communication process aimed at producing detailed critical examination and discussion. The project team used a modified form of this process in the initial round of discussions, it is worth reviewing the process, to appreciate its dynamics.

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, are better equipped to reach a workable outcome, when brought together in a panel which is chaired and facilitated so that the project team work collectively. The issue is presented to the experienced specialists through a formal statement of the issue to be considered, or other similar means, and each individual responds independently of the other specialists. The independent responses are then analysed, the issue is re-presented and further iterations of the process are undertaken as necessary. Their responses in each stage in the formal Delphi process are anonymous, and they are provided with a summary of opinions before answering the next reformulation of the issue under consideration. Areas of disagreement between specialists are developed as parts of the issue to be resolved, solutions are proposed, and facilitated by the chair, and where possible they are resolved. It is based on the dynamic that the group will converge toward the optimum response through this consensus process.

### 2.1.2 Lead Consultants Adapted Approach

The challenge of identifying route corridor options is not the same as that of forecasting market or economic conditions; however 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 corridors for the Grid West project.

There are many variations of this basic process, used outside its' 'forecasting' origins. In the 'modified Delphi process' used by the project team in generating route corridor options, questionnaires were not used, but the project team applied the process in a workshop format. Each specialist was requested to independently suggest their own route corridor options, 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 are presented in the Constraints Report[6], which had been collectively generated and agreed by the project team, and brought to public consultation.

In bringing these first round independent suggestions to the project team forum, the preferred position of each specialist was subject to discussion and debate. Over time, this brought the process of route corridor identification to an agreed outcome, by consensus, in an iterative fashion, with required

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

refinements discussed and agreed between the specialists, and recorded. 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 options to be first brought to the table.

This approach was tested in an internal workshop, to ensure that it would be effective, and it was found that in highly constrained areas, there is likely to be good agreement on the positioning of potential route corridors in such areas, because the range of options is narrower. In less constrained areas however, the project team recognised in the initial process-proving workshop, that it was necessary to visualise and weigh the collective effect of many separate constraints. The project team accordingly recognised the need for a supporting tool, which would help the specialists to visualise the impact on corridor position of several constraints, some of which overlap at a given location.

This led the project team to adopt *spatial analysis*[7] 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 and it is outlined in greater detail in later sections of this report.

The overall process used is summarised in the attached flowchart Figure 2-1.

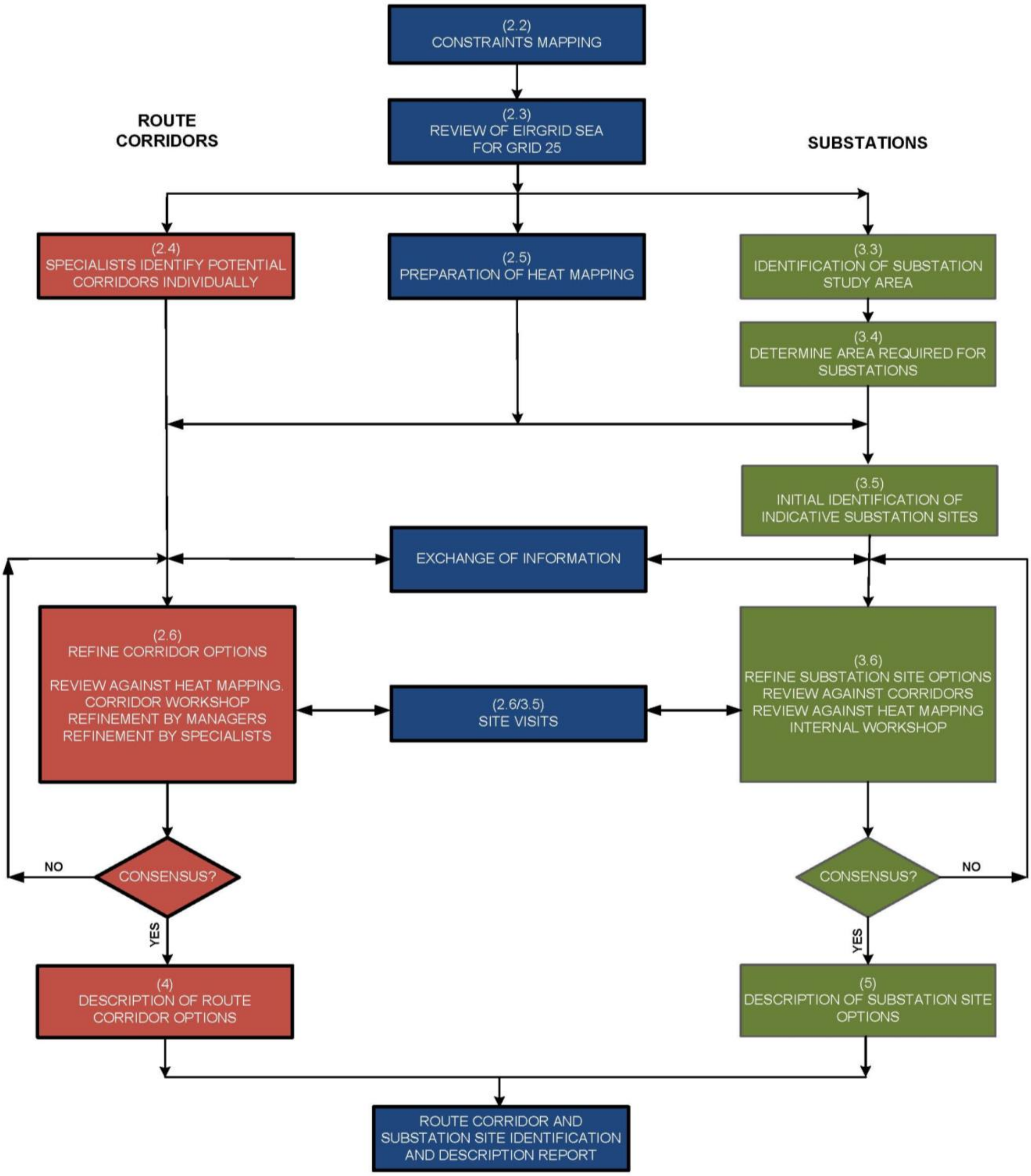
The adopted Delphi process is based on the application of the expertise of project specialists in the following disciplines:

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

These specialists applied their expertise in identifying potential route corridors which best mitigate the constraints within their specialism and, through the iterative process, set out, discussed and refined these route corridors until consensus was reached on a preferred set of route corridor options. The process was supported by advanced GIS mapping techniques to provide more detailed information to support decision making.

[7] ArcGIS Spatial Analyst provides a range of spatial modeling 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.

**Figure 2-1 Flow Chart Illustrating Route Corridor and Substation Site Selection Process**




***Note: the brackets relates to the section of the report where this information is included.***

## 2.2 CONSTRAINTS MAPPING

The starting point for the selection of potential route corridors, is the constraints mapping and associated Constraints Report that has already been produced for the Grid West project.[8]

The key environmental constraints maps 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)**

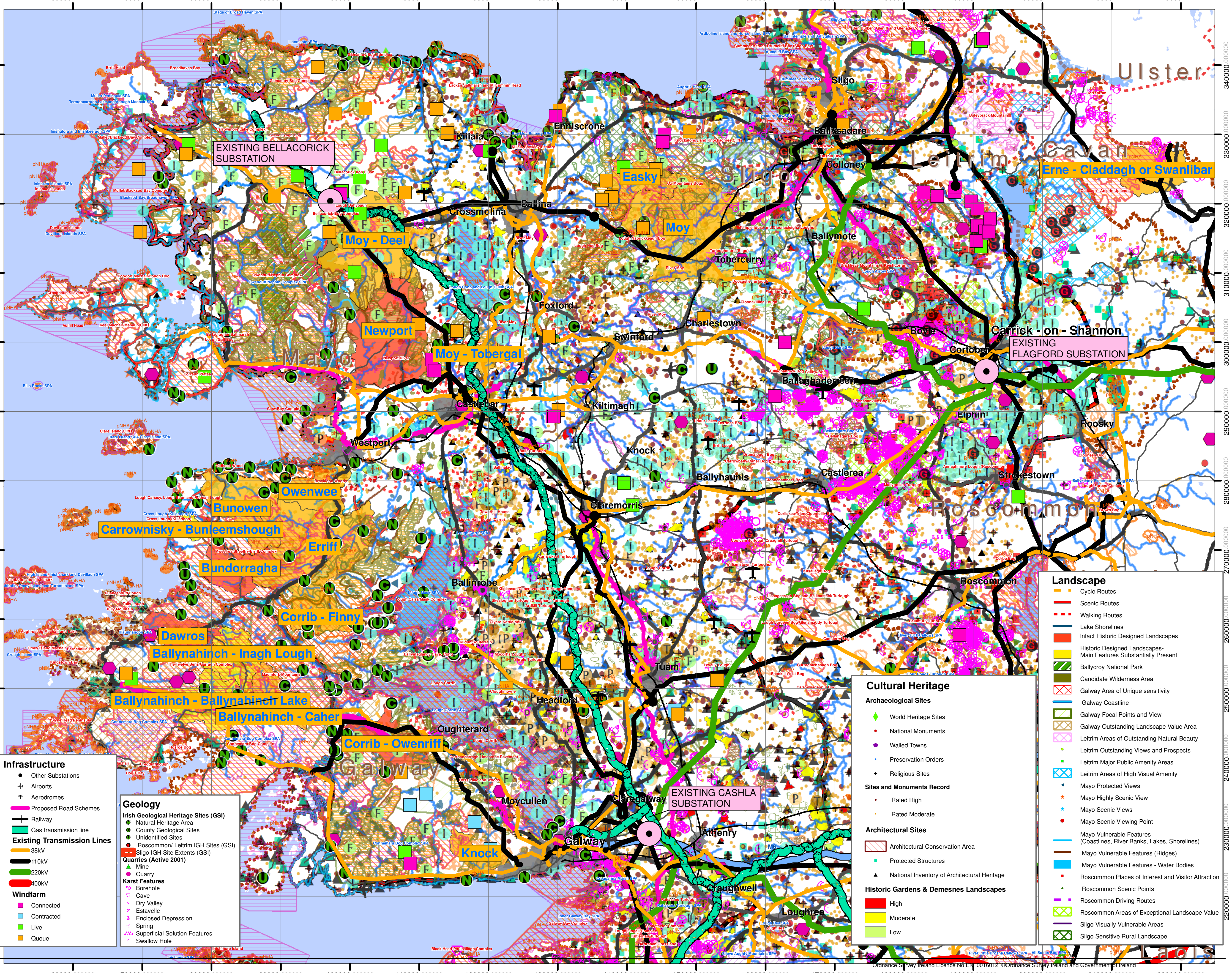
- Settlements
- Cultural Heritage
- Utilities & Infrastructure

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, refer to section 2.5 of this report), 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 based on impact avoidance through careful positioning. This process helps to define less constrained areas, which will form 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.

These constrained areas are shown in Figure 2-2 and were published for public consultation in August 2012.

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




## Ecology

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

**Designated Sites**

- Special Area of Conservation
- Special Protection Areas
- Natural Heritage Areas/ Proposed Natural Heritage Areas

**Features of ecological significance**

- Fen
- IWeBS Site
- Potential Turlough
- Turlough
- Coastal Lagoon
- Limestone Pavement
- Semi-natural Grassland
- Woodlands
- Intact Raised Bog
- Raised Bog (un-surveyed)
- Wetland
- Salt Marsh
- Blanket Bog
- Wet Heath

**Fresh Water Pearl Mussel Catchment**

- Catchments of SAC populations listed in S.I. 296 of 2009
- Catchments of other extant populations
- Catchments with pre-1970 live records

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: GRID WEST ELECTRICITY TRANSMISSION SCHEME

Title: CONSTRAINTS WITHIN STUDY AREA

Scale @ A3: 1:500,000

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

Project Director: M.Garrick


TOBIN
Patrick J. Tobin & Co. Ltd.
Consulting, Civil and Structural Engineers,
Market Square, Castlebar,
Co. Mayo, Ireland.
tel: +353-(0)1-8030406
fax:+353-(0)1-8030409
e-mail: info@tobin.ie
www.tobin.ie




Figure 2.2

A

Key sensitive areas (noted on Table 2-2 as primary constraints), are treated as areas which should be avoided. If it proves not to be possible to avoid these areas, then additional mitigation measures, including partial undergrounding, may need to be considered.

## 2.3 REVIEW OF EIRGRID SEA FOR GRID25 IMPLEMENTATION PROGRAMME 2011 – 2016 (IP)

The Implementation Programme (IP) 2011-2016 is the practical implementation of the EirGrid Grid25 Programme for Irelands' national grid. EirGrid, recognising its' obligations under the SEA Directive and Irish law, prepared a Strategic Environmental Assessment (SEA) and published an SEA Statement and Environmental Report to provide 'a clear understanding of the likely environmental consequences of decisions arising from the Grid25 IP'. The project team reviewed the EirGrid SEA Environmental Report of the Grid25 IP prior to developing the Grid West project approach to identification and evaluation of corridors. The Grid West project team has compared this report, to the methodology proposed for the Grid West project. The following are the constraint factors, used in the SEA constraint heat mapping process.

- Special Areas of Conservation (SACs);
- Special Protection Areas (SPAs);
- Ramsar Sites;
- National Parks;
- UNESCO Sites;
- Elevation › 200m;
- Slope › 30 Degrees;
- Settlements;
- Natural Heritage Areas (NHAs)/Proposed NHAs;
- Natural Land Use Types; and
- Lakes and Estuaries.

Similar constraints have been used for the Grid West project, augmented to include datasets which address difficulties encountered in sourcing data at the time of preparation of the SEA Environmental Report, and outlined in Section 3.10 of that report. In relation to Ramsar sites, the Grid West project team has not specifically used this as a constraint as all Ramsar sites in the study area are already included within the Natura 2000 network i.e. within SAC and or SPA sites. The Grid West project team has conservatively used slopes in excess of 15 degrees as a screening factor, as opposed to slopes in excess of 30 degrees, as the project team consider that the more strict avoidance of slopes over 15 degrees, where possible, is preferable in the Grid West study area, where stability of slopes and of blanket peat deposits, and the need to control slopes of construction/access roads are particular regional factors. In addition, the Grid West project does not specifically use natural land use types[9] as a constraint; they have however included constraints which correlate with these constraints (e.g. designated sites, uplands, annexed habitats). All other constraints applied in the SEA for Grid25, are included in the Constraints for the Grid West project.

[9] In the Environmental Report for the Grid25 Implementation Programme 2011-2016, SEA it states that "natural land use types" correlate well with the annexed habitats, designated sites and upland areas

The SEA also details its Strategic Environmental Objectives (SEOs) as outlined in Table 2-1.

**Table 2-1 Strategic Environmental Objectives (SEOs)10**

| SEO Code | SEO |
|---|---|
| B1 | To ensure compliance with the Habitats Directive with regard to the protection of Natura 2000 Sites and Annexed habitats and species |
| B2 | To ensure compliance with Article 10 of the Habitats Directive with regard to the management of other environmental features – which by virtue of their linear and continuous structure or their function act as stepping stones - which are of major importance for wild fauna and flora and essential for the migration, dispersal and genetic exchange of wild species |
| B3 | To avoid significant impacts on relevant habitats, species, environmental features or other sustaining resources in Wildlife Sites |
| L1 | To avoid significant adverse impacts on the landscape, especially with regard to those arising from impacts on the factors which comprise the Landscape Constraints Rating Map |
| CH1 | To avoid unauthorised impacts upon archaeological heritage (including entries to the RMP) and architectural heritage (including entries to the RPSs) |
| C1 | To help to facilitate the achievement of higher level government targets contained in the Government's Energy White Paper Delivering a Sustainable Energy Future for Ireland - the Energy Policy Framework 2007-2020 and relating to the Kyoto Protocol |
| HH1 | Minimise proximity of development to concentrations of population in order to reduce actual and perceived environmental effects |
| W1 | To prevent impacts upon the status of surface waters in line with the recommendations outlined in the River Basin Management Plans |
| W2 | To prevent pollution and contamination of ground water in line with the recommendations outlined in the River Basin Management Plans |
| MS1 | To minimise effects upon the sustainable use of land, mineral resources or soils |

The objectives detailed in Table 2-1 above, reproduced from the Environmental Report of the SEA, are being adhered to in the Grid West project, particularly in the identification of the constraints and in the identification of route corridor options and substation site options. For example B1, B2 and B3 in relation to ecological objectives are also considered primary constraints for the Grid West project. The landscape constraints (L1) are also taken into consideration, with the project team also considering slope, at a more demanding level of 15 degree slope, while 30 degree slopes are outlined in the EirGrid SEA. Cultural heritage (CH1) as a constraint has been taken into account in the Grid West project in both the constraints mapping and the route corridor identification stage.

The project team understands the SEA observation that building new transmission infrastructure in the West Region will lead to difficulties in meeting the requirements of the Habitats Directive as well as potentially significant visual impacts'. The project team has tried to ensure that corridors are located in areas where they can be absorbed into the landscape i.e. in 'white space', or least constrained areas, as outlined in Objective L1. Given the nature of transmission lines, landscape impact, with this type of infrastructure, is a particular challenge. The SEA highlights the potential, in Section 8.11.4 of the SEA,

[10] Source:- Table 7.2 of the Environmental Report for the Grid25 Implementation Programme 2011-2016, SEA

for environmental conflicts to ‘occur in the crossing of ecologically and scenically sensitive areas’. For this reason, the project team has ensured that ‘avoidance of impact’ is the key approach and design priority adopted in the identification of route corridors. However in some instances it is understood that avoidance is not always possible, there will be some potential impacts from this type of development, (e.g. route corridors crossing SAC’s), but the project team has selected corridors which will minimise this impact.

## 2.4 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. 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 undertook to identify route corridor options in least constrained areas (white space), where possible. This work was initially carried out by each specialist working independently.

This independence is not, however, exercised in ignorance of other constraints, which were available to all on the constraint mapping. While, under the modified Delphi process, route corridor option generation 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 their 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, preparatory to a workshop discussion, where any element of group-conditioning of initial positions, is deliberately avoided.

In this context, the main constraints considered at this stage include Cultural Heritage, Landscape, Ecology, Engineering and Settlements.

It was considered that bedrock Geology is not a defining constraint in influencing the identification of route corridor options, but mapping of peat deposits has been used as a constraint. Geological features are often quite localised, and are considered within the engineering discipline. Geology as a constraint will also be considered at later stages of the project when decisions are made with regard to the specific route of the transmission line. In addition, the main Water constraints largely correspond with ecological constraints (e.g. rivers, lakes and freshwater pearl mussel habitat); therefore the hydrogeologist did not seek to identify separate potential route corridors to those of the ecologist.

The potential route corridors identified by each specialist were then mapped and an internal workshop convened to review the common routing and the differences in routing, so as to identify an agreed set of potential route corridors, as described herein.

## 2.5 PREPARATION OF HEAT MAPPING

The approach taken for this 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. In the study area, as detailed in the Constraints Report (August 2012), there are more than 80 identified constraints layers, of different importance across the study area, and many of which overlap. This raised the question as to how best to present, in a visual and meaningful way, the collective presence of only some, or perhaps all, of these constraints in a given area and how should the project team take into account, in that visualisation, that some constraints, such as statutorily designated lands, are more critical than others, e.g. local constraints.

Accordingly, 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 categorisation of constraints into the primary, secondary and other constrained areas, as defined herein, to allow the specialists to understand the extent, degree of accumulation, and relative impact of various constraints on the route corridors.

Spatial analysis was used to examine the extent to which a given unit area (the 'pixel') is covered by several mapped constraints, of different degrees of criticality, and to derive a visual way to represent the constraint density in that location. The Consultants' team term this process 'heat mapping', where the analogy with temperature is such that more densely constrained locations are 'warmer' in the heat map. Our specialists can then be guided by the heat map, to concentrate their efforts to agree potential route corridor positions in the 'cooler' least constrained areas.

Spatial analysis can be applied to geographic information system (GIS), data to allow the analysis and graphical representation through heat mapping of multiple influencing factors, such as constraints. The results, both visually and quantitatively, can be used to either analytically determine, or to inform and guide, the selection process. For this application to the Grid West project, the output, in the form of a graphical heat map, is used as a support tool to assist the various specialists in determining potential route corridors.

### *2.5.1 How Spatial Analysis is Applied*

*ArcGIS Spatial Analyst*, is proprietary software which provides a broad range of powerful spatial modelling and analysis capabilities. It allows the project team to create, query, map, and then analyse granular or 'cell-based' raster data. '*Heat mapping'* is a product of spatial analysis, which provides a coloured visualisation of the cumulative intensity of overlapping constraints in each cell, or pixel, of the study area. The size of the pixel is chosen to best balance computing power requirements, with granularity of the visuals over the study area for the Grid West project, given scale of the study area, a 100m x 100m pixel size has been selected as optimum in this regard.

Using the analogy of heat, the simultaneous presence of several constraints overlapping in a pixel, will result in a higher '*temperature*' in a 100m x 100m cell or pixel, and the profile of temperature right across the study area can then be visualised as a three-dimensional surface, where the specialist team members are trying to avoid the high temperature areas. They can visualise and seek to identify route corridors along the lower temperature areas or 'areas' of least temperature in the three dimensional surface. This will guide their deliberations, mediated by their experience and expertise, to identify the best corridor positions, for later evaluation.

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), this process is outlined herein.

All Constraints were discussed by the specialists, following the first Consultant workshop and were categorised by agreement into three groups (Primary Constraints, Secondary Constraints and Other Constraints).

- Primary Constraints are those which should be avoided. If it is possible to locate route corridors away from Primary Constraints, then this is a priority design objective.
- Secondary Constraints should be avoided, where possible, but mitigation measures should be considered, if unavoidable. Examples include Sites & Monument Records (MMRs), 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[11] assigned by each specialist, appropriately sized, having regard to the impact they were seeking to avoid. These buffer zones are to allow 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 constraint layers to be analysed, the categorisation allocated and the buffer zones are set out in more detail in the schedule included in Annex 2.1'Constraints Classification Sheet'.

[11] 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.

**Table 2-2 Details of Constraint Type**

| Primary Constraints | Secondary Constraints | Other Constraints |
|---|---|---|
| Constraints which should be avoided. Examples include population centres, Natura 2000 sites, National Monuments. | Constraints which should be avoided, where possible. Mitigation measures would be considered, if unavoidable. Examples include Sites & Monuments Records (SMR's), river crossings | 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 |

The three groups of layers have a nominal value assigned 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.

Areas of 'cooler temperature' emerge by the assignment of these values; the assigned values do not overwhelm likely combinations of secondary constraints, by nearby presence of a single primary constraint. It is important to emphasise that at the time of making this decision on how to score primary, secondary and other constraints in heat mapping, the project team did not know the impacts of this decision in terms of the heat mapping outcome, or corridor generation, nor did the project team subsequently revise it at any time.

It is also important to understand that heat mapping, is essentially a colour coding of the values obtained by addition of individual numbers, each calculated from a multiplicative weight applied to the constraint present in a pixel. As such, there are no 'guidelines' or 'standards' to be used, in what is essentially an arithmetic process.

The SEA dealt with a high level group of just twelve constraints, and it anticipated that later work, in landscape mapping for example, would examine certain micro-landscape features, at regional level, 'through route selection and lower tier assessments'[12]. The Grid West project team has developed a more detailed group of more than 80 constraints, addressing information difficulties acknowledged in Section 3.10 of the SEA; this requires the management of a greater number of constraints, with wider classifications and weighting. It should be noted therefore, that while the number of Grid25 SEA constraints has increased in the Grid West project approach, and heat mapping weightings differ, the coverage of these constraints is maintained similar to that adopted in the SEA.

[12] Section 3.10.2 Mapping of Landscape Constraints (pg 17) of the Environmental Report for the Grid25 Implementation Programme 2011 – 2016.

### 2.5.2 Methodology for Spatial Analysis (Heat Mapping)

The process of development of the heat mapping was as follows:

- The study area was divided in a number of cells or pixels, the size of which determined as described above. It was considered that each cell should be 100m x 100m as a balance between computing effort and visual granularity, so that there are 100 cells in each square kilometre of the study area.
- Each cell defines a small unit of area, in which several constraint layers may overlap, so that several are present in the same cell.
- Every constraint layer was originally constructed as a vector[13] layer. All layers were converted to rasters[14] with an appropriate cell value (2, 10 or 50) corresponding to the assigned constraints group.
- After processing all the layers, the *Cell Statistics* tool which is a part of *Spatial Analyst Extension*, was applied to sum up the values in the input rasters on a cell-by-cell basis. All raster layers were merged and their values in each cell were summarised. The total summed value in each cell was then used to generate the heat mapping ‘temperature’ in that cell.
- The heat map was visually coloured as follows:

    - Cell value >49: Red
    - Cell value >29,<49 Orange
    - Cell value >9,<29 Yellow
    - Cell value >5,<9 Light green (lime green)
    - Cell value >2<5 Dark green

This methodology is graphically illustrated in Figures 2-3 to 2-7.

[13] Vector layers hold scalable vector objects. At any time in the future you can change its size, position and colours. They are saved in a certain way that is not tied to fixed pixels.

[14] Raster data type consists of rows and columns of cells, with each cell storing a single value. Raster data can be images (raster images) with each pixel (or cell) containing a colour value. A raster cell stores a single value.

**Figure 2-3 Part of pNHA (purple line) and SAC layer (black line) as a vector layer**

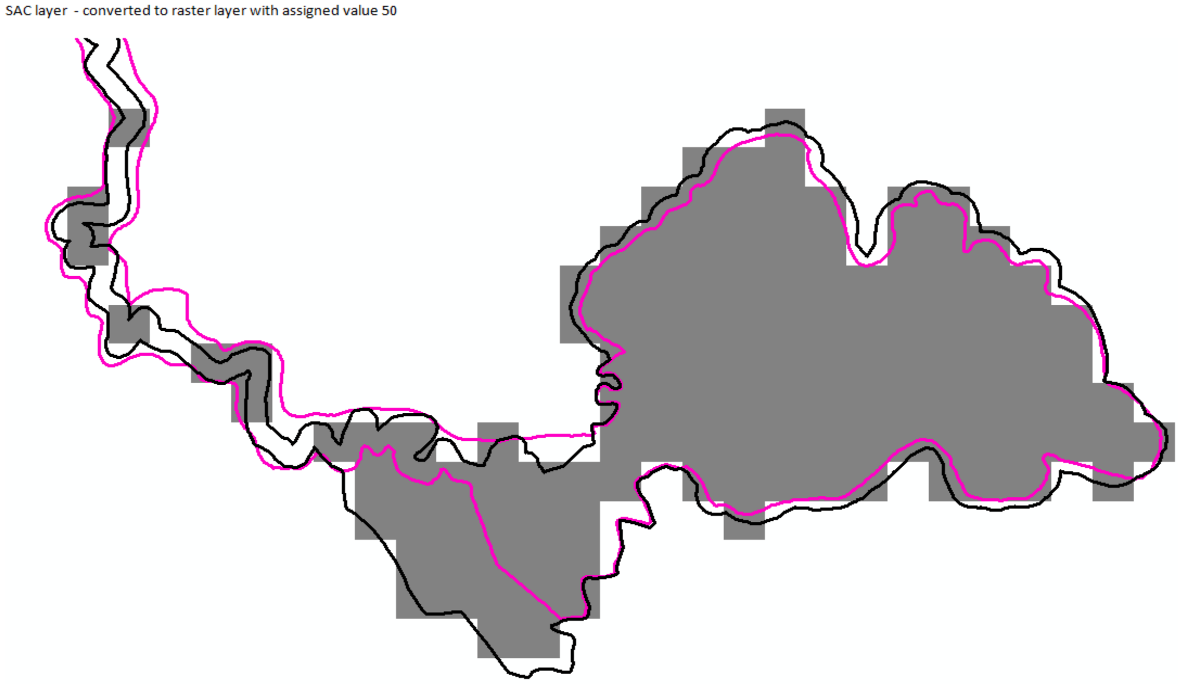



**Figure 2-4 SAC layer (black line) converted to raster layer with assigned value in each cell = 50**

And pNHA layer converted to raster with assigned value 10

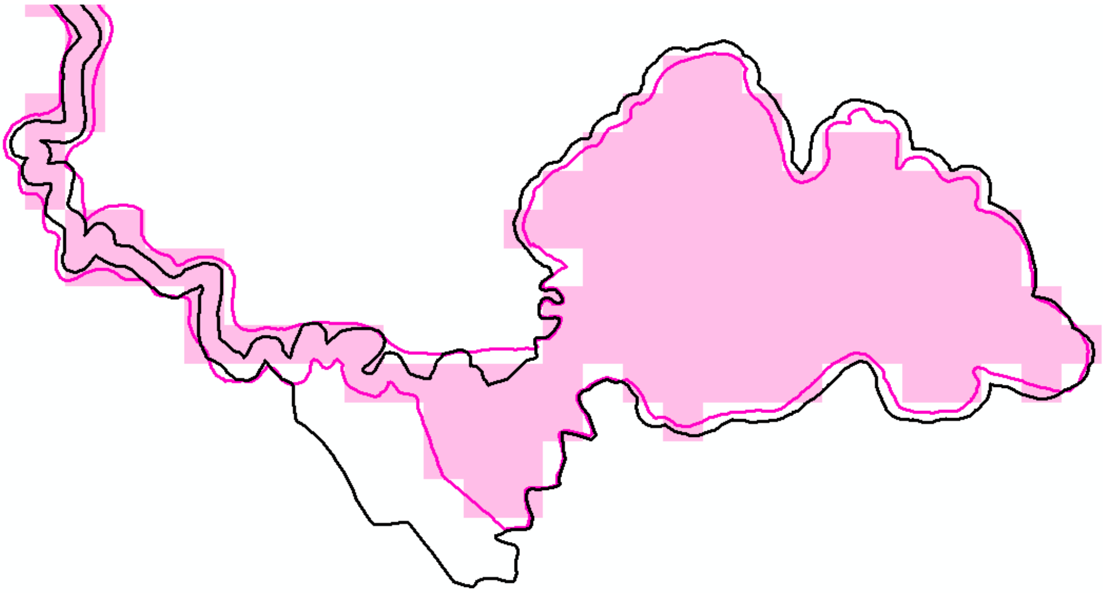


**Figure 2-5** pNHA layer (purple line) converted to raster with assigned value in each cell = 10

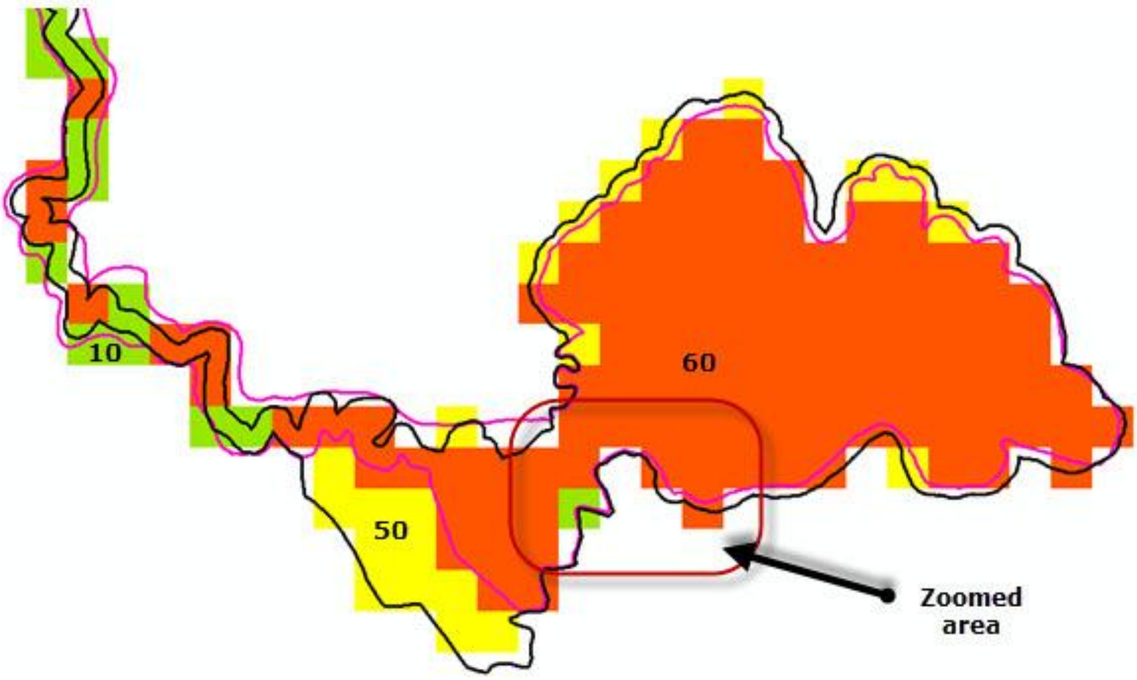



**Figure 2-6** Combined pNHA and SAC layer with summarised valued of pixels (value ranges between 10 and 60)

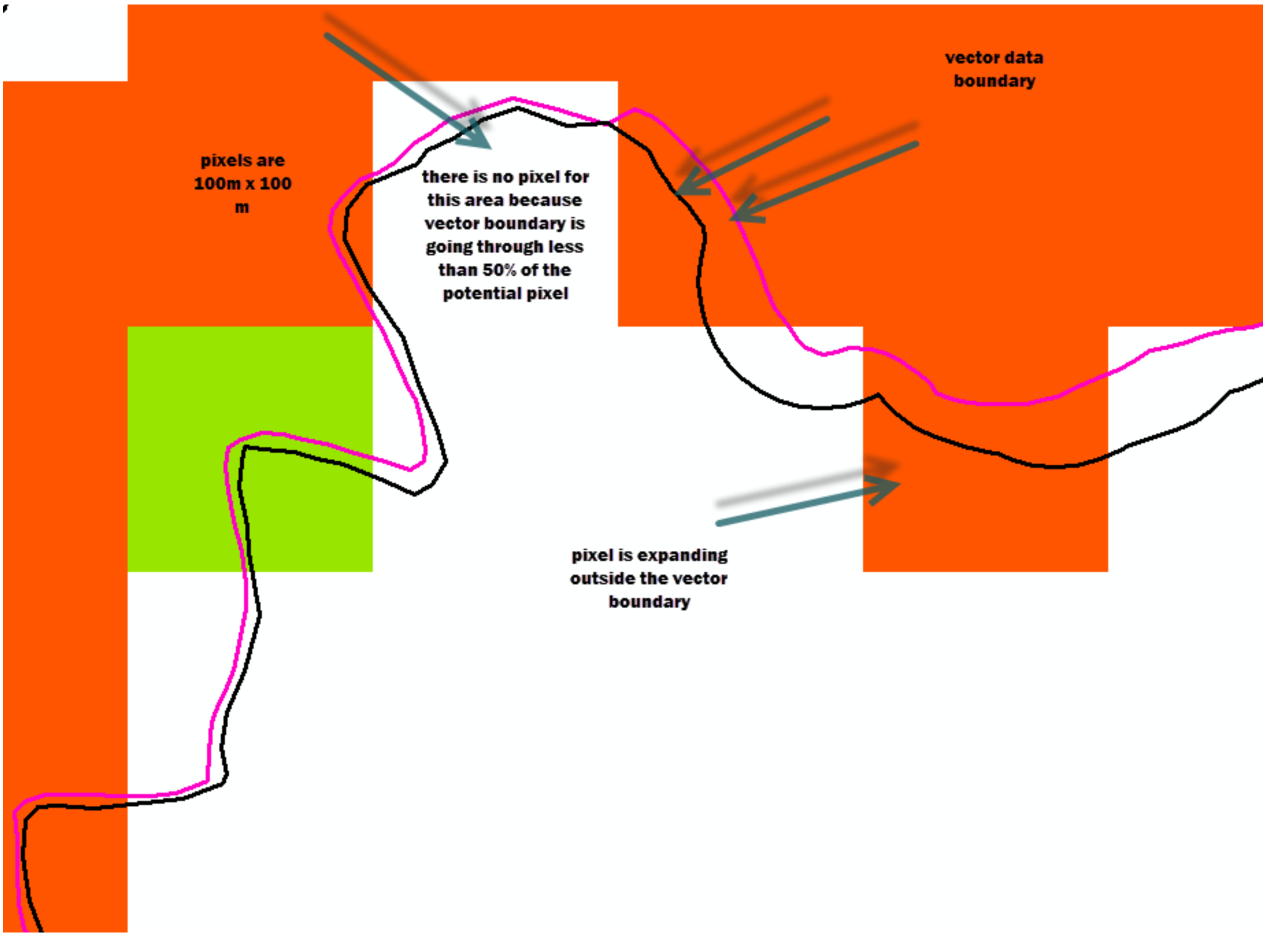
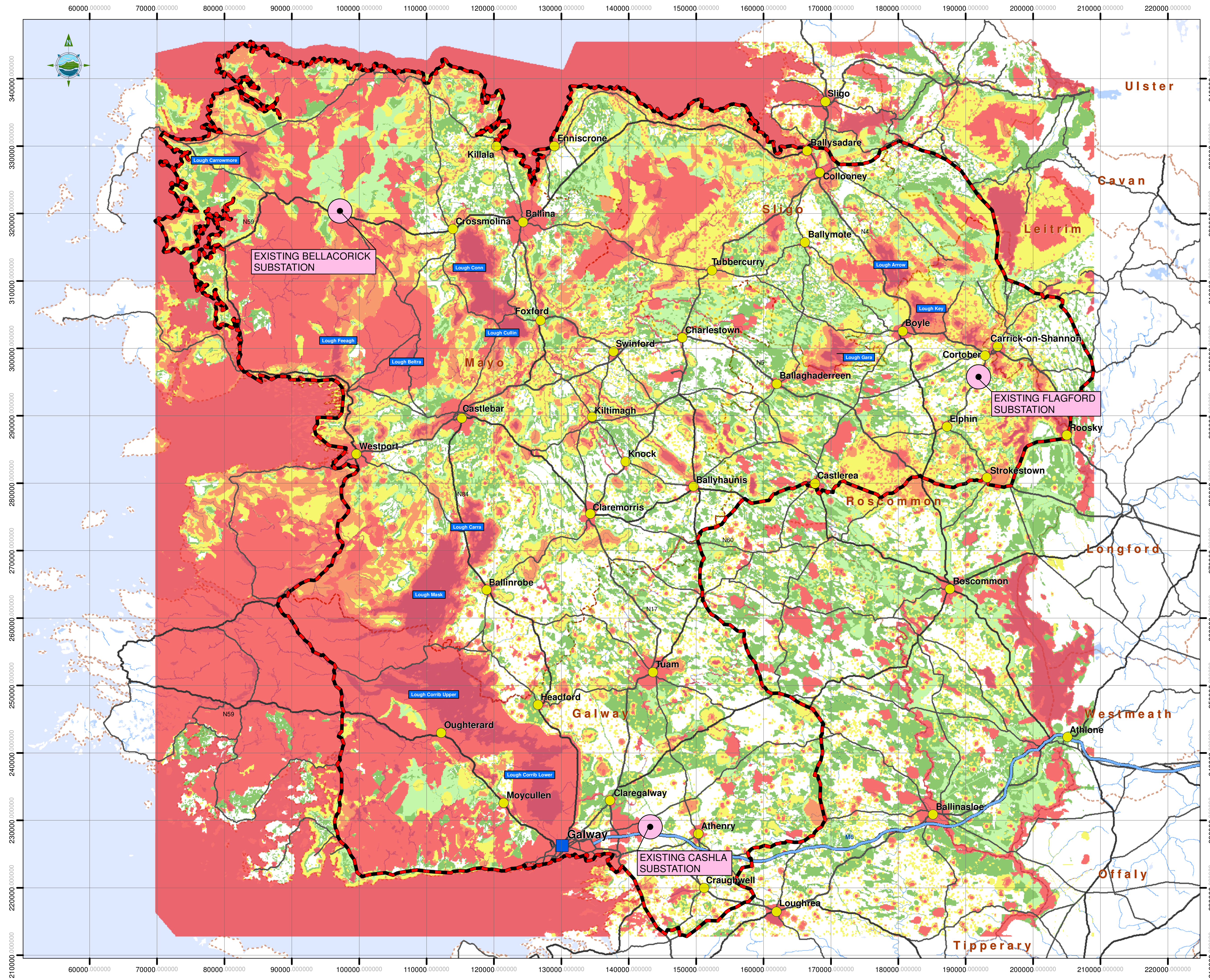



**Figure 2-7** **Resolution of Heat Mapping with details of Rasterisation**

It is important to remember that spatial analysis heat mapping does not 'select' the route corridor options. It is an analytical tool which informs the discussions of the environmental and engineering specialists who make those selections, by providing the necessary granularity, on a pixel scale granulated basis, in the balancing of several constraints, all of which may be present at the same location. It helps to answer the question:

"*If we were trying to stay as far as possible from these constraints, prioritised in the manner our specialists have agreed, where would we position a corridor*?"

The resulting Heat Map for the Study Area is shown in Figure 2-8.




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

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:

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


TOBIN
Patrick J. Tobin & Co. Ltd.
Consulting, Civil and Structural Engineers,
Market Square, Castlebar,
Co. Mayo, Ireland.
tel: +353-(0)1-8030406
fax:+353-(0)1-8030409
e-mail: info@tobin.ie
www.tobin.ie



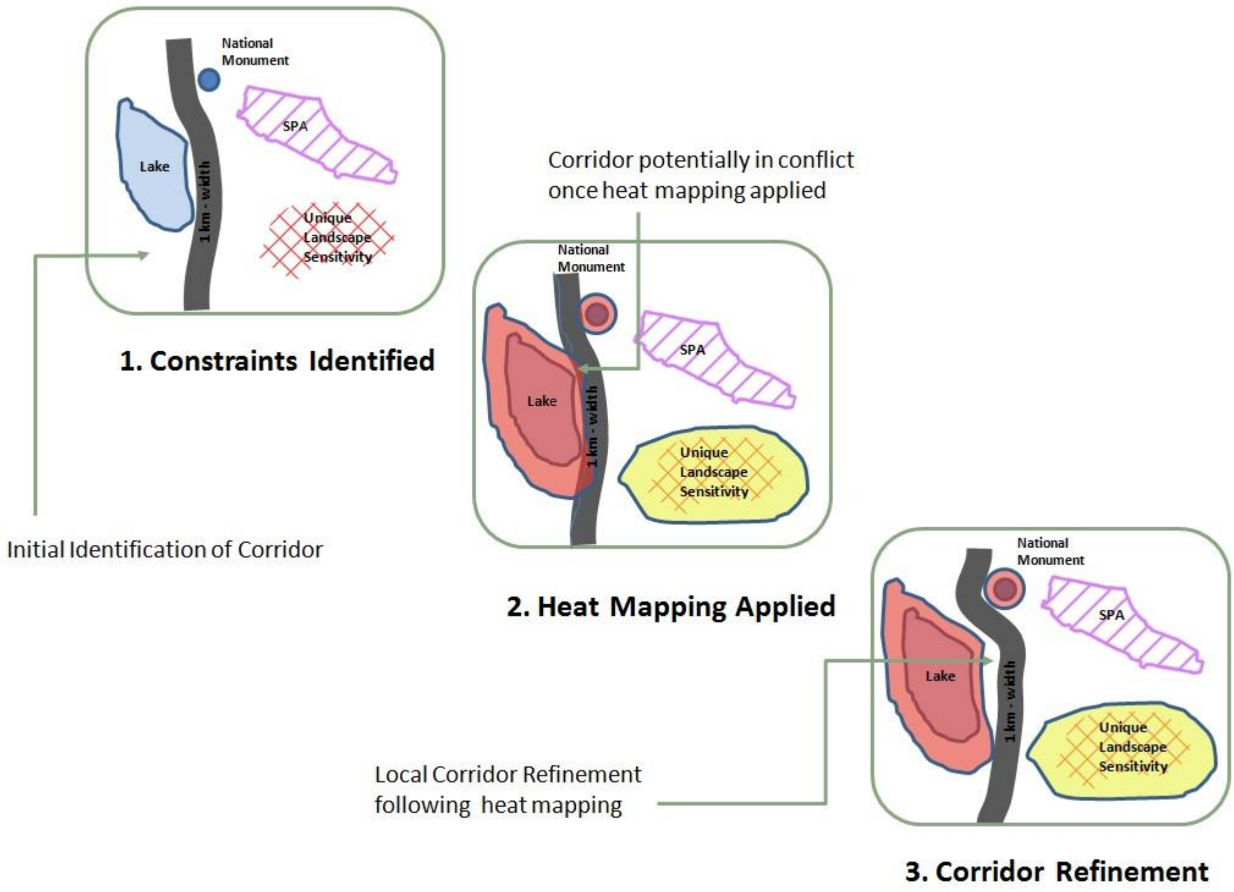

Figure 2.8

A

## 2.6 REFINING ROUTE CORRIDORS

The refinement of route corridors is an iterative process, with initially identified route corridors being refined following review of heat mapping, site visits, input from stakeholder consultation and specialist input. Figure 2-9 below details this process.

**Figure 2-9 Corridor Refinement Process**




### *2.6.1 Refining Corridor Options against Heat Mapping*

The Grid West study area is heavily constrained; however the distribution of the type of influencing constraints varies. For this reason, it is natural that different specialisms will be more influential in some geographic areas and less in others. For example, the area around Bellacorick is highly constrained by statutorily designated sites and hence the ecologist needed to contribute significantly to the decision making in this area.

Once the heat mapping was developed, the Consultants' specialists' team embarked on a programme of site visits to examine the route corridor options against site topography and features on the ground, this was done in a number of stages.

### 2.6.2 Corridor Workshop

Following the ground truthing exercise, a workshop was jointly held between the Consultants' project team and EirGrid in October 2012, in order for the project team to present the shortlisted route corridors, to the extent that they had been refined at that particular time. At this workshop, the *process* for refinement was presented, including any findings from the initial site visits. Following confirmation from EirGrid that they accepted the approach taken with regard to the identified route corridors, the project team completed the refinement process. As noted in Figure 2-9, this involved further detailed site visits of route corridors and substation site locations which had been identified.

### 2.6.3 Further Refinement of Corridors

The shortlisted set of route corridor options were taken to the next stage of verification, which involved detailed site surveys including reviewing aerial photography and more detailed topographical data. The purpose of these site surveys 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.

This work included the Environmental and Engineering Managers, and members of their project team, going on site and checking key pinch points to verify alignments and constraints. This involved driving public roads within and along the route corridors, using a GPS tracking device, and recording each point of interest by taking notes and photographs (using a GPS camera) at these locations. The notes were logged in the GIS system during the windscreen surveys and the photos were linked to each note in the GIS system.

Following the site visits, the identified potential route corridors were modified using the notes and the photographs from these surveys. Refinements of the route corridors 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, key specialists (ecologist, archaeologist and landscape architects) also completed site surveys, in order to review and validate refined corridors in relation to their particular constraints, taking into account the knowledge gained at the workshops, and the spatial analysis in the form of 'heat mapping'.

Each specialist provided the Environmental and Engineering Managers with comments on the refined corridors and any recommendations they considered necessary, to further refine the corridors.

## 2.7 CONFIRMATION OF REFINED CORRIDORS

Following the site visits by the Engineering and Environmental Managers and the key specialists, the route corridors were further refined.

Once the route corridor options were fully refined, as detailed in Figure 2-9 herein, the route corridor naming system was also finalised and the refined route corridors were then signed off by the Lead Consultant Project Manager and sent to all specialists for both final review and evaluation.

The final refined potential corridors are shown on the Heat Mapping in Figure 4-2.

# 3. METHODOLOGY FOR SUBSTATION SITE IDENTIFICATION

## 3.1 INTRODUCTION

This section sets out the methodology used for identifying the potential locations of the substation for the Bellacorick node, including areas both remote from and adjacent to the existing substation site, and the new or extended substation required at either Cashla or Flagford. The substation site selection process was done in parallel with, and informed by, the potential route corridor identification process.

Two substation technologies have been considered for the Grid West project. Both technologies are commonly applied across the world, however Air Insulated Switchgear (AIS) is the predominant technology used in the Irish national grid. A brief explanation each of the technologies is as follows:

- *Air Insulated Switchgear with gas Insulated or vacuum circuit breakers (AIS)*: 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 4m plus, usually achieved using steel supports, and post insulation, to mount the high voltage (HV) equipment. These large insulating distances lead to larger, more sparse substation layouts as shown in Plate 3-1.

**Plate 3-1 Typical AIS Layout**

- *Gas Insulated Switchgear (GIS):* Gas Insulated Switchgear (GIS) substations utilises SF6 gas to insulate the high voltage components and conductors, reducing the electrical clearance distances dramatically, to 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 Indoor GIS Substation**

The substation site identification process identified potential locations for both Air Insulated Switchgear (AIS) and Gas Insulated Switchgear (GIS) substations. The substation sites were identified in a process that involved three phases,

(i) Preparatory work to establish study areas and the requirements at each node;

(ii) Initial desk-based studies to identify potential substation sites in each study area using available mapping, including the constraints mapping and the heat mapping; and

(iii) Refinement of the substation site selection by site visits, review by other specialists and comparison with the corridors identified.

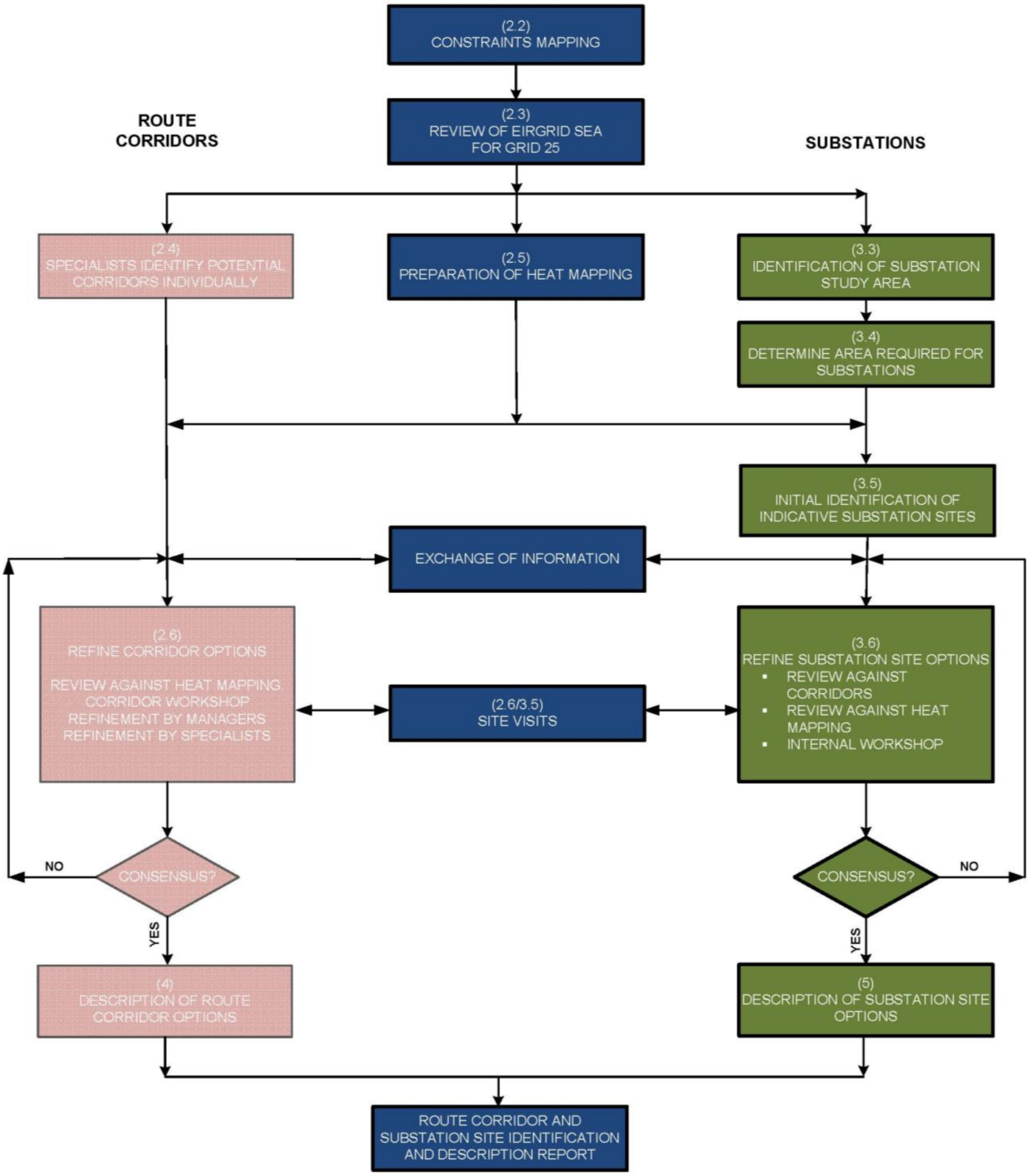
The process applied for potential substation site identification was similar to that used for corridor identification, as originally illustrated in Figure 2-1. This is repeated as Figure 3-3 herein for clarity.

## 3.2 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 substations 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 sites. At this early stage in the project, the identified extent of the study area was not necessarily fixed. The limits could have been extended, or otherwise altered, in light of ongoing project development, including information gathering, technical, environmental and other studies and public and stakeholder consultation.

**Figure 3-1 Substation Site Identification Process**




***Note: the brackets relates to the section of the report where this information is included.***

The nodes required were:

(a) A location for the new 400/110kV Bellacorick substation, either adjacent to the existing substation or at a remote location, taking into consideration environmentally designated areas and the wind farm developments;
(b) A location for a 400kV substation at Cashla, either within, adjacent to or in close proximity to the existing Cashla substation; and
(c) A location for a 400kV substation at Flagford, either within, adjacent to or in close proximity to the existing Flagford substation.

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

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

## 3.3 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 feasible options, with reasonable constraints boundaries.

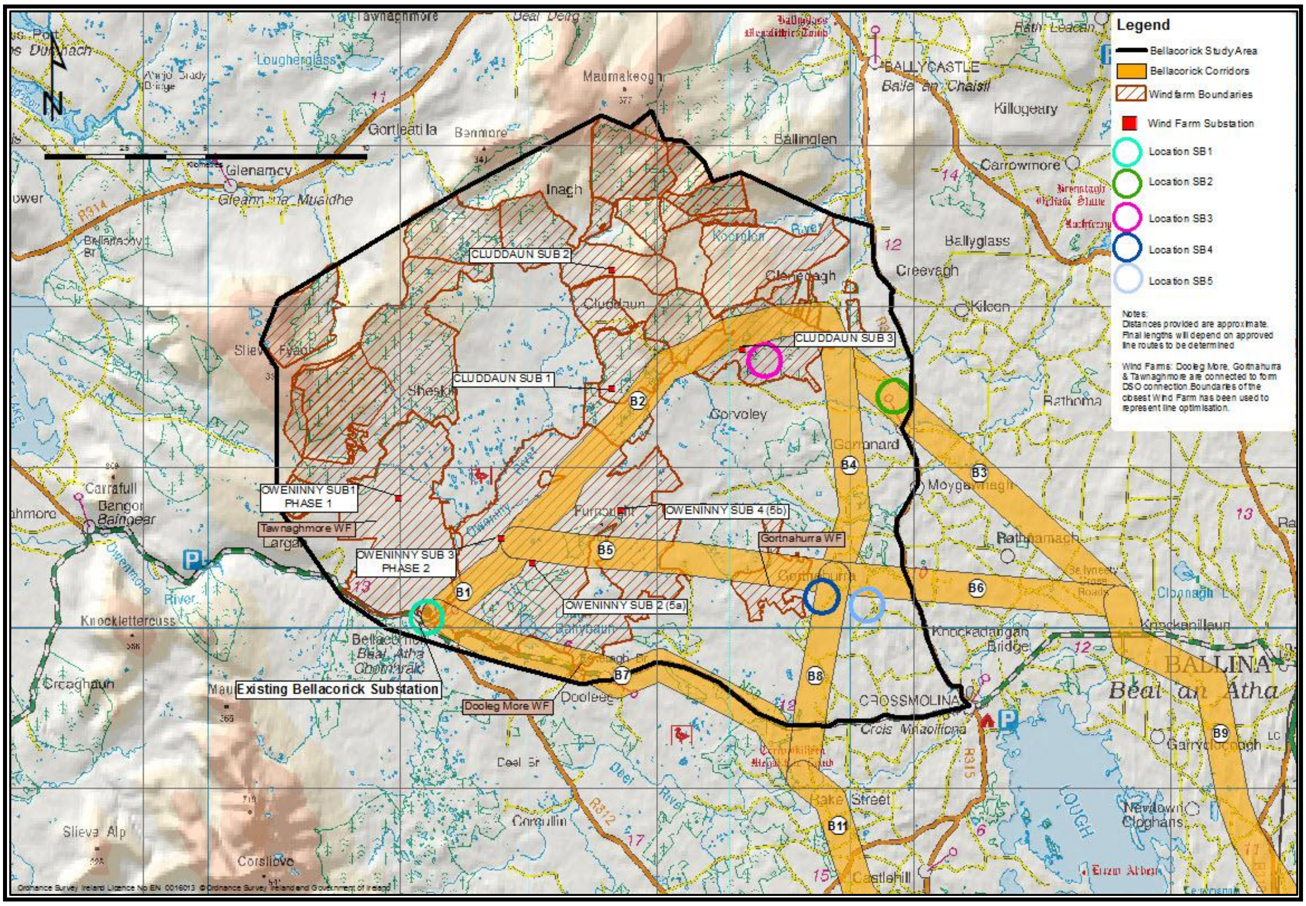
### *3.3.1 Bellacorick Substation Study Area*

The study area for the proposed 400/110kV substation in or around Bellacorick was generally bounded as follows:

- To the west by the western most extents of the wind farms to be connected to new Bellacorick substation and by the area of the Carrowmore Lake complex SPA/SAC, Slieve Fyagh Bog SAC and Owenduff Nephin Complex SPA. These designated areas form a natural barrier of concentrated constraints, which would make it difficult to develop a 400kV transmission line or substation.
- To the south by the boundary of the wind farms which form the greater proportion of Gate 3 connections to the new Bellacorick substation and/or the N59, whichever was more southern.
- To the east by the R315, which also forms the eastern most limits of the wind farms.
- To the north by the known boundaries of the potential wind farms to be connected to the new Bellacorick substation.

Figure 3-2 herein shows the Bellacorick substation study area.

**Figure 3-2 Bellacorick Node Substation Site Study Area**




## 3.3.2 *Flagford and Cashla Substations Study Areas*

As set out above, it was technically preferable for operational and cost reasons that the new 400kV substation at either Flagford or Cashla be built as an extension of the existing substation. The land area required for the new substation was significant and, depending on other constraints, there may not have been sufficient space adjacent to the existing substations. In the planning context, therefore, the sequential principle was applied, whereby potential sites adjacent to the existing substation would be preferred and, only if suitable sites were not available, then the area would be expanded outwards i.e. to remote substation sites.

The benefits of a proposed adjacent substation extension include:

- Utilisation of some of the existing infrastructure and electrical systems, thus reducing overall land requirements;
- Less likelihood of interference to third parties, as all apparatus would all be within a single enlarged site;
- Increased safety, as the general public are aware of the present arrangements;
- Reductions in additional security requirements; and

* Construction activities are facilitated and there is proven access to the site for delivery of heavy equipment.

It was therefore proposed that a study area be considered with a nominal radius of 1km from the existing substation for each of Flagford and Cashla. This would limit any interconnecting circuits to approximately 1km, which may facilitate connection utilising underground cable circuits, with the benefit of potentially limiting the visual impact. A short length of underground cable would be acceptable technically in this situation.

Figure 3-3 and Figure 3-4 below show the study areas for Cashla and Flagford respectively.

**Figure 3-3 Cashla Substation Study Area**

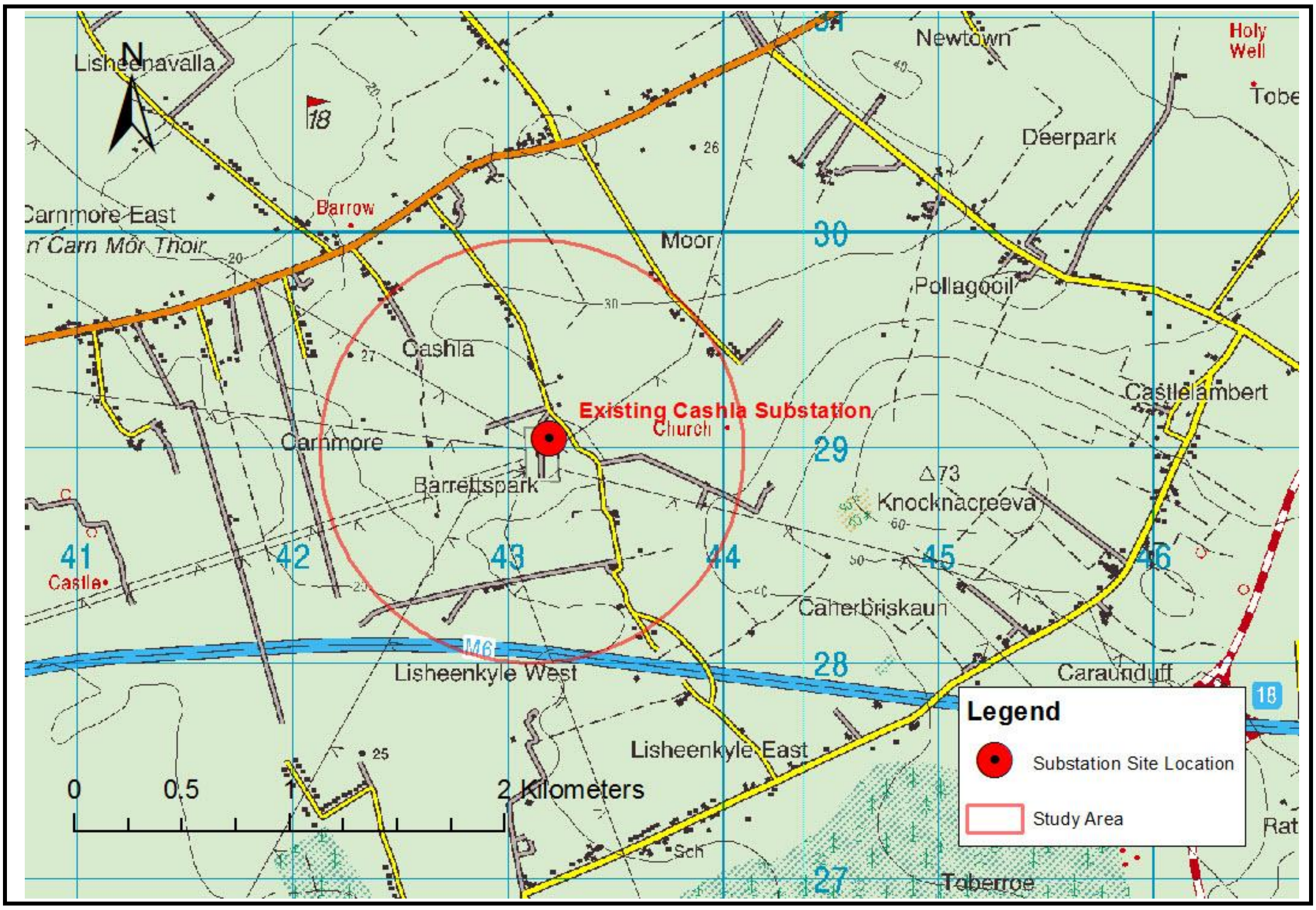


**Figure 3-4 Flagford Substation Site Study Area**


## 3.4 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.

Following discussions with EirGrid as to the potential final development requirements, the areas summarised in Table 3-1 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 3-1 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 |

## 3.5 INITIAL IDENTIFICATION OF INDICATIVE SUBSTATION SITE AREAS

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 and data, the heat mapping, publically available Bing aerial photography[15] and qualitative input by the engineering specialist. Bing aerial photography was used as this provided sufficient resolution to allow initial identification of the site areas but avoided the need to obtain detailed aerial survey photography of the whole study areas at this early stage.

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

At this stage, potential sites areas for both AIS and GIS substations were identified, with neither technology being considered as preferred.

The initial substation site identification process was started once an initial 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.

In the identification process, the size and nature of the substations and their equipment required that the 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 within that site area or location. Therefore the next step in the substation site area identification process was to technically evaluate and assess each potential location.

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

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

### 3.5.1 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 land from and existing features and 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.

### 3.5.2 Local Constraints

The following constraints were taken into consideration:

- ***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.
- ***The need to relocate existing circuit**s; 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.
- ***Slope;*** a review of topographical mapping as any site needs to be relatively flat to minimise civil engineering cost and construction impact.

- ***Accessible;*** a substation site requires roads suitable for the delivery of the expected loads of transformers and high voltage equipment.

### *3.5.3 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, site areas were selected that showed 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 avoided areas 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 identification, although only those constraints occurring within the respective substation study areas needed to be considered.

### *3.5.4 Specialist Review of Initial Sites*

Following the identification of technically suitable substation sites, the other specialists in the project team reviewed the proposed substation site areas, 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 site areas 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 local historical monuments, local habitats such as rivers and streams or hedgerows and specific localised landscape considerations, including opportunities for screening.

## 3.6 REFINEMENT OF SUBSTATION 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.

### *3.6.1 Review against Corridors*

It was a primary consideration that the substation sites identified had to be accessible from at least one of the potential route corridors. During the corridor refinement process, the location of the route corridors sometimes changed, resulting in the substation site areas no longer being accessible from a route corridor. Thus, there was an ongoing iterative process to verify that the substation site areas identified, aligned with the potential route corridors as the corridors were refined.

### 3.6.2 Review against Constraints Mapping and Heat Mapping

As far as reasonably practical, substation sites were selected so as to have no environmental constraints as defined by the constraints mapping and the specialists' local knowledge. As the site area locations were refined, the project team constantly reviewed the emerging locations against the heat mapping and the constraints mapping to ensure that this was achieved. In particular, these tools were used to ensure that the site areas identified, avoided key sensitive areas, as described above.

### 3.6.3 Site Visits

As part of the route corridor site visits for the corridor refinement process referenced in this report, the project team also visited the location of each potential substation site area that had been identified through the refinement process. This included going on site and visually reviewing each site to verify its suitability under the general selection principles and to check for constraints that may not have been apparent from the aerial photography and mapping. This involved driving as close as possible to the substation site using public roads, using a GPS tracking device, and taking notes and photographs (using a GPS camera) at these locations. The notes were logged in the Geographic Information System (GIS) during the site surveys and the photographs were linked to each note in the GIS.

Following the site visits, the substation sites were modified using the notes and the photographs from these site visits.

### 3.6.4 Substation Site Review by Environmental Specialists

As a final element of the refinement process, the substation sites identified by the Engineering Team were reviewed by the environmental specialists on the team, as a final check that there were no unknown or unexpected environmental constraints, which may affect the suitability of the identified site areas.

# 4. DESCRIPTION OF ROUTE CORRIDOR OPTIONS

## 4.1 INTRODUCTION

Following the identification of the initial route corridor as outlined in chapter 3, a number of refined, notionally 1km wide, route corridor[16] options were identified, in which to site a 400kV transmission line. In total, 16 route corridor options have been identified. These refined route corridor options are divided into three representative locational groups; the Bellacorick route corridor, the Cashla route corridor and the Flagford route corridor 'groups', as this grouping facilitates combining route corridor elements, so that the least constrained corridor option from Bellacorick (to the north) could link with the least constrained corridor options to Flagford (to the east) or to Cashla (to the south). These corridor options (or sections of corridors) are first categorised as follows:

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

Therefore, most of the route corridor options associated with the Bellacorick route corridor group can be linked to other route corridor options associated with either the Flagford or Cashla group of route corridor options.

## 4.2 DESCRIPTION OF ROUTE CORRIDOR OPTIONS

The following Table 4-1 is a list of all identified potentially feasible route corridor options with Figures 4-3 – 4-21 depicting each corridor option individually, and also combined, with the study area.

Note that there may be some instances where the linking of corridors is not considered to be practicable, 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 significantly additional length of corridor required to connect both.

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

The lengths provided in subsequent sections are indicative of that section of corridor only. The full length of the route corridors are developed later when the least constrained Bellacorick route corridor options are combined with the least constrained Cashla and Flagford route corridor options.

Composite route corridors are described by adding the relevant sections of each of the identified

[16] Potential Route Corridor is 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.

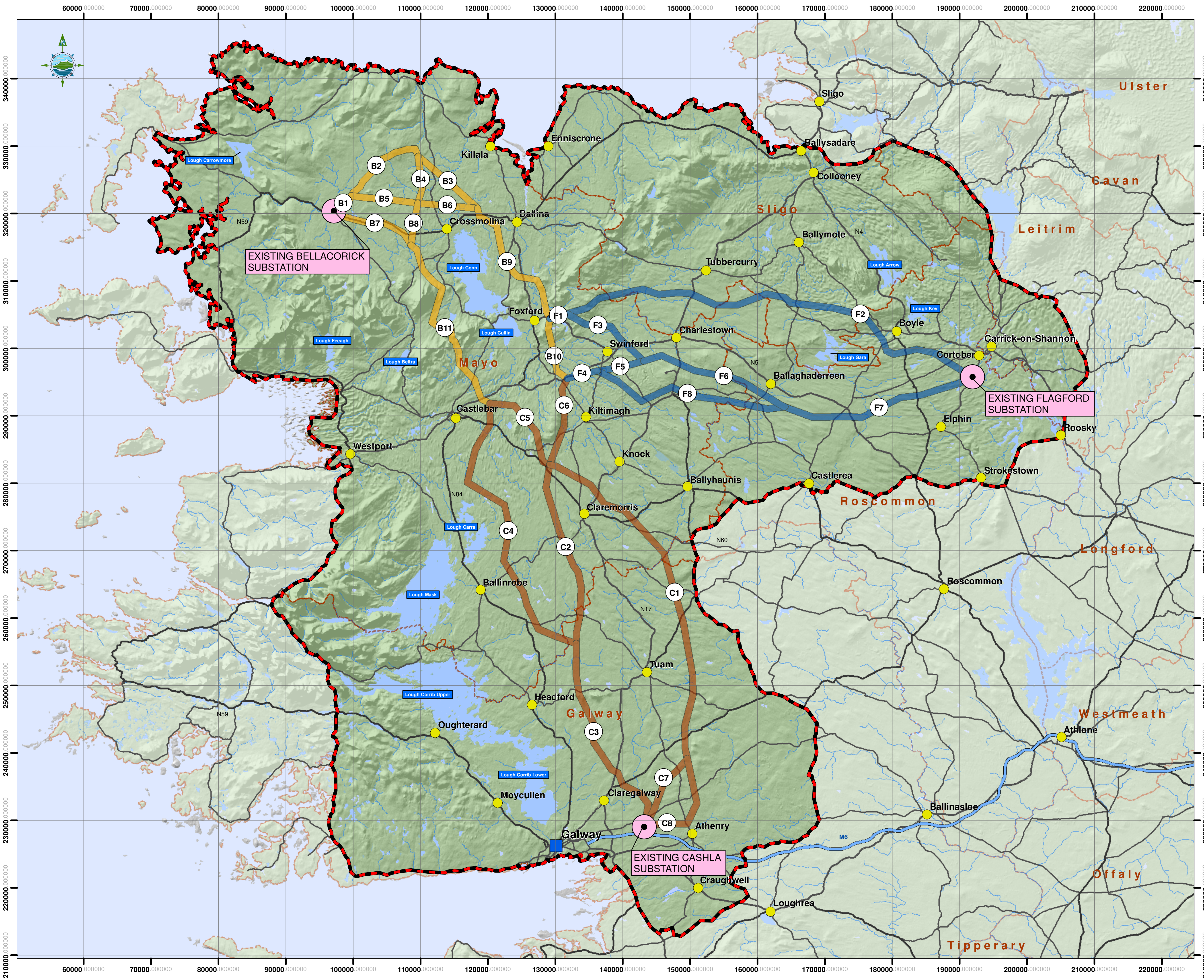
corridors, for example, B1/B2/B3/B9 make up one composite route corridor. Refer to Table 4-1 for a list of composite route corridor options.

**Table 4-1 List of Route Corridor Options**

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

Reference should be made to Figure 4-1 for the Potential Route Corridors Map and to Figure 4-2 for Potential Route Corridors with the Heat Map also presented.

As can be seen from Figure 4-2, the identified route corridor options avoid, where possible, the identified constraints. This process of impact avoidance by good positioning has been described in detail in previous chapters.




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

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

| | | | | |
|---|---|---|---|---|
| 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

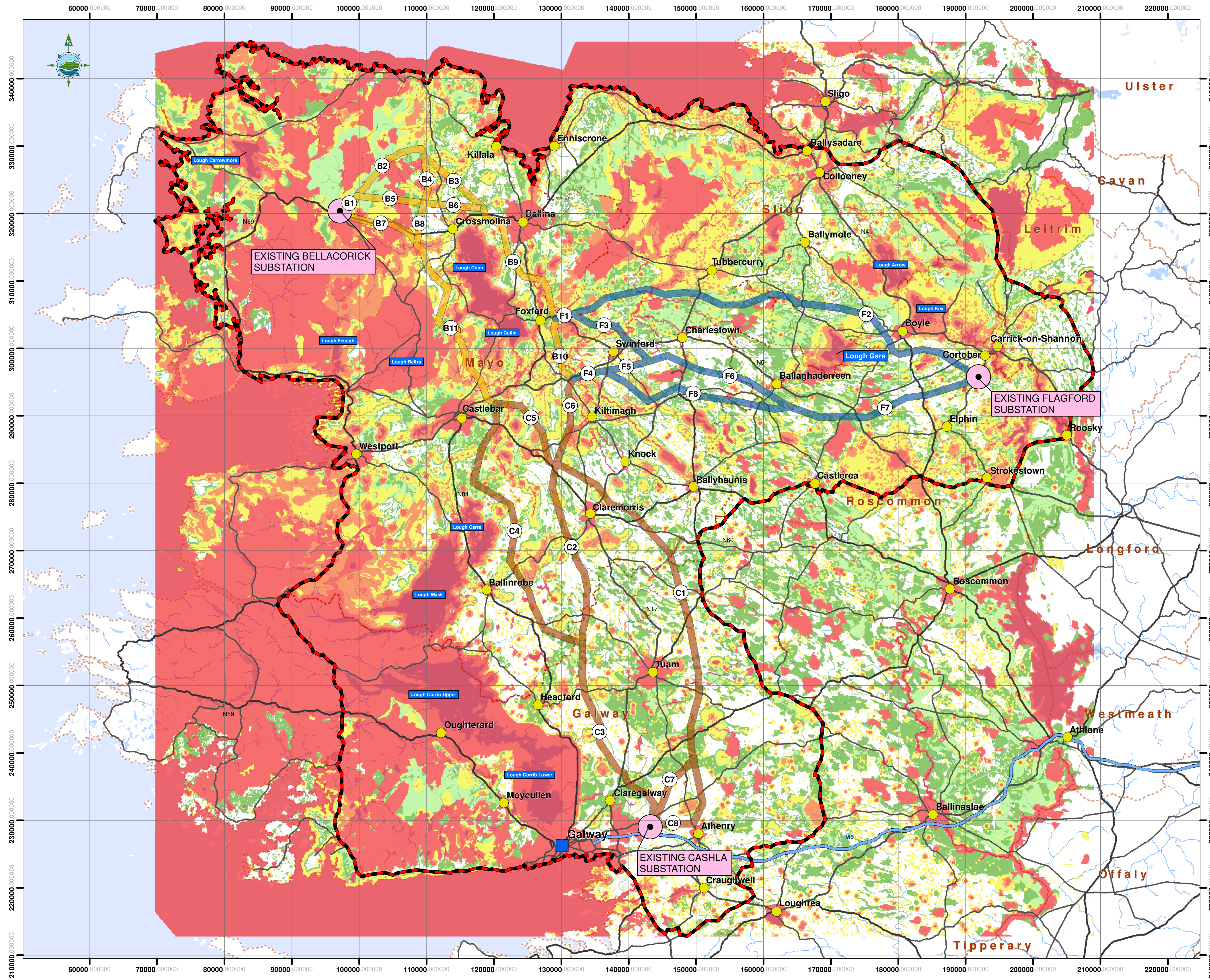
Prepared by: G.Fil | Checked: M.Hogan | Date: February 2013

Project Director: M.Garrick


TOBIN
Patrick J. Tobin & Co. Ltd.
Consulting, Civil and Structural Engineers,
Market Square, Castlebar,
Co. Mayo, Ireland.
tel: +353-(0)1-8030406
fax:+353-(0)1-8030409
e-mail: info@tobin.ie
www.tobin.ie




Figure 4.1 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**

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: POTENTIAL ROUTE CORRIDORS OPTIONS WITH HEAT MAPPING

Scale @ A3: 1:500,000

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

Project Director: M.Garrick

TOBIN
Patrick J. Tobin & Co. Ltd.

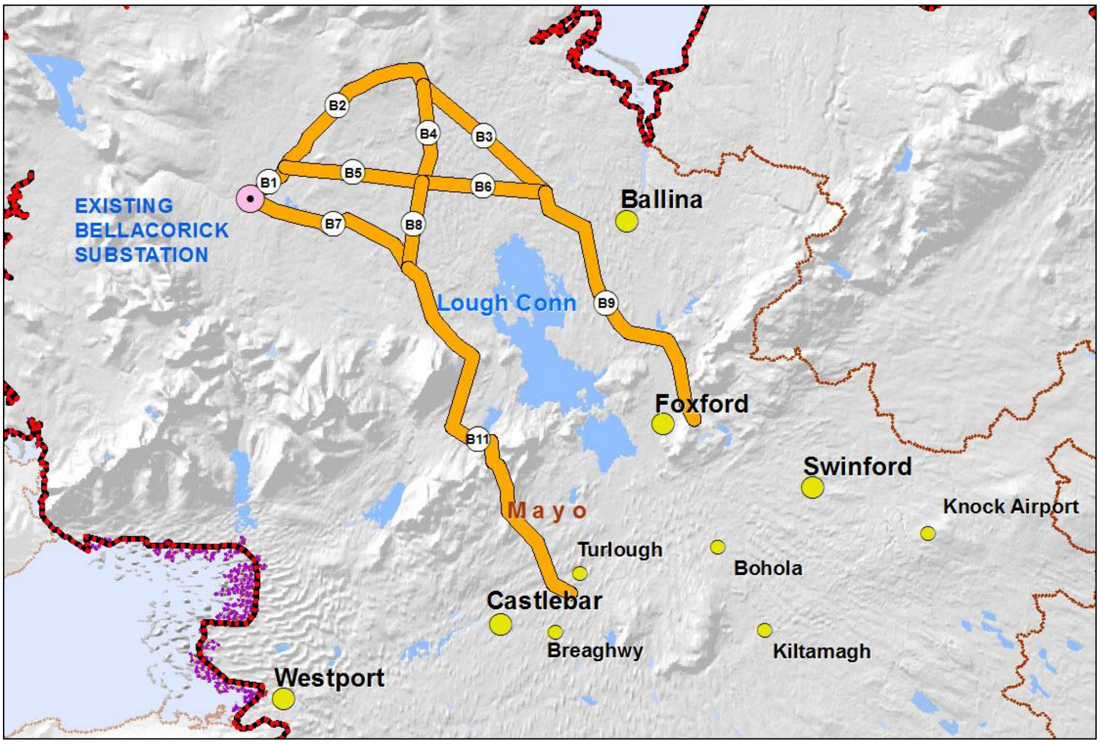

Consulting, Civil and Structural Engineers,
Market Square, Castlebar,
Co. Mayo, Ireland.
tel: +353-(0)1-8030406
fax:+353-(0)1-8030409
e-mail: info@tobin.ie
www.tobin.ie




Figure 4.2 A

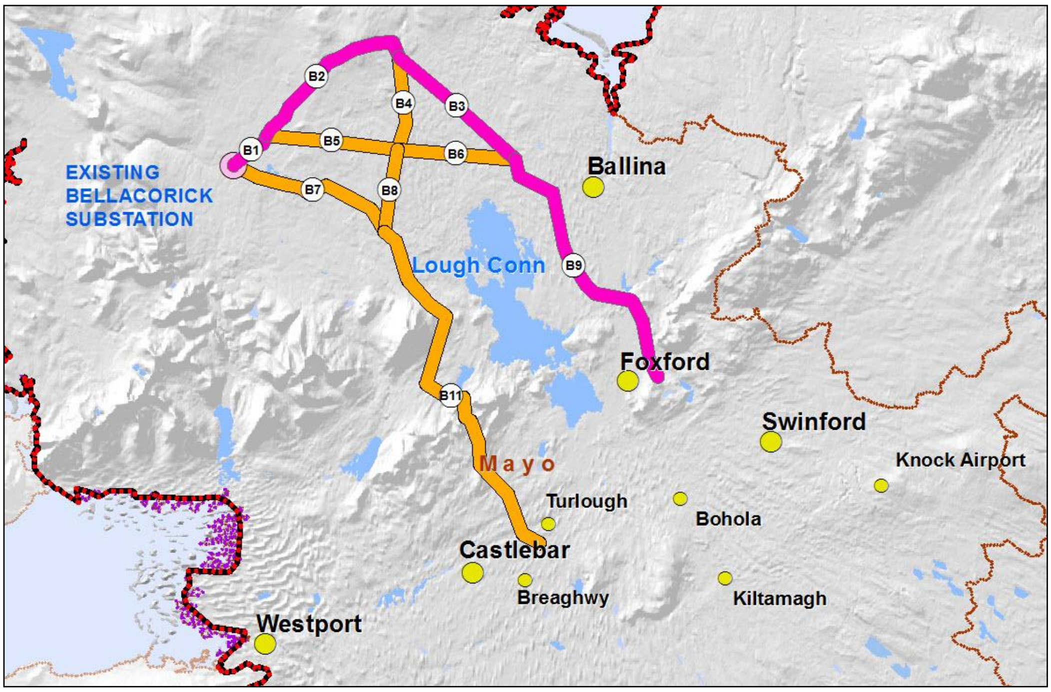
### 4.2.1 Bellacorick Route Corridor Options B1, B2, B3, B4, B5, B6, B7, B8 & B9

**Figure 4-3 Route Corridor Options from Bellacorick Substation Site**



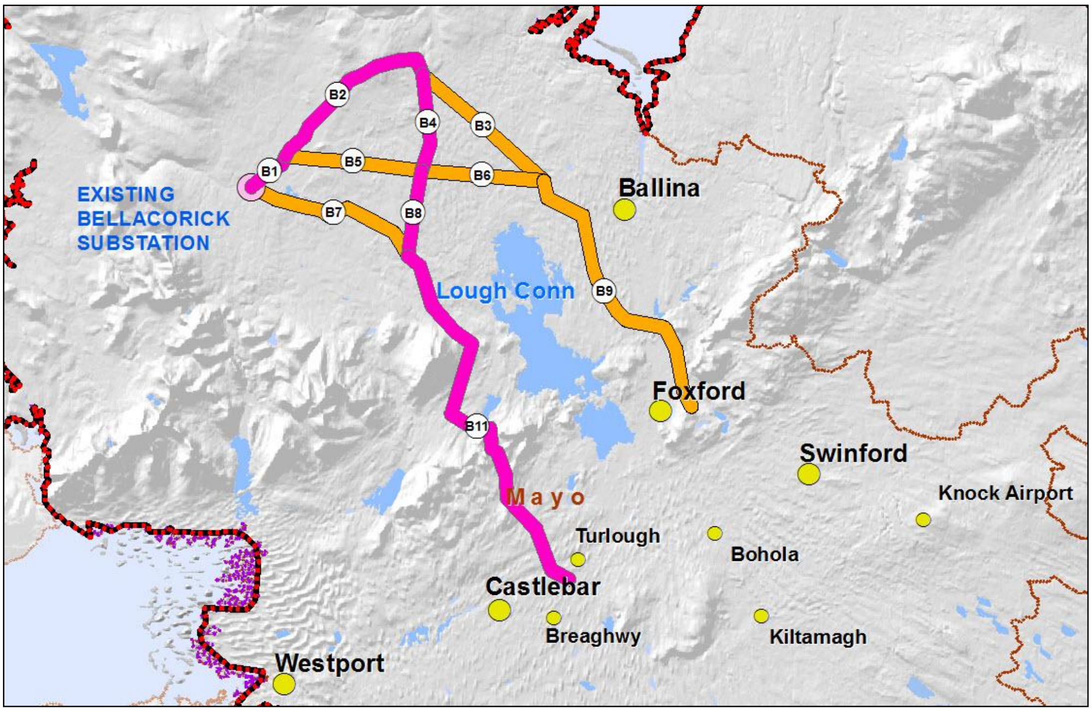

- Note that all route corridor options emanate from the existing Bellacorick substation, but these route corridors also accommodate the other potential substation site options within the Bellacorick substation study area.
- The B1/B2/B3/B9 and B1/B5/B6/B9 Route Corridor Options run *east* of Lough Conn.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

**Figure 4-4 Route Corridor B1/B2/B3/B9**



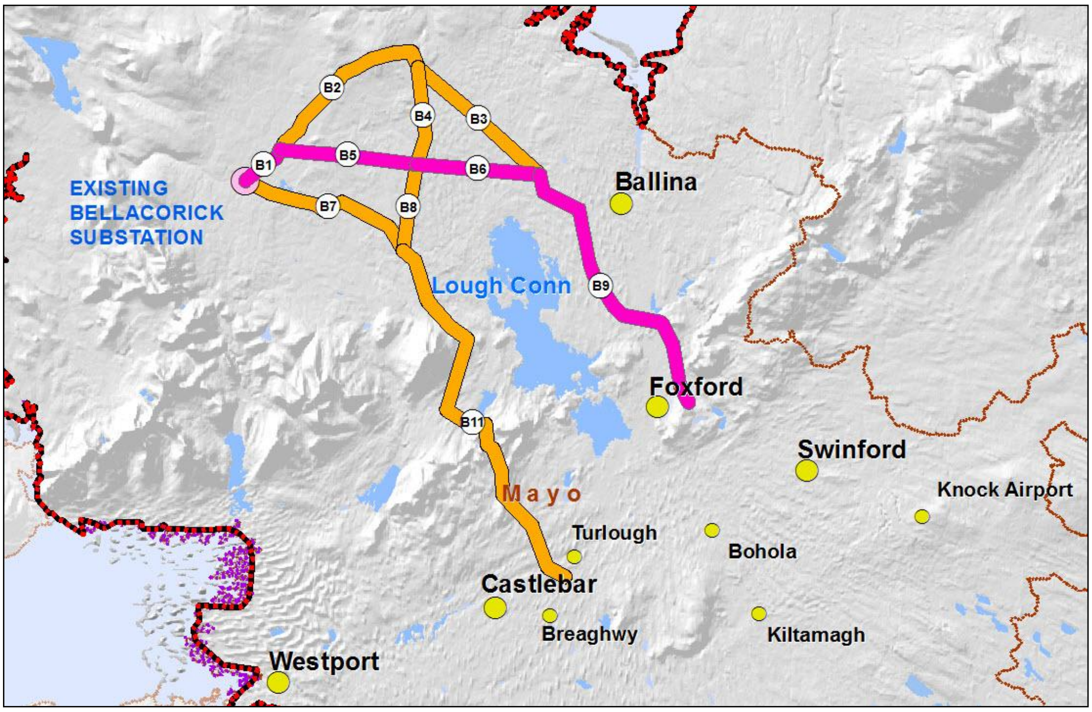

***Route Corridor Option B1/B2/B3/B9*** runs in a north easterly and then easterly direction from the existing Bellacorick substation before turning south east and running southwards, west of Ballina. It runs to the east of Lough Conn and terminates near Foxford. The length of this section of route corridor is approximately 51.2km.

**Figure 4-5** **Route Corridor B1/B2/B4/B8/B11**



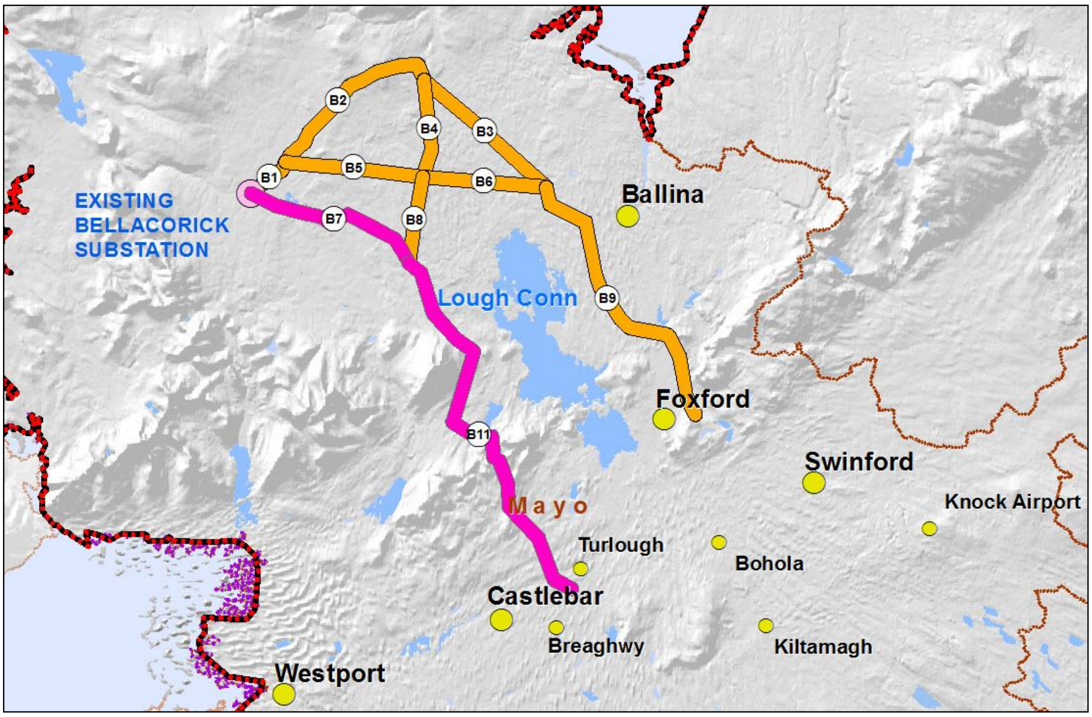

***Route Corridor Option B1/B2/B4/B8/B11*** runs in a north easterly and then easterly direction from the existing Bellacorick substation before turning to the south and running to the west of Lough Conn. It terminates to the north east of Castlebar. The length of this section of route corridor is approximately 61.0km.

**Figure 4-6** **Route Corridor B1/B5/B6/B9**



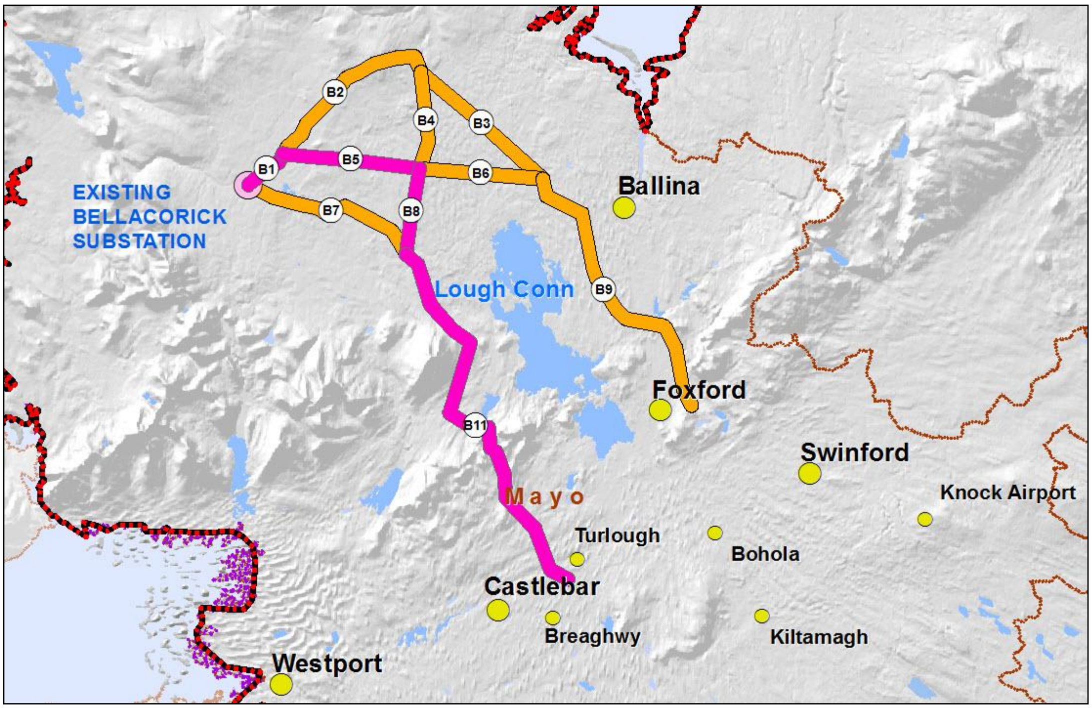

***Route Corridor Options B1/B5/B6/B9*** runs in a north easterly and subsequently easterly direction from the existing Bellacorick substation; it then takes a similar south easterly direction to route corridor option B1/B2/B3/B9, from an area west of Ballina. The length of this section of route corridor is approximately 44.3km.

**Figure 4-7 Route Corridor B7/B11**




***Route Corridor Option B7/B11*** runs in a south easterly direction from the existing Bellacorick substation. It then turns further to the south east from an area north west of Lough Conn. It takes a similar direction to route corridor option B1/B2/B4/B8/B11, in that it runs west of Lough Conn. The length of this section of route corridor is approximately 43km.

**Figure 4-8** **Route Corridor B1/B5/B8/B11**




***Route Corridor Option B1/B5/B8/B11*** runs in an north easterly, and subsequent easterly direction from the existing Bellacorick substation; it then turns to the south and takes a similar direction to route corridor option B1/B2//B3/B9 and B7/B11, from an area north west of Lough Conn. The length of this section of route corridor is approximately 49.8km.

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

**Figure 4-9** Route Corridor Options to Cashla Substation Site

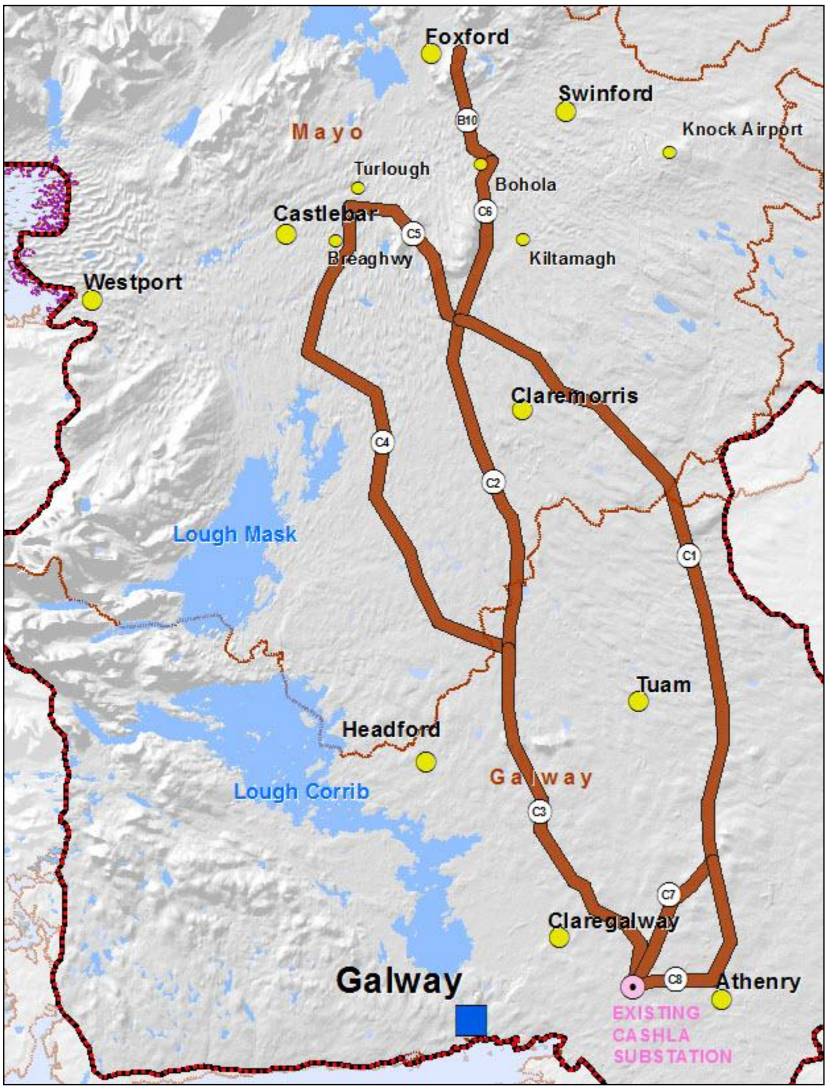
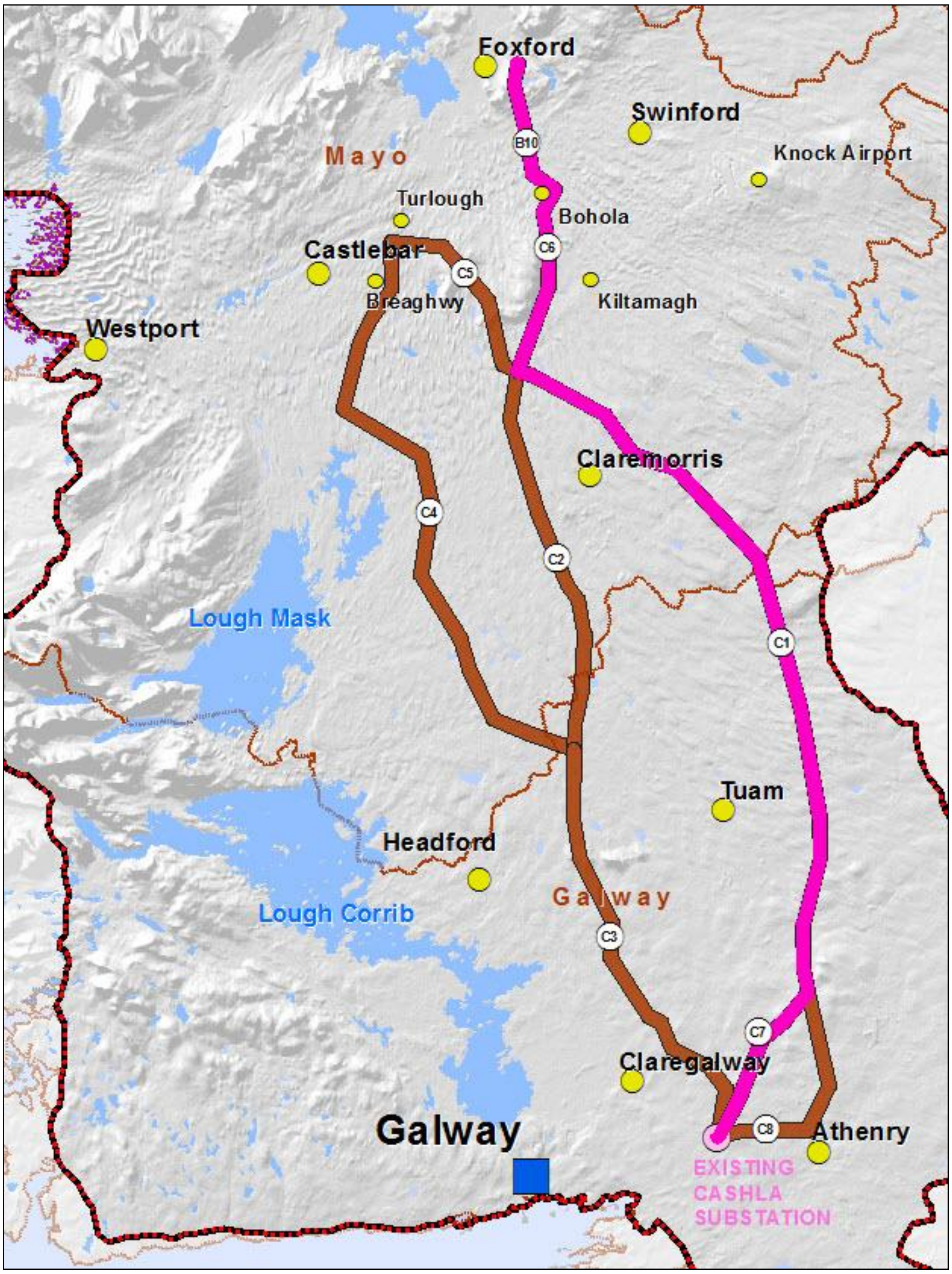
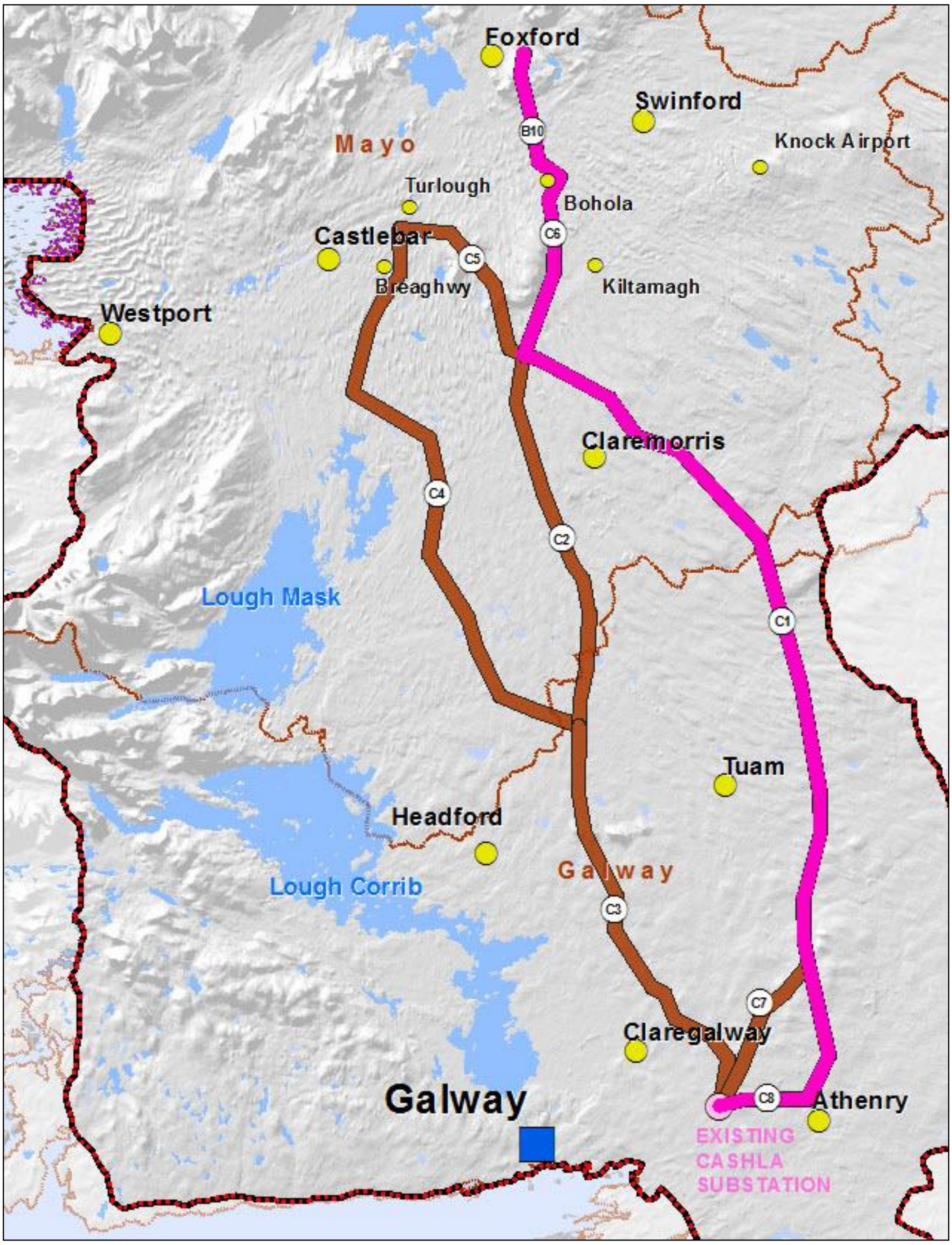


**Figure 4-10 Route Corridor B10/C6/C1/C7**



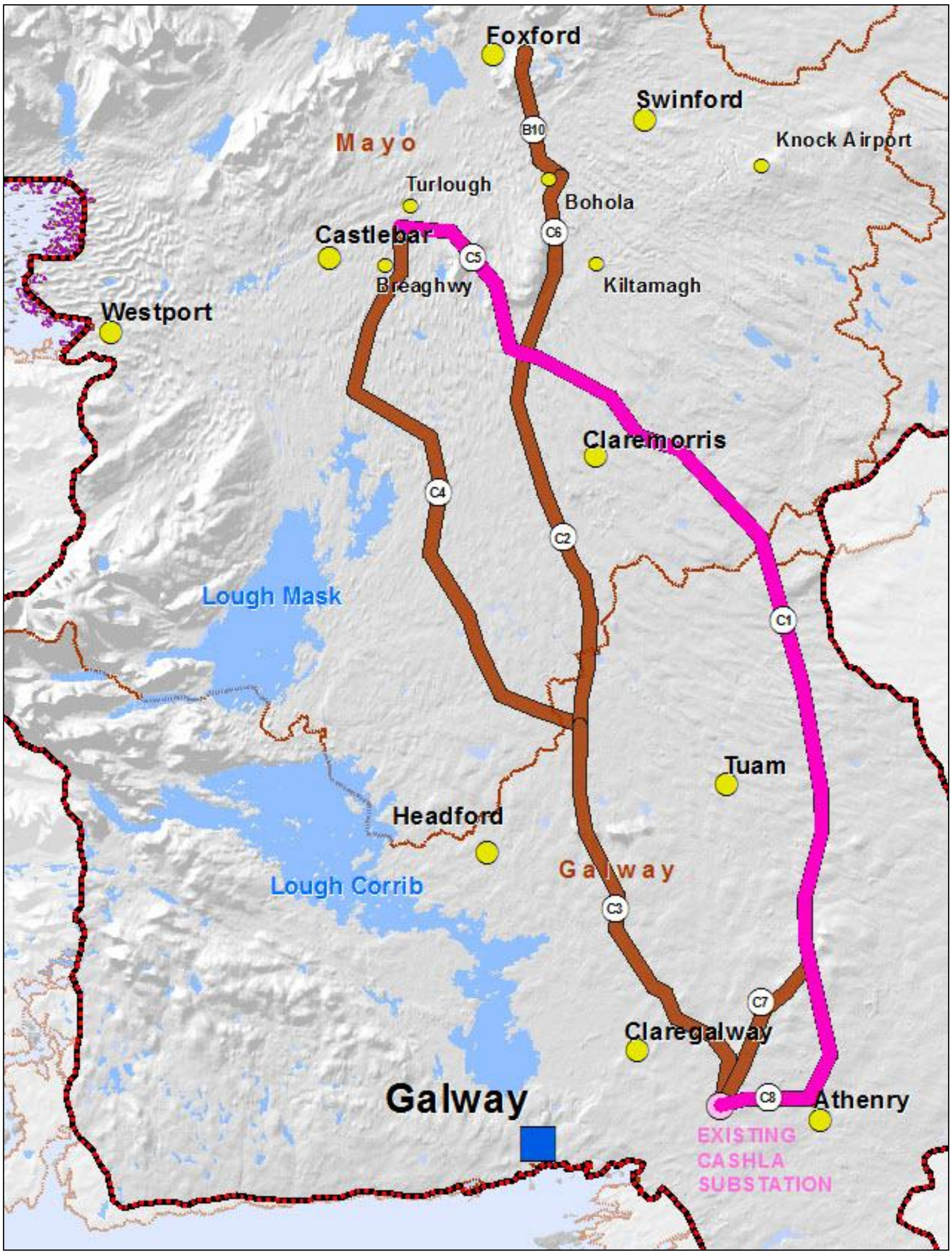

**Route Corridor Option B10/C6/C1/C7** This corridor option is an easterly route corridor option in the Cashla sector. It extends southwards and south eastwards from a point east of Foxford, (approximately 3.5km north west of Kiltamagh). It passes to the east of Claremorris, Tuam and Claregalway, before turning to the south west at an area north west of Athenry, then entering Cashla from the north east. B10/C6/C1/C7 and B10/C6/C1/C8 are largely identical route corridors, except in the environs of Athenry. The length of this section of route corridor is approximately 88.6km.

**Figure 4-11** **Route Corridor B10/C6/C1/C8**



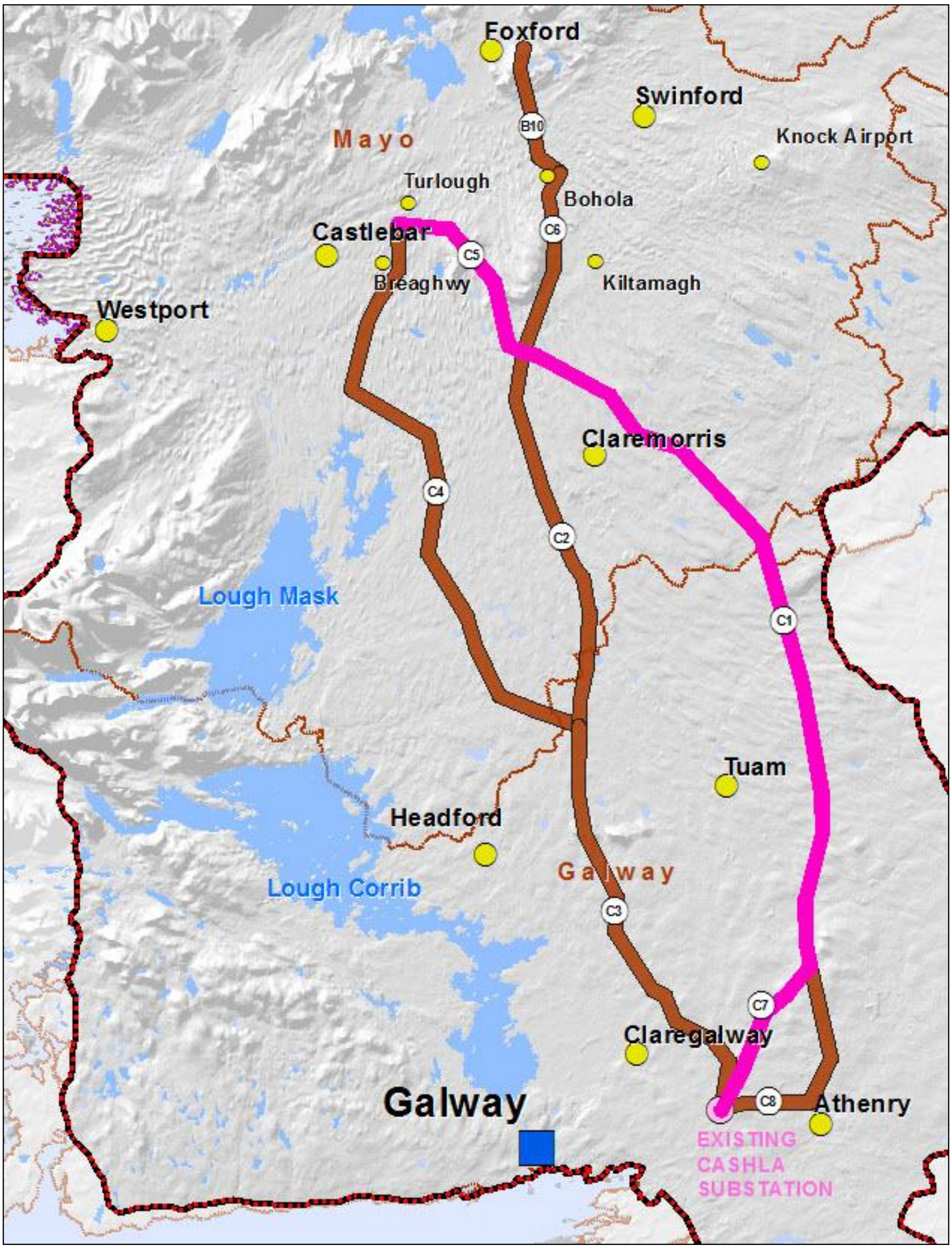

**Route Corridor Option B10/C6/C1/C8** is a similar route to B10/C6/C1/C7, with the exception that at its southern end, it passes north of Athenry and enters Cashla from a more easterly direction. The length of this section of route corridor is approximately 93km.

**Figure 4-12 Route Corridor C5/C1/C8**



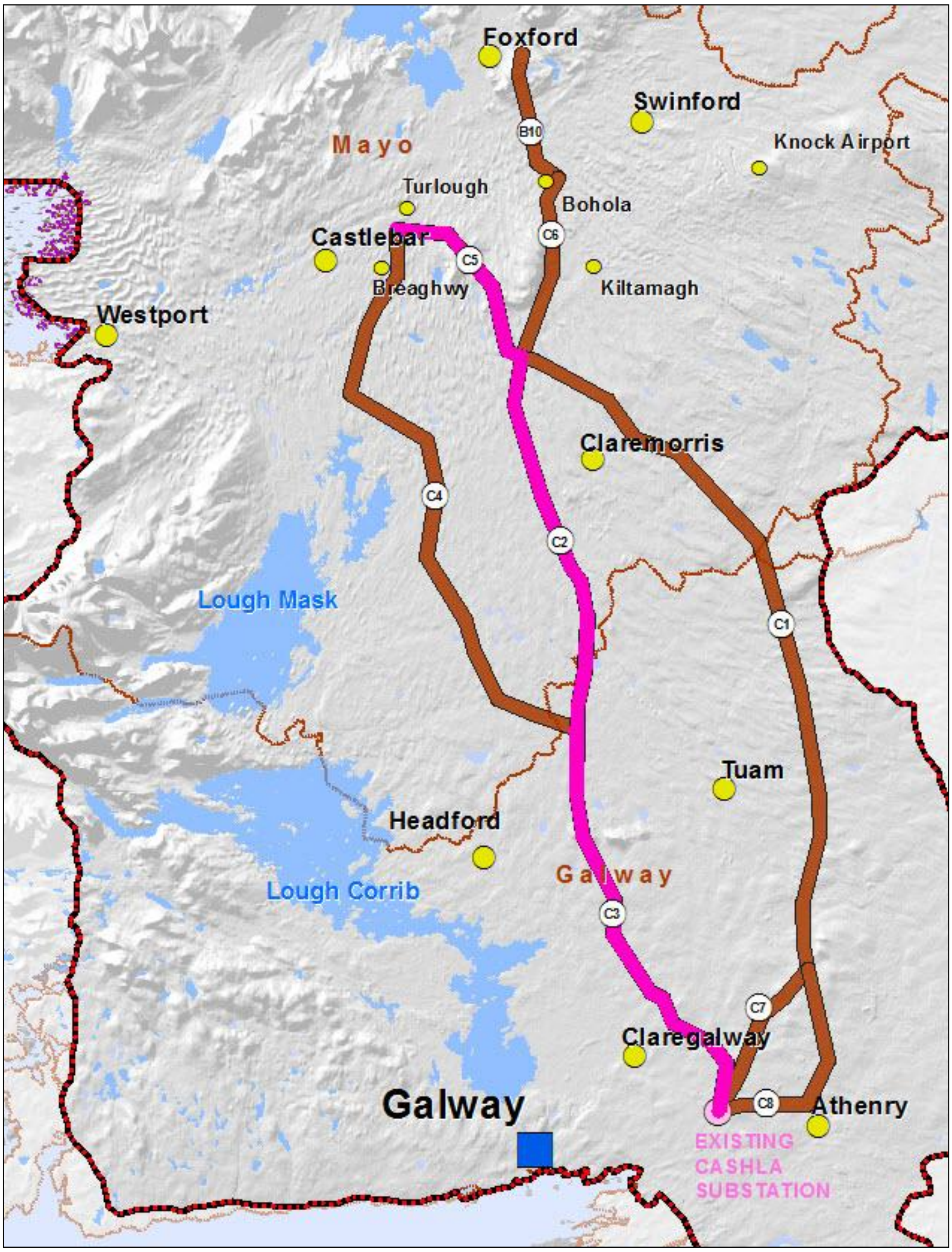

**Route Corridor Option C5/C1/C8** is a similar route corridor option to B10/C6/C1/C7, with the exception that the start point is closer to Castlebar. C5/C1/C8 and C5/C1/C7 are largely identical route corridors, except in the environs of Athenry. The length of this section of route corridor is approximately 84.1km.

**Figure 4-13 Route Corridor C5/C1/C7**



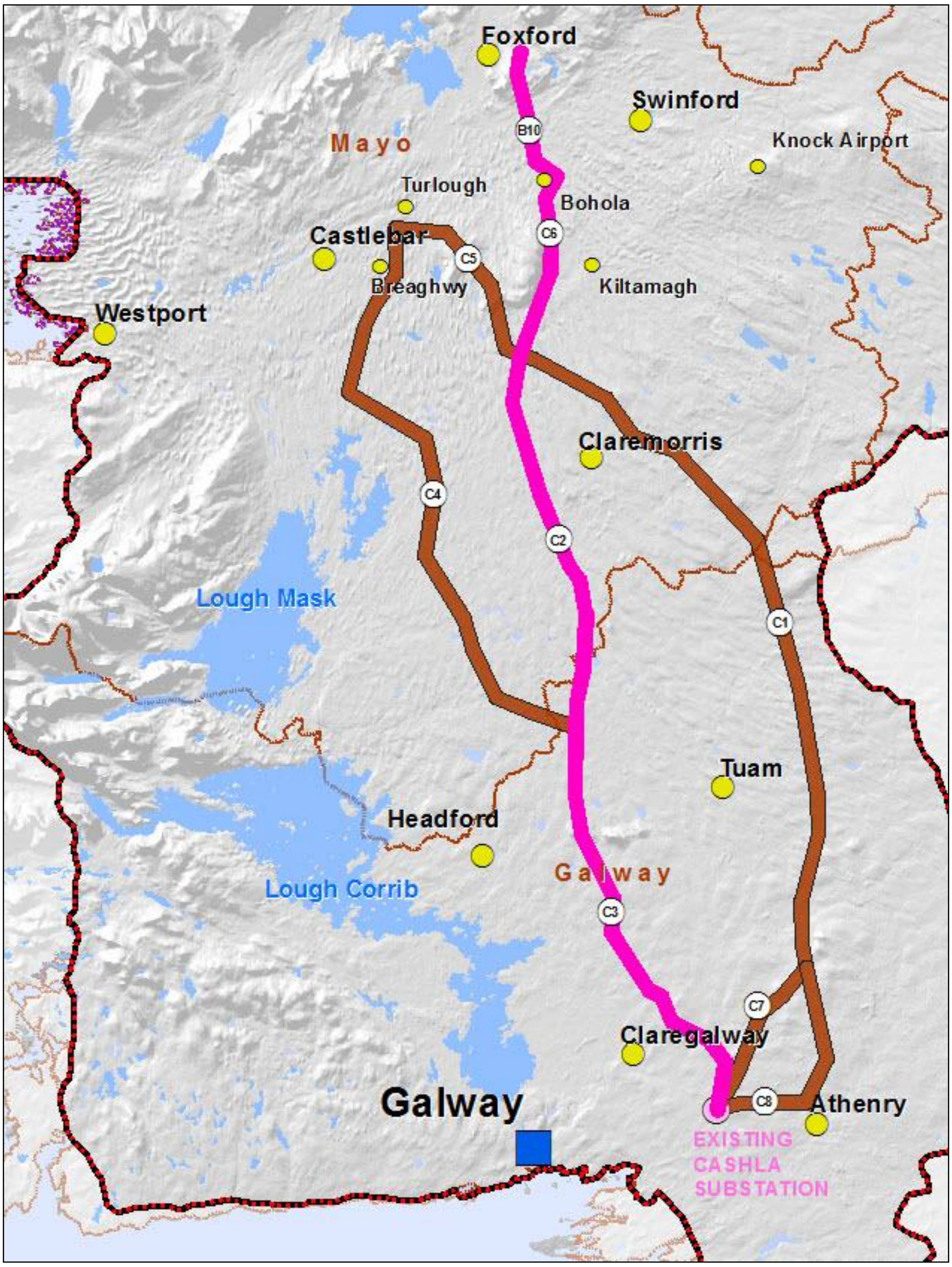

**Route Corridor Option C5/C1/C7** is a similar route corridor option to B10/C6/C1/C8, with the exception that the start point is closer to Castlebar, similar to the start point for C5/C1/C8 and C5/C1/C7. C5/C1/C8 and C5/C1/C7 are largely identical route corridors, except in the environs of Athenry. The length of this section of route corridor is approximately 79.8km.

**Figure 4-14 Route Corridor C5/C2/C3**



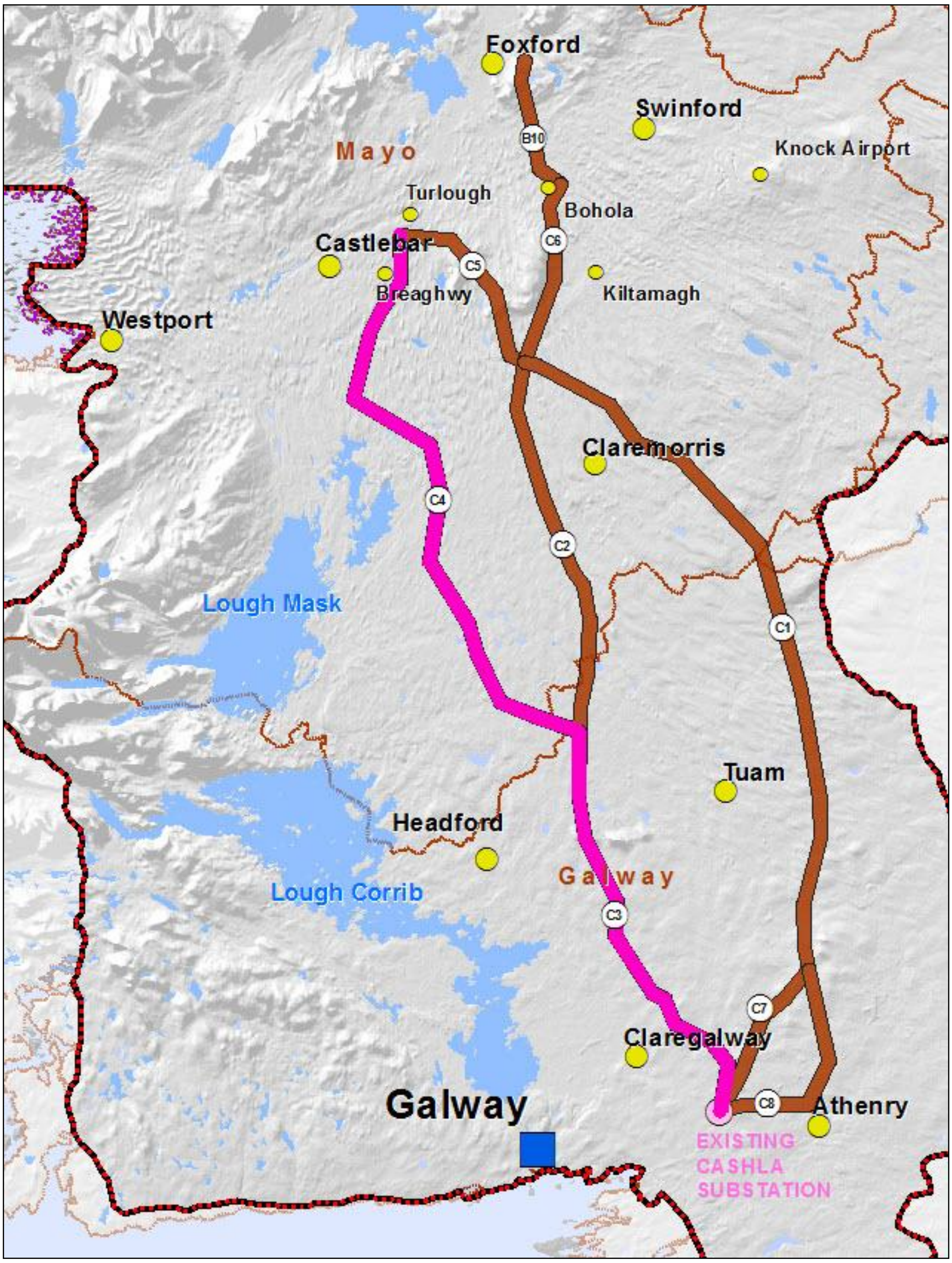

***Route Corridor Option C5/C2/C3*** The start point for this route corridor option is the same as that for route corridor option C5/C1/C8 and C5/C1/C7; it extends generally southwards, running west of Claremorris and Tuam and east of Claregalway. The length of this section of route corridor is approximately 73.4km.

**Figure 4-15 Route Corridor B10/C6/C2/C3**




***Route Corridor Option B10/C6/C2/C3*** This route corridor option is similar to C5/C2/C3, with the exception that the start point is similar to route corridor option B10/C6/C1/C7 and B10/C6/C1/C8 (i.e. approximately 3.5km north west of Kiltamagh). The length of this section of route corridor is approximately 82.3km.

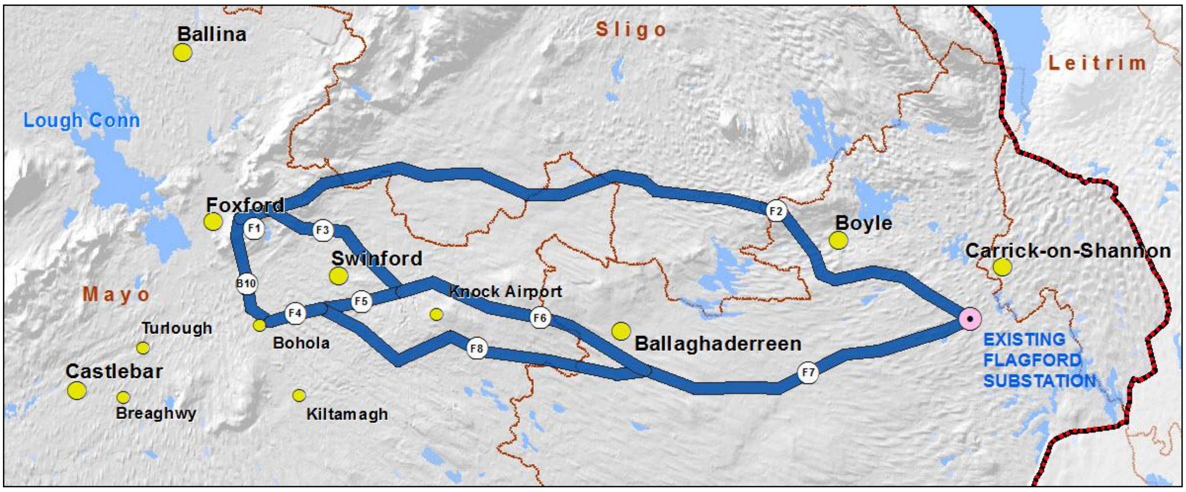
**Figure 4-16 Route Corridor C4/C3**




***Route Corridor Option C4/C3*** is the most westerly route corridor option. It runs from a point, just north east of Castlebar, west of Claremorris and Tuam and east of Claregalway. The length of this section of route corridor is approximately 76.2km.

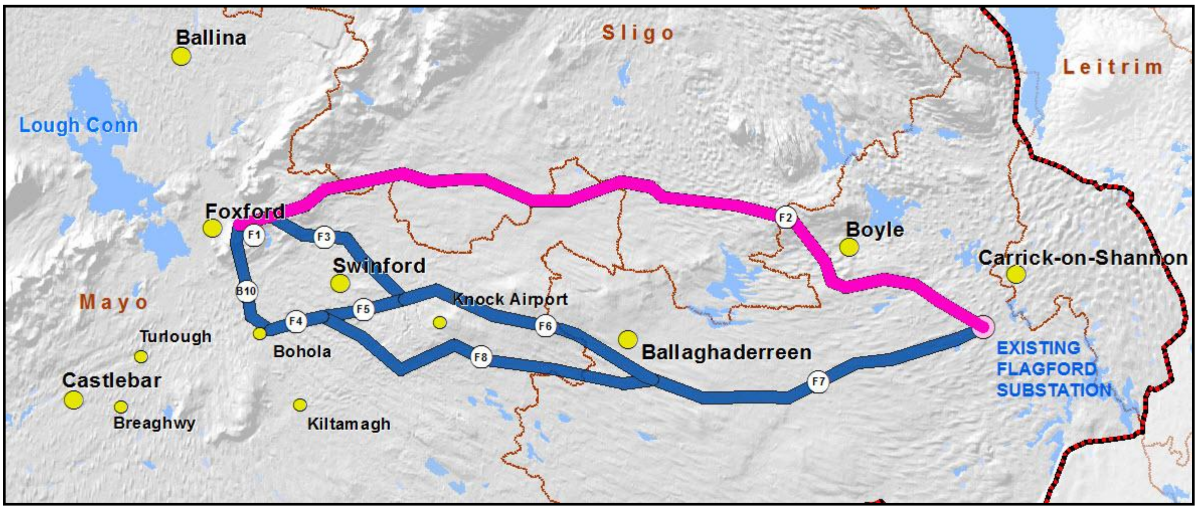
### 4.2.3 Flagford Route Corridor Options F1, F2, F3 & F4

**Figure 4-17 Route Corridor Options to Flagford Substation Site**



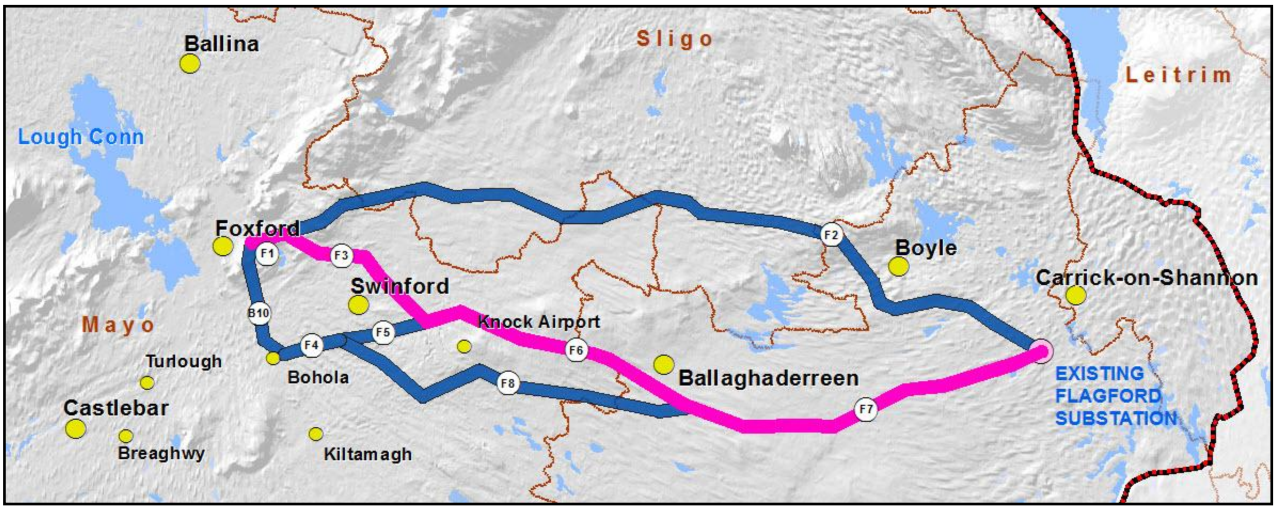

- Flagford Route Corridor Options are referred to as F options, e.g. F1, F2, F3 and F4.

**Figure 4-18 Route Corridor F1/F2**



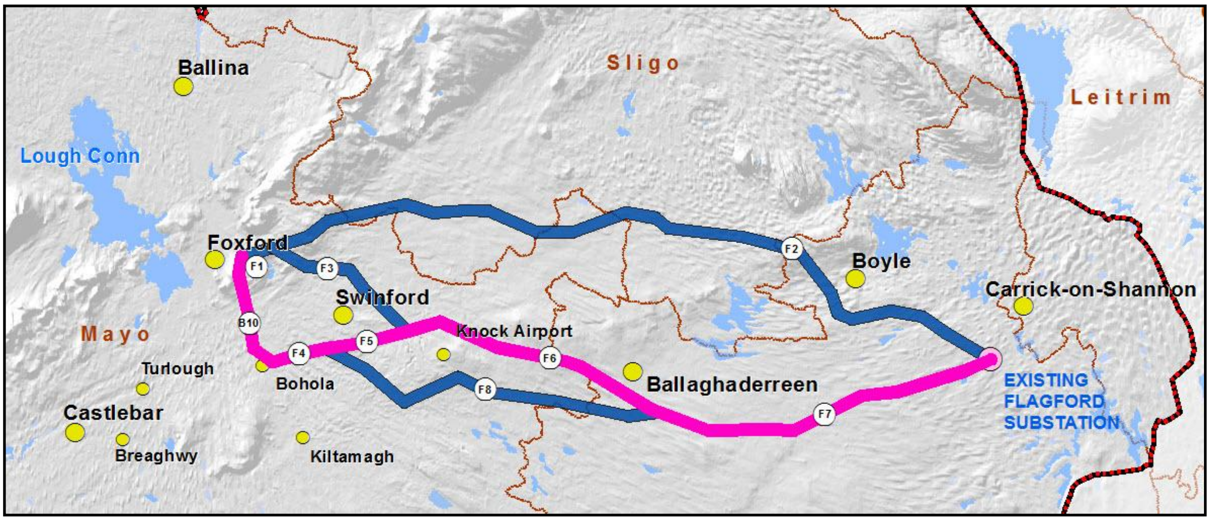

***Route Corridor Option F1/F2.*** This route corridor option is the most northerly of the route corridor options that run towards Flagford substation. It commences east of Foxford (approximately 2km east of Foxford, just south of the N26). It runs north east of Foxford, north of Swinford and Ballaghaderreen and just south of Boyle. The length of this section of route corridor is approximately 69.2km.

**Figure 4-19 Route Corridor F1/F3/F6/F7**



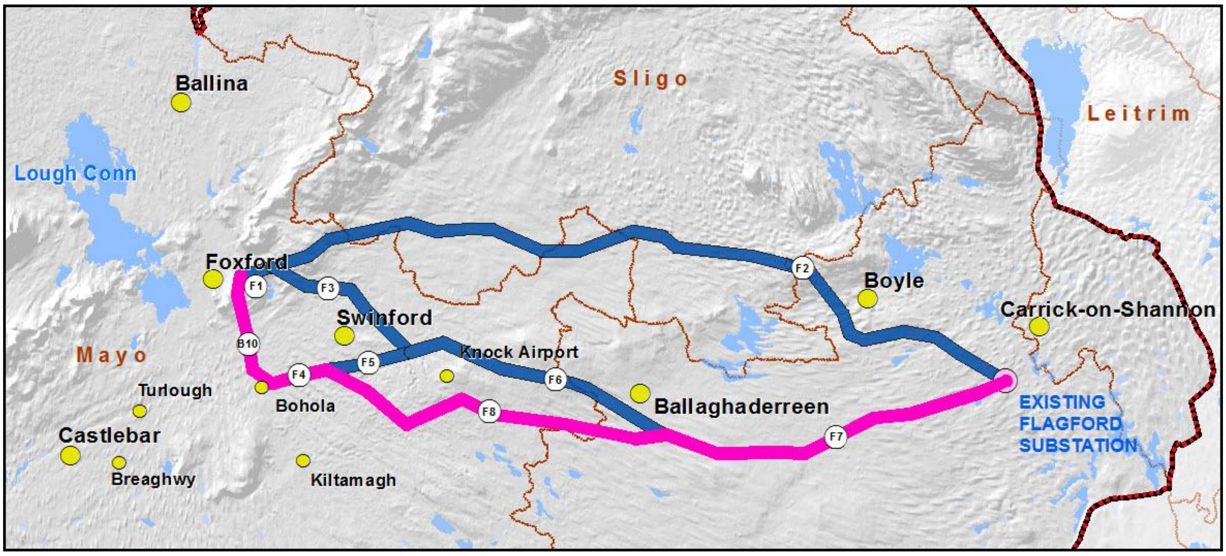

***Route Corridor Option F1/F3/F6/F7.*** This route corridor option runs in a southerly direction towards Flagford substation; it starts at the same point as route corridor option F1/F2. It runs north east of Foxford, north of Swinford and south of Ballaghaderreen. The length of this section of route corridor is approximately 68.8km.

**Figure 4-20 Route Corridor B10/F4/F5/F6/F7**




***Route Corridor Options B10/F4/F5/F6/F7*** this route corridor option commences at a point approximately 1km east of the village of Bohola. It runs just south of Swinford, north of Knock Airport and south of Ballaghaderreen. This route corridor option converges with route corridor option B10/F4/F8/F7 approximately 4km south east of Ballaghaderreen. The length of this section of route corridor is approximately 73.6km.

**Figure 4-21 Route Corridor B10/F4/F8/F7**




***Route Corridor Option B10/F4/F8/F7.*** This route corridor option starts at the same point as route corridor option F3. It runs just south of Swinford, south of Knock Airport and south of Ballaghaderreen. This route corridor option converges again with route corridor option B10/F4/F5/F6/F7 approximately 4km south east of Ballaghaderreen. The length of this section of route corridor is approximately 74km.

# 5. DESCRIPTION OF SUBSTATION SITE OPTIONS

*Note: In this chapter 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 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 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.

## 5.1 GENERAL

As detailed in chapter 3 of this report, 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 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 links 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 evaluations be carried out concurrently.

All the subsites areas/locations identified to date have been identified by desk top studies and then visual site surveys. No intrusive surveys have been undertaken to verify the suitability of the locations/site areas 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 location/site area be identified as the least constrained.

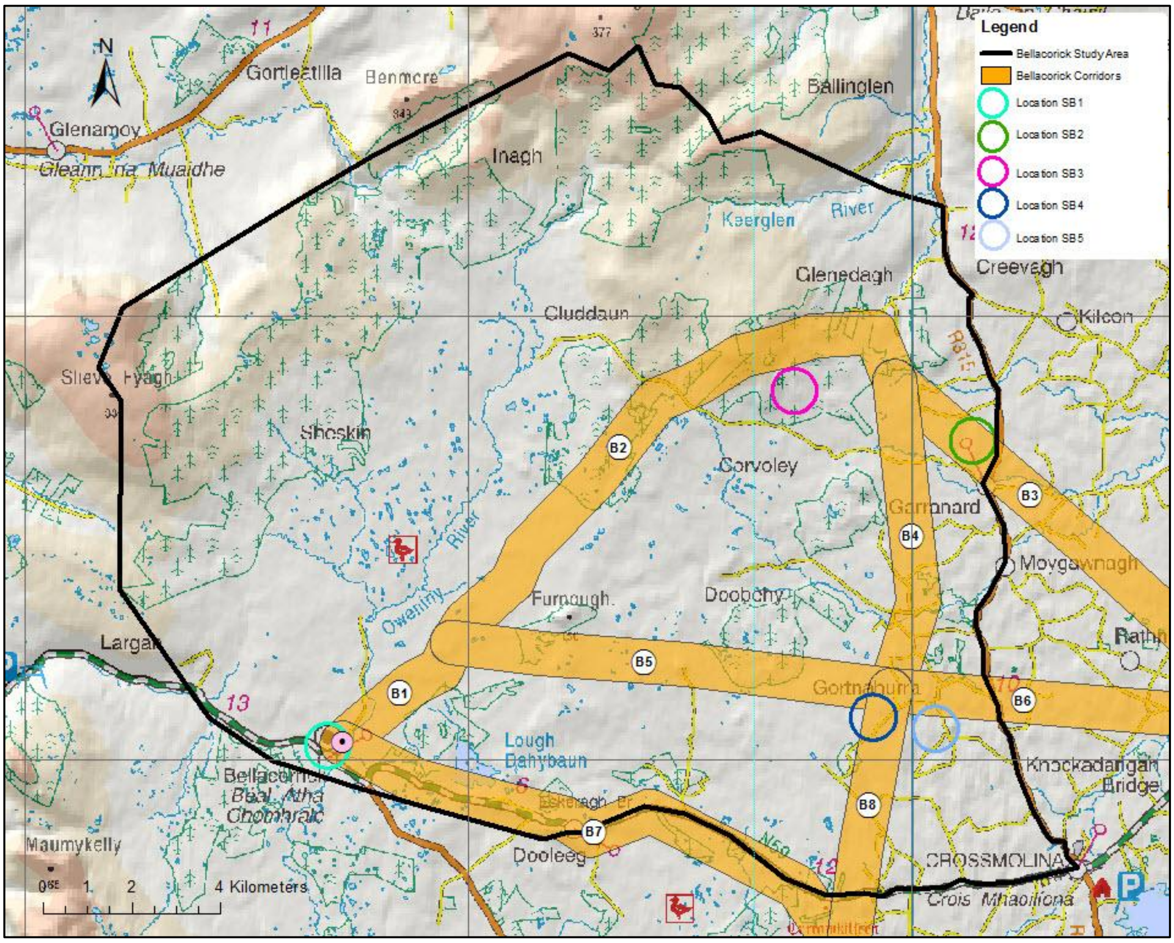
## 5.2 BELLACORICK NODE SUBSTATION SITES

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 as 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 5-1 herein.

- Location SB1: Extension to the existing Bellacorick 110/38kV substation on the land previous used for the peat-fired power station.
- Location SB2: New Bellacorick 400/110kV location to north east of the study area.
- Location SB3: New Bellacorick 400/110kV location to the north east of the study area.
- Location SB4: New Bellacorick 400/110kV location to the south east of the study area.
- Location SB5: New Bellacorick 400/110kV location to the south east of the study area.

**Figure 5-1 Potential Bellacorick Substation Locations**



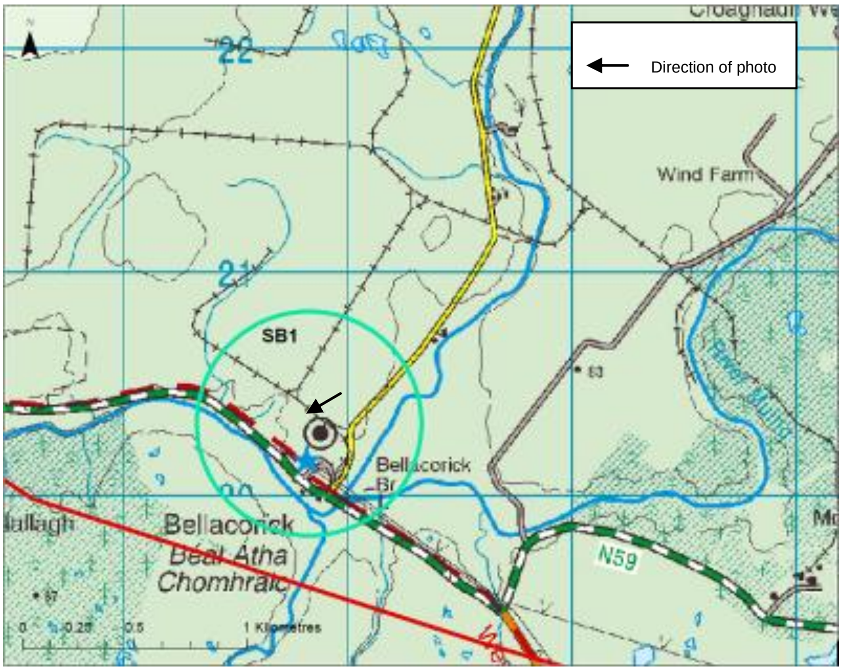

A brief description of each location is provided herein.

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

Location SB1[17] 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. 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.

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 Bellacorick site.

**Figure 5-2 Bellacorick Substation Location SB1**

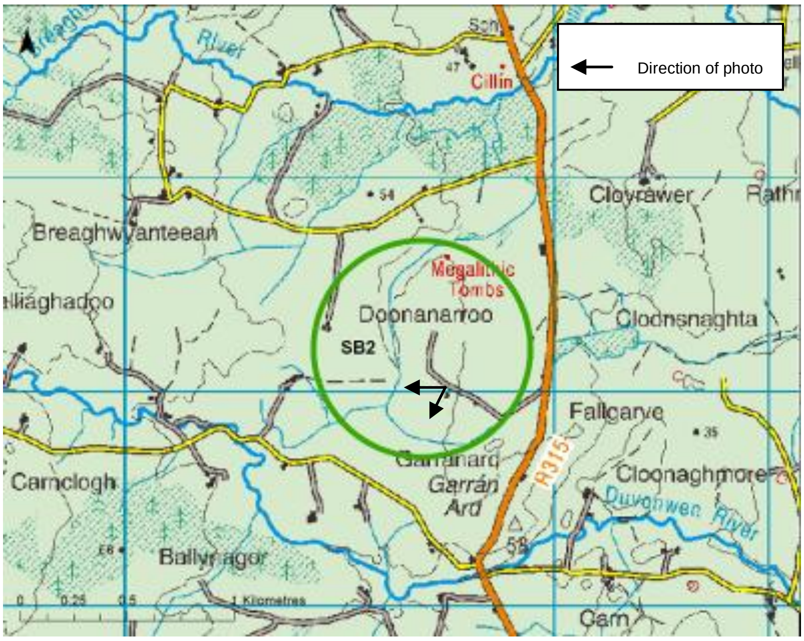



[17] SB1 is effectively a substation site (not a location) but for consistency within this section of the report is referred to as a location.

**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 new location to the north east of the study area. This location has been identified as being potentially suitable to locate the proposed new 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 B2.

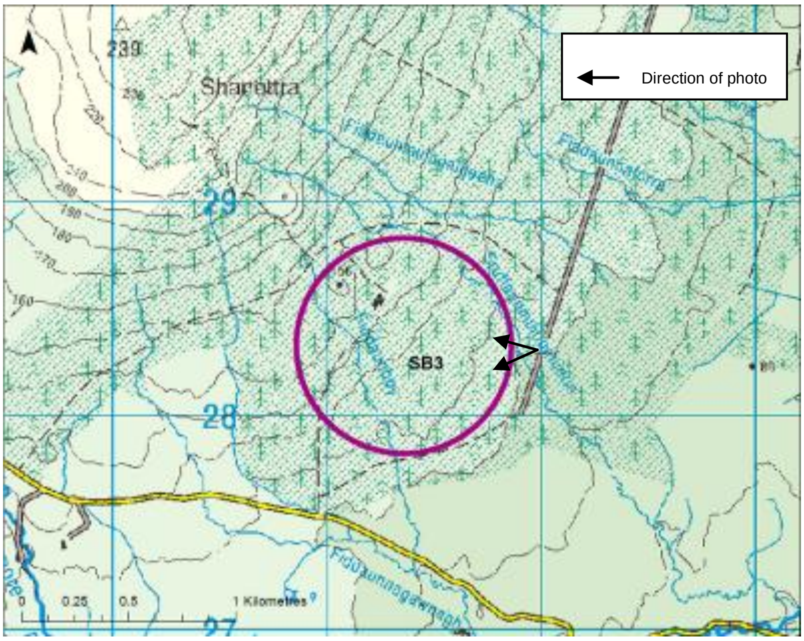
**Figure 5-3 Bellacorick Substation Location SB2**




**Location SB3: New Bellacorick 400/110kV Substation Location to the North East of Study Area**

Location SB3 will require a new substation site to be found within the north east of the study area. Initial investigations indicate that this is a potential location that offers an area with likely suitable geotechnical conditions to facilitate the 400/110kV GIS substation and would be connected to the existing Bellacorick substation by a new 110kV 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 the site. The location offers natural visual screening and is not located close to known dwellings. However, the location is within a wind farm and may impact on potential wind turbine locations. The location is within the proposed corridor section B3.

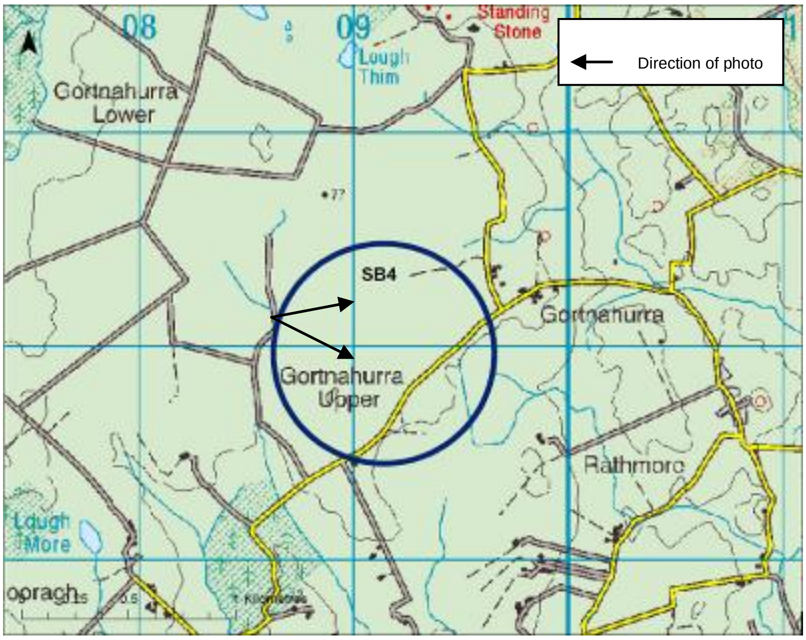
**Figure 5-4 Bellacorick Substation Location SB3**




**Location SB4: New Bellacorick Substation 400/110kV Location to the South East of Study Area**

Location B4 is positioned 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 corridor sections B5 and B7, which travel through a highly constrained area, including SPA. If a route through this area is not obtainable, then an alternative route to the north, along route corridors section B2/B1 would be required. The mapping shows that this adds considerable length to the connecting 110kV lines. The location is within the proposed route corridors section B5 and section B8.

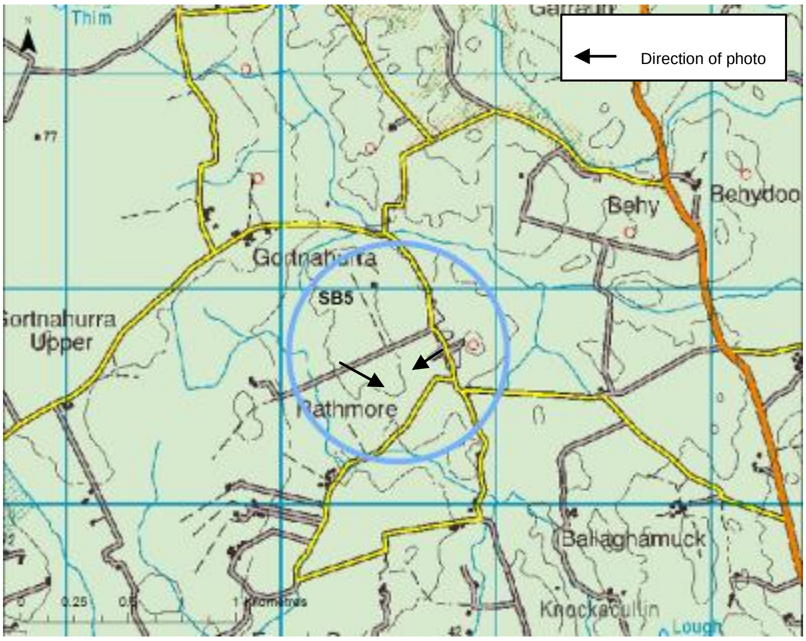
**Figure 5-5 Bellacorick Substation Location SB4**




**Location SB5: New Bellacorick 400/110kV Substation Location to the South East of Study Area**

Location SB5 is positioned 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.

**Figure 5-6 Bellacorick Substation Location SB5**




## 5.3 CASHLA 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 to 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 the new Cashla 400kV substation may need to incorporate undergrounding for the final approaches into the substation.

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.

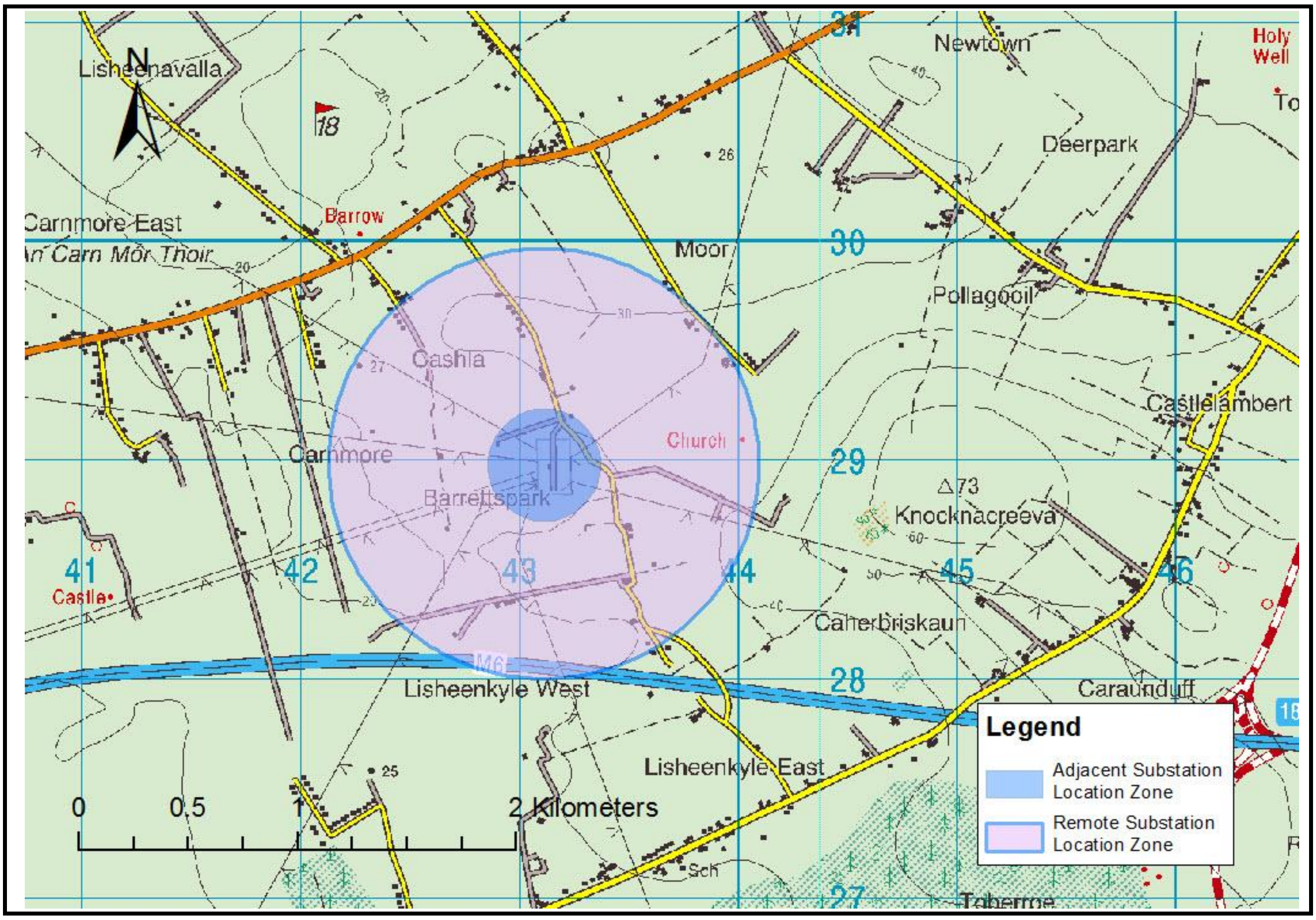
The Flagford and Cashla proposed substation sites are defined and evaluated provisionally as site areas. Prior to Stage 1 consultation, they are to be understood as located within the Adjacent Substation Location Zone or the substation, rather than being identified as a '*defined footprint'*. Precise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

Refer to Figure 5-7 and 5-8 where adjacent sites would be located within the inner adjacent substation location zone and remote sites within the outer remote substation location 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. The extents of these zones are shown in Figure 5-7 Cashla Substation Location Zones.

**Figure 5-7 Potential Cashla Substation Location Zones**



### 5.3.1 Adjacent Substation Location Zone

**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, on a section of land suitable for a new GIS substation. Underground cables to the 220kV busbars will be required to connect to the existing Cashla substation southern busbar sections. 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**

Site area SC2 is adjacent to the southern boundary of the existing substation and initial investigations indicate that it offers suitable topography, a low concentration of constraints, suitable geotechnical conditions and facilitates connection to the existing 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, but on the other side of a local road. Initial investigations indicate that the substation site area offers an area of suitable size for 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 this site area offers a suitable area of land with acceptable ground conditions and topography to develop a GIS substation. The site area would connect directly to the existing 220kV busbar; however, due to the position of the proposed substation between the two existing 220kV towers, the connection to a Grid West 400kV transmission line would 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. Initial investigations indicate that this 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 southern approaching lines. 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 site area will extend the 220kV from the southern end of the existing yard and would then establish a 400kV switchyard to the south east.

**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.

### *5.3.2 Remote Substation Location Zone*

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

Site area SC8 is within the study area but is remote from the existing Cashla substation to the north. Initial investigations indicate that the site area offers an area of land, suitable for a GIS substation with suitable geotechnical conditions, topography and with no constraints present. This site area would facilitate connection to the new 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 site, in an area that is clear of the quarry. Initial investigations indicate that the site area offers an area of land with suitable geotechnical conditions and topography sufficient to locate a GIS substation. This 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 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 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 visually associated with the factory, reducing its visual impact. It also facilitates connection to the new Grid West 400kV line. However, an underground 220kV cable connection would be required to the existing substation.

## 5.4 FLAGFORD 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 northeast.

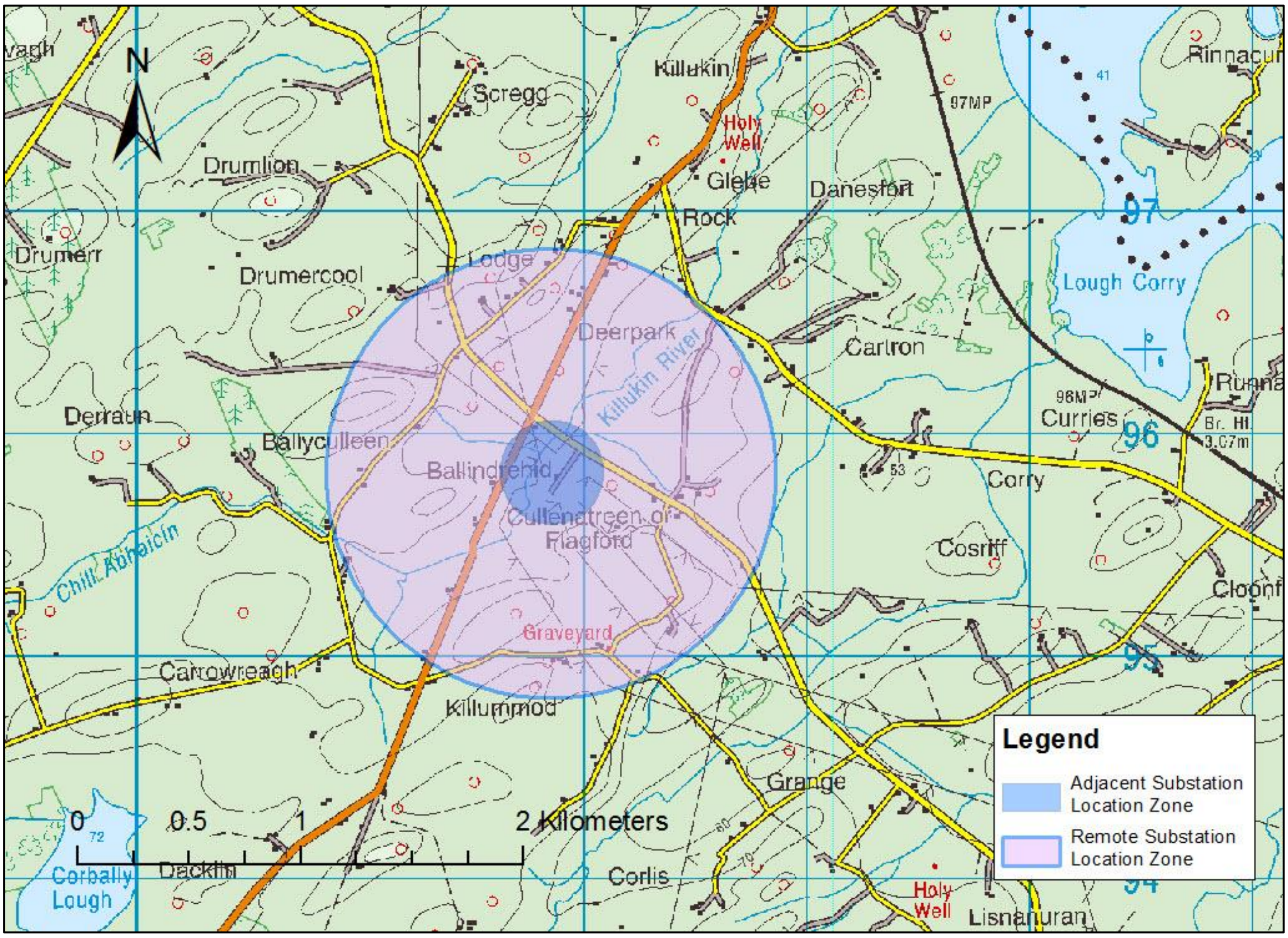
As for the Flagford substation, two alternative approaches have been considered when assessing potential substation sites near the existing Flagford substation:

- ***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 site, 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.

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. The extents of these zones are as shown in Figure 5-8. All of these site areas are considered as part of the substation evaluation in the event that an adjacent site cannot be found.

.

**Figure 5-8 Potential Flagford Substation Location Zones**



### 5.4.1 Adjacent Substation Location Zone

**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 site. 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 a possible future southern approaching line, will be made via underground cable.

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

Site area SF2 is situated adjacent to 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**

Site area SF4 proposes the construction of an AIS substation to the southwest of the existing substation site. 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.

### 5.4.2 Remote Substation Location Zone

**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 is 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 the existing electricity lines, if the Grid West line was to be routed in route corridor section F2.

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

Site area SF6 is proposed for the development of an AIS substation, in approximately the same location as substation site area SF5. 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.

## 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 modeling 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.

*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 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 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.

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

*Raster data:* type consists of rows and columns of cells, with each cell storing a single value. Raster data can be images (raster images) with each pixel (or cell) containing a colour value. A raster cell stores a single value.

*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.

*Vector Layer:* Hold scalable vector objects. At any time in the future you can change its size, position and colours. They are saved in a certain way that is not tied to fixed pixels.

## ACRONYMS

| | |
|---|---|
| **AIS** | Air Insulated Switchgear |
| **CH** | Cultural Heritage |
| **cSAC** | candidate Special Area of Conservation |
| **GIS** | Gas Insulated Switchgear |
| **GIS** | Geographic Information System |
| **GPS** | Global Positioning System |
| **HVAC** | High Voltage Alternating Current |
| **IP** | Implementation Programme |
| **NHA** | Natural Heritage Area |
| **OHL** | Overhead Line |
| **pNHA** | proposed Natural Heritage Areas |
| **RMP** | Record of Monument and Places |
| **RPS** | Record of Protected Structures |
| **SAC** | Special Area of Conservation |
| **SEA** | Strategic Environmental Assessment |
| **SEO** | Strategic Environmental Objectives |
| **SMR** | Sites and Monument Record |
| **SPA** | Special Protection Area |

# ANNEX 2.1 Constraints Classification Sheet

| | Constraints | Code | Type of layer | Site Type / Source Data | Primary Constraints | Secondary Constraints | Tertiary Constrained or Other Constraints |
|---|---|---|---|---|---|---|---|
| Landscape | Sligo Sensitive Rural Landscape | 1 | Polygon | Development Plan designation. Areas with intrinsic scenic quality and a low capacity to absorb new development – e.g. uplands, headlands. They generally support insufficient vegetative cover for screening purposes and most sites are seen against the sky or water. | | | |
| | Sligo Visually Vulnerable Areas | 2 | Line | Development Plan designation. Distinctive and conspicuous natural features of significant natural beauty or interest, which have extremely low capacity to absorb new development. | | | |
| | Roscommon Areas of Exceptional Landscape Value | 3 | Polygon | Development Plan designation. Tulsk and Rathcroghan Plateau in the centre of the county (LCA 28) and the Lough Key and Boyle River Network in the northeast of the county (LCA 16). Classification of the former area is greatly influenced by the cultural heritage significance of Rathcroghan, whereas the latter area is valued for its aesthetic and amenity qualities. | | | |
| | Roscommon Driving Routes | 4 | Line | Development Plan designation | | | |
| | Roscommon Scenic Points | 5 | Point | Development Plan designation | | | |
| | Roscommon Places of Interest and Visitor Attraction | 6 | Point | Development Plan designation | | | |
| | Mayo Vulnerable Features - Water Bodies | 7 | Polygon | Development Plan designation. Areas or features designated as vulnerable represent the principal features which create and sustain the character and distinctiveness of the surrounding landscape. These are conspicuous features of the natural landscape to which the eye is drawn because of strong contrasts of form and colour where there is contact between the land and sky or water. | | | |
| | Mayo Vulnerable Features (Ridges) | 8 | Line | Development Plan designation. Areas or features designated as vulnerable represent the principal features which create and sustain the character and distinctiveness of the surrounding landscape. These are conspicuous features of the natural landscape to which the eye is drawn because of strong contrasts of form and colour where there is contact between the land and sky or water. | | | |
| | Mayo Vulnerable Features (Coastlines, River Banks, Lakes, Shorelines) | 9 | Line | Development Plan designation. Areas or features designated as vulnerable represent the principal features which create and sustain the character and distinctiveness of the surrounding landscape. These are conspicuous features of the natural landscape to which the eye is drawn because of strong contrasts of form and colour where there is contact between the land and sky or water. | | | |
| | Mayo Scenic Viewing Point | 10 | Point | Development Plan designation | | | |
| | Mayo Scenic Views | 11 | Point | Development Plan designation | | | |
| | Mayo Highly Scenic View | 12 | Point | Development Plan designation. Highly scenic views or vistas indicate areas along public roads from which views and prospects of areas of high natural beauty and interest can be enjoyed. Sightseeing visitors are more likely to be concentrated along these areas. | | | |
| | Mayo Protected Views | 13 | Point | Development Plan designation | | | |
| | Leitrim Areas of High Visual Amenity | 14 | Polygon | Development Plan designation. Highly scenic areas, although less sensitive than Areas of Outstanding Natural Beauty (AONBs). | | | |
| | Leitrim Major Public Amenity Areas | 15 | Point | Development Plan designation | | | |
| | Leitrim Outstanding Views and Prospects | 16 | Point | Development Plan designation. Protected views and prospects - these views are primarily of the County's lakes and upland areas from public roads and are an important resource for the development of tourism in the county. | | | |
| | Leitrim Areas of Outstanding Natural Beauty | 17 | Polygon | Development Plan designation. These are the areas of highest quality landscape in the County which the Council is committed to protecting. | | | |
| | Galway Outstanding Landscape Value Area | 18 | Polygon | Development Plan designation | | | |
| | Galway Focal Points and View | 19 | Polygon | Development Plan designation | | | |
| | Galway Coastline | 20 | Line | Landscape feature | | | |
| | Galway Area of Unique sensitivity | 21 | Polygon | Development Plan designation | | | |
| | Candidate Wilderness Area | 22 | Polygon | Coillte project in progress | | | |
| | Ballycroy National Park | 23 | Polygon | National Park | | | |
| | Intact Historic Designed Landscapes | 24 | Polygon | Designed Landscape listed in National Inventory of Architectural Heritage | | | |
| | Historic Designed Landscapes-Main Features Substantially Present/Demesnes Moderate | 25 | Polygon | Designed Landscape listed in National Inventory of Architectural Heritage | | | |
| | Lake Shorelines | 26 | Line | Landscape feature | | | |
| | Walking Routes | 27 | Line | Development Plan designation/Irish Trails Office looped walk/indicated on OS Discover Series maps/Sli na Slainte/other identifed walks | | | |
| | Scenic Routes | 28 | Line | Development Plan designation. Public roads that coincide generally with popular tourist routes affording unique scenic views of one or more distinctive natural features. | | | |
| | Cycle Routes | 29 | Line | Development Plan designation/indicaated on OS Discover Series maps | | | |
| Cultural Heritage | Candidate World Heritage Sites | 30 | Point | Candidate World Heritage Sites | | | |
| | National Monuments - In State Ownership or Guardianship | 31 | Point | National Monuments - In State Ownership or Guardianship | | | |
| | Potential National Monuments - In Local Authority Ownership (Religious Sites) | 32 | Point | Potential National Monuments - In Local Authority Ownership (Religious Sites) | | | |
| | National Monuments - Archaeological Monuments Subject to Preservation Orders | 33 | Point | National Monuments - Archaeological Monuments Subject to Preservation Orders | | | |
| | Walled Towns | 34 | Point | Walled Towns | | | |
| | Sites & Monuments Record Structures | 35 | Point | Sites & Monuments Record Structures - Rated High | | | |
| | Architectural Conservation Areas | 36 | Polygon | Architectural Conservation Areas | | | |
| | Record of Protected Structures | 37 | Point | Record of Protected Structures | | | |
| | National Inventory of Architectural Heritage | 38 | Point | National Inventory of Architectural Heritage | | | |
| | Designed Landscapes & Historic Gardens--Demense Extents - Rated High | 39 | Polygon | Designed Landscapes & Historic Gardens--Demense Extents - Rated High | | | |
| | Designed Landscapes & Historic Gardens--Demense Extents - Rated Moderate | 40 | Polygon | Designed Landscapes & Historic Gardens--Demense Extents - Rated Moderate | | | |
| | Designed Landscapes & Historic Gardens--Demense Extents - Rated Low | 41 | Polygon | Designed Landscapes & Historic Gardens--Demense Extents - Rated Low | | | |
| | Designated Areas - NHA | 42 | Polygon | Source NPWS: These are Nationally Designated Site - Rated National Importance and potentially sensitive to the development. | | | |
| | Designated Areas - SPA | 43 | Polygon | Source NPWS: These are Natura 2000 site. European and Nationally Designated Site- Rated International Importance | | | |
| | Designated Areas - SAC | 44 | Polygon | Source NPWS: These are Natura 2000 sites. European and Nationally Designated Site- Rated International Importance and potentially sensitive to the development | | | |
| | Designated Areas - pNHA | 45 | Polygon | Source NPWS: These are Proposed Nationally Designated Site. May potentially be of National Importance. Recognised in Co Development Plans | | | |
| | Fens | 46 | Point | Source NPWS: Significant Ecological Receptor sensitive to development. Rating not confirmed but evaluation will range between County and International Importance | | | |

| | Constraints | Code | Type of layer | Site Type / Source Data | Primary Constraints | Secondary Constraints | Tertiary Constrained or Other Constraints |
|---|---|---|---|---|---|---|---|
| Ecology | Wintering bird Site - International / National/ Regional | 47 | Point | Source Bird Watch Ireland: Significant Ecological Receptor sensitive to development. Rating not confirmed but evaluation will range between County and International Importance | | | |
| | I-webs Site Local | 48 | Point | Source Birdwatch Ireland: Locally Significant Ecological Receptor potentially sensitive to development. | | | |
| | Turloughs | 49 | Point | Source NPWS: Significant Ecological Receptor sensitive to development. Evaluation will range between County and International Importance | | | |
| | Potential Turloughs | 50 | Point | Source NPWS: Not enough information currently to fully evaluate. Detailed as a precaution as may be evaluated as being of National/ International importance importance. | | | |
| | Coastal Lagoon | 51 | Polygon | Source NPWS: Significant Ecological Receptor sensitive to development. Evaluation will range between County and International Importance | | | |
| | Limestone Pavement | 52 | Polygon | Source NPWS: Significant Ecological Receptor sensitive to development. Evaluation will range between County and International Importance | | | |
| | Woodland Habitat | 53 | Polygon | Source NPWS: Significant Ecological Receptor sensitive to development. Evaluation will range between Local and International Importance | | | |
| | Semi Natural Grasslands | 54 | Polygon | Source NPWS: Significant Ecological receptor reletively less sensitive to development. Evaluation will range between Local and International Importance | | | |
| | Intact Raised Bog | 55 | Polygon | Source NPWS: Significant Ecological Receptor sensitive to development. Rating not confirmed but evaluation will range between County and International Importance | | | |
| | Raised Bog (un-surveyed) – vegetated | 56 | Polygon | Source NPWS: Not enough information currently. Detailed as a precaution as at least some of this area has potential of being of National/ International importance importance. | | | |
| | Fresh Water Pearl Mussel Catchments (SI. Catchments) | 57 | Polygon | Source NPWS: Highly sensitive receptor to water pollution impacts. River lake and some riparian ares are designated Natura 200( site. European and Nationally Designated Site- Rated International Importance. In addition the overall watershed is defined as "sensitive Areas" for specific SAC sites where activities will be carefully scrutinised for planning purposes. Note the precautionary approach required re EU Habitats Directive will be a significant issue to overcome if project consideres these watersheds | | | |
| | Fresh Water Pearl Mussel Catchments (other catchments) | 58 | Polygon | Source NPWS: Highly sensitive receptor to water pollution impacts. Not designated though populations potentially of International Importance. In addition the overall watershed is defined as "sensitive Areas" where mitigation will require careful consideration. | | | |
| | Salt Marsh | 59 | Polygon | Source NPWS: Significant Ecological Receptor sensitive to development. Evaluation will range between County and International Importance | | | |
| | Blanket Bog | 60 | Polygon | Source NPWS: Significant Ecological Receptor sensitive to development. Evaluation will range between Local and International Importance | | | |
| | Wet Heath | 61 | Polygon | Source NPWS: Significant Ecological Receptor sensitive to development. Evaluation will range between Local and International Importance | | | |
| | Lakes | 62 | Polygon | Source Ordnance Survey Ireland: Highly sensitive habitats potentially of National/ International Importance | | | |
| | Rivers | 63 | Line | Source Ordnance Survey Ireland: Highly sensitive habitats potentially of National/ International Importance | | | |
| Settlements | Town | 64 | Polygon | Settlement | | | |
| | Villages | 65 | Polygon | Settlement | | | |
| infrastructure / Engineering | Existing Transmission Lines | 66 | Point | EirGrid | | | |
| | Aerodromes | 67 | Polygon | IAA - Pieter Van Velzen | | | |
| | Airports | 68 | Line | Ireland West Airport - Tomas Grimes<br>Galway Airport Ronan Mc Goldrick | | | |
| | Gas Pipeline | 69 | | Bord Gais - Donncha O Sullivan | | | |
| | Road Schemes | 70 | | NRA | | | |
| | Railway Line | 71 | Polygon | Iarnróid Eireann | | | |
| | Wind farms | 72 | Polygon | Wind Farms Developers | | | |
| | Avoidance of areas of extreme slope greater than 30º | 73 | | Topography Maps | | | |
| Water | Estuarine (Transitiona)l Water Bodies | 74 | Polygon | EPA | | | |
| | Coastal Water Bodies | 75 | Polygon | EPA | | | |
| | Flood Plains | 76 | Polygon | OPW | | | |
| | Coillte - Forestry | 77 | Polygon | Coillte | | | |
| | Potential Turloughs | 78 | Point | As Ecology | | | |
| | Turloughs | 79 | Point | As Ecology | | | |
| | Fresh Water Pearl Mussel | 80 | Polygon | As Ecology | | | |
| | River Basin Districts | 81 | | N/A | | | |
| | Lakes | 82 | | As Ecology | | | |
| | Rivers | 83 | | As Ecology | | | |
| Geology | Irish Geological Heritage Sites | 84 | Point | GSI | | | |
| | Quarries | 85 | Point | GSI/IMQS | | | |
| | Mines | 86 | | GSI/IMQS | | | |
| | Karst Features in undesignated areas | 87 | Point | GSI | | | |
| | Subsoils (Peat) in undesignated areas | 88 | Polygon | GSI | | | |
| | | | | **Note:**<br>**Primary Constraints are highlighted in red**<br>**Secondary Constraints are highlighted in orange**<br>**Other Constraints are highlighted in yellow** | | | |

# The Grid West Project

Lead Consultant's Stage 1 Report

March 2013