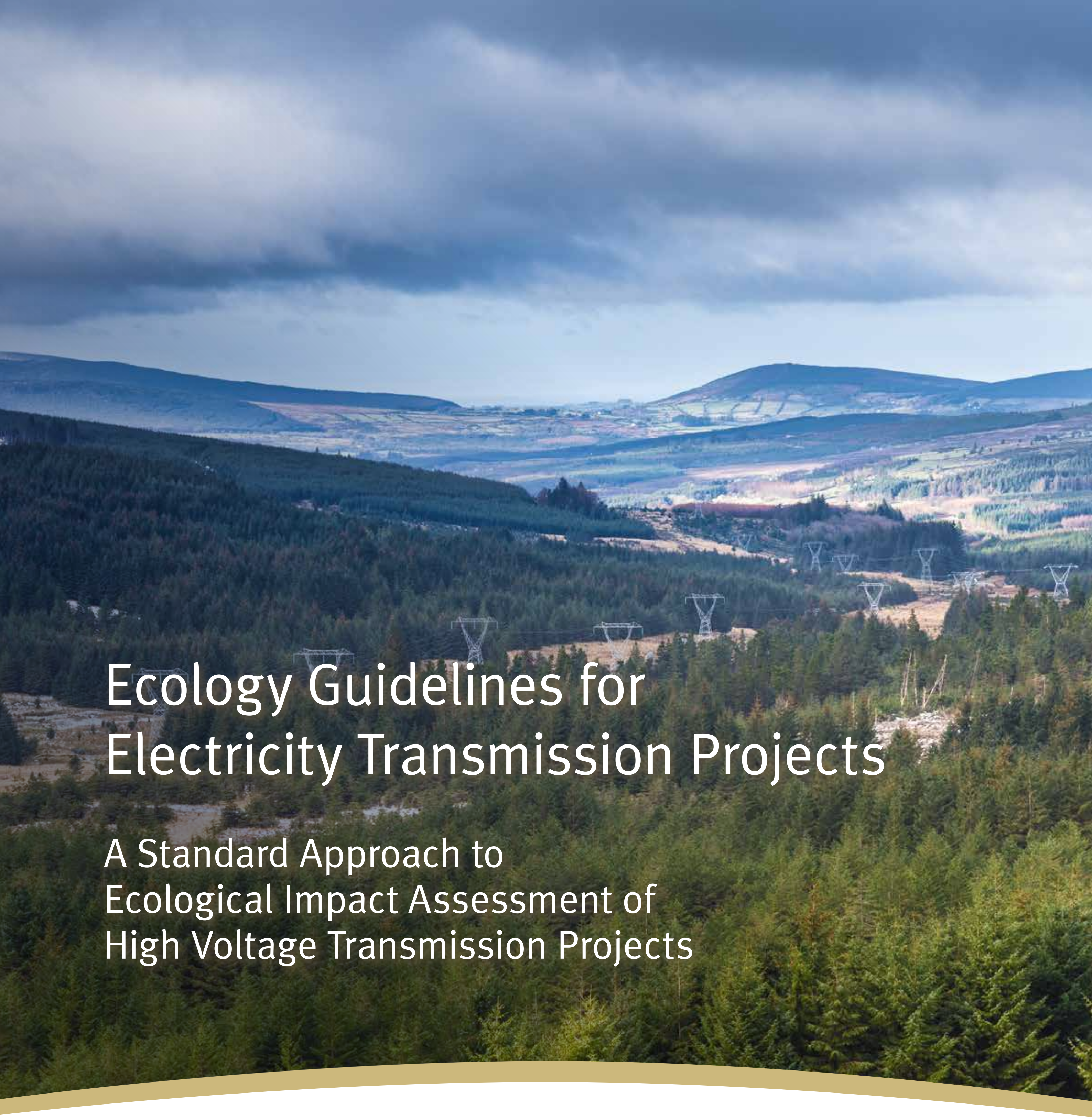

Ecology Guidelines for Electricity Transmission Projects

A Standard Approach to Ecological Impact Assessment of High Voltage Transmission Projects

EIRGRID

Delivering a cleaner energy future

ESB Energy for generations

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Table of Contents

Foreword

EirGrid is delighted to publish our second Ecology Guidelines for Electricity Transmission Projects in conjunction with ESB Networks, and in consultation with the National Parks and Wildlife Service.

EirGrid operates and develops the electricity transmission grid in Ireland. This includes interconnection with neighbouring grids and the wholesale electricity market. The grid brings power from generators to the ESB distribution network that supplies every home, farm and business in Ireland. The grid also delivers power directly to businesses that use large amounts of electricity. EirGrid ensures electricity is always available at the most economic price – today, tomorrow and for decades to come.

Electricity can be generated from renewable sources like wind and solar power. These sources of clean energy will soon replace dirty fuels like coal and oil. To prepare for this change, EirGrid must make the electricity grid stronger and more flexible.

EirGrid's work to transform the electricity system is an integral part of the Government's Climate Action Plan; the proposed energy transition is a cornerstone of Ireland's response to climate breakdown. These guidelines will help to deliver our ultimate ambition for a renewables-based power system, while maintaining an affordable, secure, and reliable power system. EirGrid is fully committed to ensuring that these developments are carried out

Since we published our first guidelines in 2012, the pace of change in research, technology and law has been matched by the pace of change in our ecosystem resulting in legislators declaring both a National Climate and Biodiversity Emergency in May 2019.

The EU Biodiversity Strategy for 2030, adopted by the European Commission in 2020 states an ambition that "by 2050 all of the world's ecosystems are restored, resilient and adequately protected". EirGrid's own ambition for 70% renewable energy by 2030 is in accordance with the EU's broader ambition in addressing the climate and biodiversity crisis and in 2021 EirGrid will publish a roadmap to identify the electrical transmission infrastructure required to deliver on its targets.

EirGrid has a statutory obligation to have due regard for the environment in the carrying out our functions. These updated guidelines provide for ecological protection during development of the high voltage transmission system.

Michael Mahon
Chief Infrastructure Officer,
EirGrid

Acknowledgements

The authors of the updated guidelines, Ciara Hamilton and Geoff Hamilton (ESB Engineering and Major Projects), Robert Fennelly (EirGrid), and Maeve Flynn (An Bord Pleanála, formerly EirGrid) wish to express their gratitude to all those who contributed to the preparation of these guidelines through their provision of recommendations, advice and content.

The authors wish to thank their colleagues in ESB Networks, ESB Engineering and Major Projects, and EirGrid who provided information on the technical aspects of transmission infrastructure and associated construction practices. The authors gratefully acknowledge feedback from the National Parks and Wildlife Service, in particular Dr. Gerry Clabby, Dr. Julie Fossitt, and Jochen Roller, as well as Michaela Kirrane (Inland Fisheries Ireland), Roisin Kearney (RSPB), Dr. Brian Caffrey (Birdwatch Ireland), and James McCrory (RPS) for their constructive input during the consultation process. Invaluable legal review was provided by Eoin Brady, and Deirdre Nagel of Mason Hayes & Curran.

Finally, thanks to Dr. Patrick Crushell (Wetland Surveys Ireland) for providing numerous mitigation-related photographs.

Summary

Ecology guidelines updates

In 2012, EirGrid produced guidelines for professional ecologists who carry out ecological assessments of transmission projects. Since then, there have been changes in law, policy and practice. We are now updating the guidelines to reflect those changes, so that those involved in Ecological Impact Assessment (EcIA), and Appropriate Assessment (AA) adopt a standard approach. The guidelines will also be useful for the public bodies who review the EcIAs, and AA reporting submitted for transmission projects.

At the moment, our guidelines apply to onshore development only.

What are the key legislative and related changes in the new guidelines?

The key legislative and policy changes addressed in the 2021 Guidelines include:

- Changes to Environmental Impact Assessment (EIA) due to EU Directive 2014/52/EU
- Changes to Appropriate Assessment (AA) and AA Screening due to court rulings and guidance published since 2012
- Updates to the list of protected plant species, in the Flora Protection Order 2015, which now includes many non-flowering plants
- Changes to practice arising from, for instance, updates to the Chartered Institute of Ecology and Environmental Management's Ecological Impact Assessment guidance in 2019, and the new Irish Vegetation Classification
- A new EU biodiversity Strategy for 2030
- National policy changes in the National Biodiversity Action Plan 2017-2021
- The current strategy for developing the grid, in EirGrid's Grid Implementation Plan 2017-2022

You can read a full list of these and other changes in Section 2 and Appendix 1 of the full report.

How will these updated guidelines help EirGrid and you?

From a working perspective, the updated guidelines will:

- reflect and inform our Six-Step project development process (explained below);
- summarise the findings of our Evidence-Based Environmental Studies into impacts from transmission projects and measures to protect the environment; and
- provide new information on types of transmission projects and construction methods.

How will our Six-Step project development process be informed by the new information?

Our Six-Step project development process is an end-to-end process for all EirGrid's grid development projects, from their conception - the identification of a need to develop the electricity transmission grid - to their eventual construction and subsequent energisation. The process explores options and documents decisions when considering how to develop the electricity grid. We designed it as part of our commitment to public engagement and consultation, both of which actively influence the decisions we take when developing projects. At each step, we make decisions that narrow the focus for the choices required in the next step. The level of ecological consideration increases through to Steps 6, as we refine the proposed transmission project.

How will the new information use findings from our Evidence-Based Environmental studies?

Our Evidence Based Environmental Studies examine the effects of construction and the electricity transmission infrastructure (cables, stations, etc.) directly relevant to ecology. They include studies on bats, habitats, birds, water quality and aquatic ecology. We use findings from these studies to design and assess transmission projects. The studies also help us to identify optimal mitigation measures. We plan to update these studies as research and grid technology develops.

How will the new information on transmission project types and construction methods help?

These updated guidelines contain new information about typical structures and construction methods involved in transmission projects. This will help identify potential ecology impacts. Section 3 of the updated guidelines devotes 35 pages to the description of overhead lines, underground cables, and substations. This Section also has photographs from EirGrid transmission project sites, where construction is carried out by ESB Networks on behalf of EirGrid.

There are also updated visuals of all tower types, and we have also provided graphics with notes about typical construction methodologies. You will find significant new information on temporary works required, and construction methods including Horizontal Directional Drilling.

1. Introduction

1. Introduction

1.1. EirGrid Group

As part of the EirGrid group of companies, EirGrid plc (EirGrid) is the statutory electricity Transmission System Operator (TSO) in Ireland and SONI Ltd (System Operator Northern Ireland) is the licensed TSO in Northern Ireland. EirGrid Group operates and develops the electricity system in Ireland and Northern Ireland. This comprises the high voltage electricity transmission systems (also known collectively as the grid), the wholesale electricity market (Single Electricity Market – SEM) and interconnection with other systems.

In both jurisdictions, we implement and enable government policies on electricity. We are regulated as monopoly service providers. We perform our services for the benefit of every electricity user on the island of Ireland. We support the economy in both jurisdictions rather than to pursue our own commercial interests. We are an independent entity, with no vested interest in the generation or selling of electricity. We don't own the grid infrastructure and have no self-interest in adding to it.

These Guidelines apply to EirGrid projects, within the Republic of Ireland. In Northern Ireland, it is anticipated that SONI will develop its own Ecology Guidelines for Northern Irish Electricity Transmission Projects. However the SONI and EirGrid guidelines will be complementary, In light of the single biogeographic unit represented by the island of Ireland, the requirement for cross-border linear infrastructure projects, and, notwithstanding the UK's departure from the European Union.

EirGrid is responsible for all system planning, feasibility and spatial planning requirements for development of transmission infrastructure, to enable ESB Networks (ESBN), the Transmission Asset Owner (TAO) in Ireland to construct new or upgrade existing transmission infrastructure. An Infrastructure Agreement (IA) has been agreed between EirGrid as the licenced TSO and, ESBN as the licensed TAO, pursuant to Article 18 the European Communities (Internal Market in Electricity) Regulations, 2000 (S.I. No. 445/2000).

Under the IA, EirGrid has the responsibility for securing all necessary consents for the development of Ireland's electricity transmission system, while ESB is responsible for the construction and ultimate ownership of that transmission system.

EirGrid Group develops key electricity infrastructure projects, which are vital for the socio-economic development of Ireland and Northern Ireland. Under S.I. No. 445/2000, EirGrid has a statutory duty to develop the transmission system with due regard for the environment (to include biodiversity).

Electricity generated from thermal power stations as well as wind farms and other renewable sources is transferred to transmission stations and demand centres throughout the island of Ireland. It then transfers from these transmission stations into homes and business via the lower voltage electricity distribution networks. The distribution networks are respectively owned and operated by ESB Networks in the Republic of Ireland and NIE Networks in Northern Ireland.

1.2. Grid Development

The grid is a meshed network of high voltage overhead lines (OHL), underground cables (UGC) and substations. In Ireland, electricity is transmitted over the transmission system at 110 Kilovolts (kV), 220 kV and 400 kV. In the context of transboundary assessments, it is noted here that in Northern Ireland, the transmission system comprises a 110 kV network and a 275 kV network, though the latter is constructed to a 400 kV standard.

Grid development relates to any significant work on electricity transmission infrastructure and includes new build, upgrade and refurbishment projects. More than 60% of transmission circuits on the Irish system are over 35 years old and require maintenance or replacement on an on-going basis.

Grid development requires a careful balance between meeting the technical requirements of a project, project costs, and the environmental impact of a project. Generally, all practical technology options for developing the network will be considered with a view to minimising the need for new infrastructure.

EirGrid has recently implemented a new framework for developing the grid. This approach has six steps and helps to determine whether and how we develop the grid. (EirGrid, 2017[1]; Figure 1.1). Various development options are explored during these processes including an assessment of their potential for impacts on ecology and the wider environment.

Figure 1.1: EirGrid's Six-Step Development Process

1.3. Ecological Impact Assessment

The construction of new electricity transmission infrastructure and the upgrade of existing infrastructure have the potential to result in significant impacts on ecology and biodiversity. To ensure development of the transmission system is carried out with due regard for the environment, it is therefore crucial for ecological assessment and the implementation of appropriate mitigation measures to eliminate or reduce such impacts to acceptable levels. This is particularly important for larger projects or projects within or adjacent to sensitive ecological areas.

Ecological Impact Assessment (EcIA) is the process of identifying, quantifying and evaluating the potential effects of development-related or other proposed actions on habitats, species and ecosystems (Treweek, 1999[2]).

EcIA can be used for the appraisal of projects of any scale including the ecological component of Environmental Impact Assessment (EIA), set out in Directive 2011/92/EU, as amended by Directive 2014/52/EU (hereafter referred to as the EIA Directive). When undertaken as part of an EIA, EcIA is subject to the relevant EIA Regulations. However, unlike EIA, EcIA on its own is not a statutory requirement.

It is a best practice evaluation process undertaken to support a range of assessments (CIEEM, 2018[3]). For electrical transmission projects not subject to EIA, EcIAs are typically presented within the biodiversity chapter of a Planning and Environmental Considerations Report (PECR).

EIA obligations need to be considered in relation to the totality of a proposed development, not just the primary electricity transmission development.

There are other categories of EIA development which may be engaged, particularly in relation to Annex II categories of development. For example, a transmission development may in certain circumstances involve afforestation, deforestation or the construction of private roadways, each of which may need to be considered in respect of sub-threshold development.

Assessment of ecological impacts is also required to inform Screening for Appropriate Assessment (AA) – required for all transmission infrastructure projects – AA where required, under Article 6 (3) of the EU Habitats Directive (see Section 2.1.2.).

1.4. EirGrid Evidence Based Environmental Studies

EirGrid has completed independent Evidence Based Environmental Studies (EBES) (EirGrid, 2015[4], 2016a[5], 2016b[6], 2016c[7], 2016d[8]) examining the actual effects of the construction and operation of transmission infrastructure in respect of a number of environmental topics in Ireland.

These studies provide benchmarks to facilitate the robust design and assessment of transmission projects with an evidence-based understanding of likely environmental impact. The studies, while authoritative, are conceived as an ongoing body of work that can be updated to take account of new information and/or developments in understanding arising from practice and research. The findings of these evidence based studies are presented in Chapter 4 of these guidelines.

1.5. Objective of Guidelines

The first Ecology Guidelines for Electricity Transmission Projects (EirGrid, 2012[9]) were developed to ensure a standard approach to EcIA of high voltage transmission projects in Ireland and to provide good practice guidance on ecological topics of particular relevance to high voltage electricity infrastructure.

These updated guidelines aim to facilitate a better understanding amongst consultants and ecologists with reference to EcIA of electricity transmission projects in Ireland by:

- Presenting a step by step approach to EcIA related to EirGrid's Six-Step project development process;
- Providing contextual technical information on the various types of transmission projects and associated construction methodologies;
- Presenting evidence-based results on the impacts associated with transmission infrastructure projects in Ireland and advice on how to mitigate these impacts.

1.6. Audience for Guidelines

These Guidelines are targeted primarily towards professional ecologists, competent in the delivery of ecological assessments for transmission infrastructure projects.

The Guidelines may also be informative for competent authorities reviewing ecological assessments of transmission infrastructure projects, including local authorities, An Bord Pleanála, and the Foreshore Unit of the Department of Housing, Local Government, and Heritage.

Due to their technical nature, the Guidelines do not strictly follow the National Adult Literary Agency's Plain English Guidelines. (NALA, 2005-2009[10]). An executive summary will be produced in collaboration with NALA for the final version of the Guidelines.

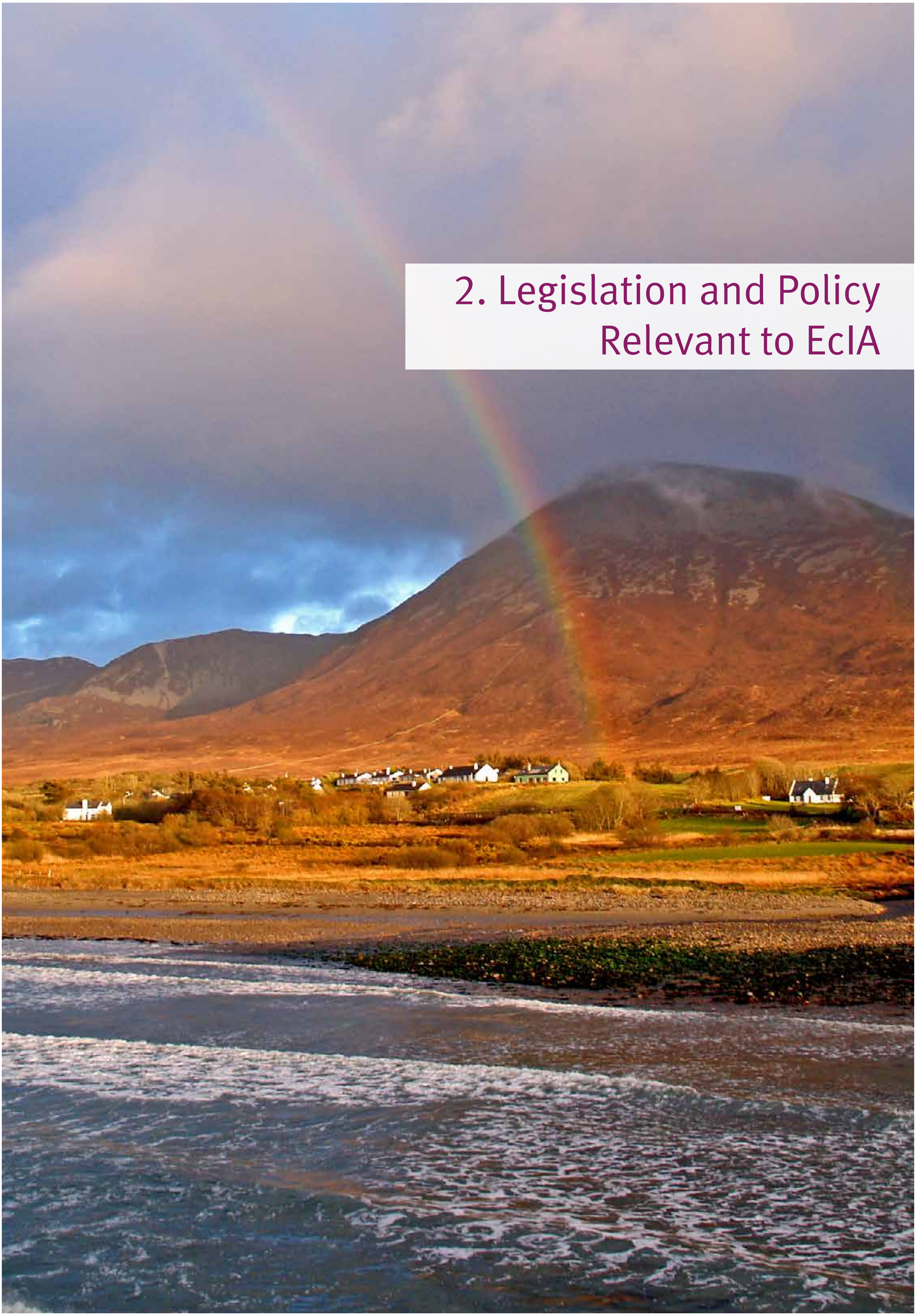
1.7. Scope of Guidelines

These Guidelines apply to onshore development only.

EirGrid will publish an amended version of these guidelines to address transmission infrastructure projects in the foreshore, and in marine areas (the Marine Guidelines). The Marine Guidelines will address the new maritime consent regime, provisionally outlined in the Marine Planning and Development Management Bill which is expected to be passed in 2021. Once commenced, the regime will replace existing State and development consent regimes and streamline arrangements for development in the foreshore and offshore on the basis of a single consent principle.

The Marine Guidelines will also address the applicable spatial and policy context set by the National Marine Planning framework which includes elements such as the Marine Planning Policy Statement, and the Marine Spatial Plan. The Marine Guidelines will incorporate outcomes of the process initiated by the Department of Housing, Local Government, and Heritage (DHLGH) in 2019 aiming at expanding Ireland's network of Marine Protected Areas (MPAs), and other changes affecting ecological assessments of marine transmission projects. Having regard to the anticipated development of large scale renewable energy projects in Ireland's offshore area, the Marine Guidelines will also have regard to ecological best practice for subsea electricity cables developed under the Convention for the Protection of the Marine Environment of the North-East Atlantic(the "OSPAR Convention").

2. Legislation and Policy Relevant to EcIA



2. Legislation and Policy Relevant to EcIA

2.1. Legislation Relevant to EcIA

2.1.1. Environmental Impact Assessment

Transmission Projects requiring EIA

Environmental Impact Assessment (EIA) is provided for in Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014, which amends Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment.

EU Requirements requires an EIA process consisting of inter alia, the preparation of an Environmental Impact Assessment Report[i] (EIAR) by the developer, specified consultations, the examination by the competent authority (CA) of the information presented in the EIAR and other relevant information, the reasoned conclusion by the CA on the significant effects of the project on the environment and the integration of the CA's reasoned conclusion into relevant decisions.

EIA Directive Projects

Article 2 of the EIA Directive provides that before development consent is given, projects likely to have significant effects on the environment by virtue, inter alia, of their nature, size or location are made subject to a requirement for development consent and an assessment with regard to their effects on the environment. Article 4 provides that subject to Article 2(4), projects listed in Annex I are subject to EIA and for Annex II projects, Member States shall determine whether the project shall be made subject to an assessment.

In relation to transmission infrastructure, the construction of overhead electrical power lines with a voltage of 220 kV or more and a length of more than 15 km is included as an Annex I project (as is any change to or extension of such projects in this Annex where such a change or extension in itself meets the thresholds, if any, set out in this Annex); Annex II Projects include the transmission of electrical energy by overhead cables (projects not included in Annex I) and any change or extension of projects listed in Annex I or Annex II, already authorised, executed or in the process of being executed, which may have significant adverse effects on the environment (change or extension not included in Annex I).

At the time of writing, the EIA Directive Annex I threshold for transmission infrastructure (i.e. for which EIA is mandatory) is construction of overhead power lines with a voltage of 220 kV or more, and a length of more than 15 km.

EIA Directive Thresholds Transposed in Irish Law

The threshold is transposed into Irish national legislation in Part 1 of Schedule 5 to the Planning and Development Regulations 2001 (amended). Under Part 2 of Schedule 5 to the Planning and Development Regulations 2001 (amended), the threshold of development transposed applies to "overhead cables… where the voltage would be 200 kilovolts or more." While it is unusual for transmission developments to have a voltage of 200 kV, with typical voltages being at a rating of 110 kV or 220 kV, the lower threshold of 200 kV is the applicable one in law, as Ireland has gone further than the Directive requires in respect of the relevant threshold.

There is no EIA category for Underground Cables. Where substations are being developed as part of an OHL project subject to EIA, the substation should also be assessed as part of that EIA.

In certain circumstances, depending on the footprint of the substation development, the threshold requirement for "urban development" may also need to be considered.

Under Part 2 of Schedule 5 to the Planning and Development Regulations 2001 (as amended), there is a threshold category for Industrial installations for carrying gas, steam and hot water, or transmission of electrical energy by overhead cables (for projects not included in Annex I) where the voltage would be 200 kilovolts or more". Case law has interpreted this threshold as requiring each of the elements of electricity, steam and hot water to be produced by a facility before the threshold category is engaged. Therefore, electricity substations will generally not be engaged by this category of EIA development, which will generally apply to thermal electricity generation stations only.

i Prior to 2014/52/EU, the Environmental Impact Assessment Report (EIAR) was referred to as the Environmental Impact Statement (EIS) in the Republic.

Article 3 of the Directive requires that EIA identify, describe and assess the direct and indirect significant effects of a project on specific factors including biodiversity (with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC) and the interaction between factors assessed.

Screening for Annex II Projects

Article 4(4) of Directive 2014/52/EU provides that where Member States decide to require a determination for projects listed in Annex II, the developer shall provide information on the characteristics of the project and the likely significant effects on the environment. The detailed list of information to be provided is specified in Annex II A (including information in relation to biodiversity). The developer shall take into account, where relevant, the available results of other assessments of the effects on the environment carried out pursuant to Union legislation other than the EIA Directive. The developer may also provide a description of any features of the project and/or measures envisaged to avoid or prevent what might otherwise have been significant adverse effects on the environment.

EIAR Information

Where EIA is required, the information to be provided in the EIAR is set out in Article 5 and Annex IV of the EIA Directive and includes a description of the project, a description of the likely significant effects of the project on the environment; a description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment, a description of the reasonable alternatives studied by the developer and an indication of the main reasons for the option chosen and a non-technical summary.

In Ireland, the EIA requirements relevant to transmission projects are transposed into Irish law in the Planning and Development Act 2000 (as amended) and the Planning and Development Regulations 2001 (as amended).

The relevant requirements of the EIA Directive have been inserted by the Planning Acts and Planning Regulations (as amended).

Draft guidance in relation to the EIA process in Ireland has been published by the EPA (2017[11]) and the Department for Housing, Planning and Local Government (2018[12]).

Transmission Projects not subject to EIA

Ecological receptors and resources must also be taken into consideration for projects that do not require EIA but which require planning permission (or indeed exemption from planning permission) under planning law. In such cases where an EIAR is not required, it is EirGrid practice that as part of the planning process, a Planning and Environmental Considerations Report (PECR) will include an assessment of impacts on biodiversity. This assessment should evaluate the full biodiversity resources of the area in terms of the habitats and species potentially affected, some of which may be legally protected and to demonstrate and record that good environmental practice has been followed. Baseline data, impact assessment and appropriate mitigation measures should be presented in the biodiversity chapter of the PECR.

2.1.2. Appropriate Assessment

The EU Habitats and Birds Directives enable all Member States to work together within the same legislative framework in order to protect the EU's most vulnerable species and habitat types.

The Habitats Directive, adopted in 1992[ii], introduced measures to cover a range of threatened or endemic (i.e. geographically restricted) species of wild animals and plants. It also introduced protection for a series of rare habitat types. The Birds Directive, adopted in 2009[iii], aims to protect all wild birds and their most important habitats across the EU.

The overall objective of the two directives is to ensure that the species and habitat types they protect are maintained, or restored, to a favourable conservation status throughout their natural range within the EU. To achieve this objective, the Habitats and Bird Directives require Member States to:

ii Council Directive 92/43/EEC, of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.
iii Directive 2009/147/EC of the European Parliament and of the Council, of 30 November 2009 on the conservation of wild birds (replacing Council Directive 79/409/EEC of 2 April 1979).

- Designate and conserve core sites for the protection of species and habitat types listed in Annex I and II of the Habitats Directive and Annex I of the Birds Directive, as well as for migratory birds. These sites form part of the EU-wide Natura 2000 Network of European sites (or 'Natura 2000' sites). More details are presented in Section 2.1.6.
- Establish a species protection regime for all wild European bird species and other endangered species listed in Annex IV and V of the Habitats Directive. This protection regime applies across the species' entire natural range in the EU (i.e. both inside and outside European sites). More details are presented in Section 2.1.6.

Article 6 of EU Habitats Directive

Article 6 of the EU Habitats Directive (92/43/EEC) sets out provisions which govern the conservation and management of European sites. Article 6(1) relates to the establishment of necessary conservation measures. Article 6(2) relates to the obligation of member states to avoid habitat deterioration and significant disturbance to species. Articles 6(3) and 6(4) set out procedures governing projects and plans likely to have a significant effect on a European site.

Article 6(3) requires that any plan or project that is not directly connected with or necessary to the management of a European site but is likely to have a significant effect on a European site(s), on its own or in combination with other plans and projects, is authorised only if it will not adversely affect the integrity of that site. Screening for Appropriate Assessment (AA) determines the requirement for AA. Screening for AA (and if required AA) must be carried out, and the assessment and conclusions recorded to ensure that plans or projects are not authorised if they are likely to adversely affect the integrity of a European site (s), having regard to the site's conservation objectives.

Consequently, where Screening indicates that a transmission project, alone or in combination with other plans or projects is likely to have significant effects on European sites (or the risks of such effects cannot be excluded on the basis of objective scientific information) AA is required under the EU Habitats Directive.

Appropriate Assessment

Article 6 of EU Habitats Directive 92/43/EEC

The relevant sections of the Directive are:

Article 6(3): Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives.

In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.

Article 6(4): If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.

Where the site concerned hosts a priority natural habitat type and/or a priority species the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion of the Commission, to other reasons of overriding public interest.

The stages of Appropriate Assessment are set out in methodological guidance documents published by the European Commission (EC, 2001[13] & EC, 2018a[14]).

Reports relating to the Appropriate Assessment process are produced and made available as stand-alone documents.

It must be emphasised that the Appropriate Assessment process is a separate legal process to the EIA process and is applicable to projects or activities which may not be subject to EIA or require planning permission. In terms of electricity transmission development, this may include the repair of lines, uprating of lines or potentially intrusive activities such as site investigation, geophysical investigation works or archaeological testing, or other intrusive advance works.

Exempted Development

Exempted development is development for which planning permission is not required. Categories of exempted development are set out in the Planning and Development Act, 2000 (as amended) and Planning and Development Regulations, 2001 (as amended).

In the context of (onshore) electricity transmission projects in Ireland, developments normally exempted from planning requirements lose their exemption where an AA is required under the Planning and Development Act (as amended). Accordingly, the AA Screening outcome will determine, in such instances, whether an onshore development requires planning permission or not.

The EU Habitats Directive in Ireland

The provisions of the Habitats Directive have been integrated into the Planning and Development Act 2000 (as amended) and the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended).

Specific guidance relating to Appropriate Assessment for plans and projects in Ireland has been published by the National Parks and Wildlife Service (NPWS) (DoEHLG, 2009[15]). Subsequent procedural guidance on conducting an AA, including the relative roles of the NPWS, the Development Applications Unit of the Department of Culture, Heritage and the Gaeltacht (DCHG; since redesignated the DHLGH), and the minister of the DCHG (whose duties now lie with the minister of the DHLGH) has also been published on the NPWS website.

EirGrid is a Public Authority under the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended). As such, EirGrid makes the AA Screening Determinations for electricity transmission projects which do not require planning.

In Ireland, it is the responsibility of the competent authority (or consent authority) to undertake AA for proposed plans or projects. This is completed based on information submitted by the applicant (in the form of an AA Screening or Natura Impact Statement (NIS)), compiled by ecological specialists working for or on behalf of the applicant.

See Section 2.1.5, regarding planning implications for developments impacting Natural Heritage Areas (NHA).

Case law regarding Appropriate Assessment

In addition to the Habitats Directive being implemented in the respective jurisdictions through the aforementioned regulations, the practical application of the Directive is also directly influenced by case law arising as a consequence of court decisions in Ireland, and Europe. Practitioners undertaking AA in relation to transmission infrastructure projects are expected to be cognisant of up-to-date case law and how it may influence the requirements, conclusions and measures proposed in AA-specific reports.

All assessments must apply all relevant up-to-date case law. The EC (2018a[14]) document '*Managing Natura 2000 sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC*' provides a helpful review of the case law relating to AA up to November 2018.

Article 10 of EU Habitats Directive

Article 10 of the Habitats Directive recognises the importance of ecological coherence in protecting European sites and requires Member States to protect landscape features that are of major importance for wild flora and fauna through land use planning and development.

These features are those which, because of their linear and continuous structure or their ability to function as "stepping stones" are essential for migration, dispersal and genetic exchange within the landscape. Examples given in the Directive are rivers with their banks, traditional field boundary systems (such as hedgerows), ponds and small woods. Under the Planning and Development Act 2000 as amended, Development Plans must include objectives for the encouragement of the management of features of the landscape, such as traditional field boundaries, important for the ecological coherence of the Natura 2000 network and essential for the migration, dispersal and genetic exchange of wild species.

New electricity transmission projects should consider, inter alia, the network of landscape features within the 'zone of influence' and the maintenance of connectivity within and between ecological sites. The 'zone of influence' for a project is the area over which ecological features may be affected by biophysical changes as a result of the proposed project and associated activities. This is likely to extend beyond the project site, for example where there are ecological or hydrological links beyond the site boundaries (CIEEM, 2018[3]).

The long-term survival of many species and habitats is dependent upon maintaining the ecological coherence of the ecosystems in which they occur and allowing free movement of species and genetic resources within the landscape.

2.1.3. Water Framework Directive

The EU Water Framework Directive 2000/60/EC (WFD) requires all Member States to protect and improve water quality in all waters so that good ecological status is achieved at the latest, by 2027. The WFD was first transposed in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003), and subsequently by a number of amending and additional regulations. The WFD applies to rivers, lakes, groundwater, and transitional coastal waters. Transmission projects affecting water bodies should take account of the Water Framework Directive. Technical assessments of potential risks to water body status carried out under the WFD may also be used to support biodiversity reporting for EIA projects and/or AA reporting.

2.1.4. Environmental Liability Directive

The Environmental Liability Directive (2004/35/EC) has the objective of making operators of activities which cause environmental damage financially liable for such impacts. It imposes duties on operators of 'Occupational Activities' to take immediate steps to prevent damage if there is an imminent threat, and to control damage which is occurring so as to limit its effects.

The Regulations implement the 'polluter-pays' principle, to prevent and remedy environmental damage. It holds operators, whose activities have caused environmental damage, financially liable for remedying this damage and holds those whose activities are causing an imminent threat of environmental damage liable to take preventive actions.

The EU Environmental Liability Directive

Under the terms of the Environmental Liability Directive, environmental damage is defined as:

- Direct or indirect damage to species and natural habitats protected at Community level by the Birds Directive or the Habitats Directive;
- Direct or indirect damage to the aquatic environment covered by the Water Framework Directive;
- Direct or indirect contamination of the land which creates a significant risk to human health.

Included within the definition of protected species and natural habitats under the terms of the Directive are:

a. Species mentioned in Article 4(2) of the Birds Directive or listed in Annex I thereto or listed in Annexes II and IV to the Habitats Directive; and

b. Habitats of species mentioned in Article 4(2) of the Birds Directive or listed in Annex I thereto or listed in Annex II to the Habitats Directive, and the natural habitats listed in Annex I to the Habitats Directive and the breeding sites or resting places of the species listed in Annex IV to the Habitats Directive.

The European Communities (Environmental Liability) Regulations 2008 (as amended) transpose the Directive in Ireland.

In the case of Ireland, the Environmental Protection Agency (EPA) has been designated as the competent authority for all aspects of the aforementioned Regulations. The National Parks and Wildlife Service (NPWS) may be consulted by the EPA where a potential case of biodiversity-related environmental liability arises. Guidance (EPA, 2011[16]) on the implementation of the European Communities (Environmental Liability) Regulations 2008 is available from the EPA website.

2.1.5. Wildlife Acts

The Wildlife Acts 1976 to 2018 as amended ('the Wildlife Acts') are the principal national legislation providing for the protection of wildlife and the control of some activities that may adversely affect wildlife.

The protection of Nature Conservation sites under the Wildlife Acts are described in Section 2.1.6.; while species protections under the Wildlife Acts are described in 2.1.7.

The planning and development of electrical transmission projects may trigger a variety of licensing requirements under the Wildlife Acts, to permit potentially disturbing ecological surveys in the course of producing EcIAs, and/or to permit disturbing mitigation works during construction or operation.

The Minister (whose role is delegated to the NPWS' Wildlife Licencing Unit) has the power to attach conditions to any licence granted under the Act and to vary them.

The requirements of the Wildlife Acts must be considered at all times during a planned transmission development. It should also be noted that development which would otherwise be considered exempted development, is no longer exempt if it could have an adverse impact on an area designated as a Natural Heritage Area (NHA).

2.1.6. Nature Conservation Sites: Legislation

Nature conservation sites include those designated under International, European and National legislation. These areas are considered to be of prime importance for the conservation of biodiversity.

Nature Conservation Sites in Ireland

Nature conservation sites in Ireland are designated by the National Parks and Wildlife Service (NPWS) of the Department of Culture, Heritage and the Gaeltacht under national and European legislation and other international directives and conventions. European (Natura 2000) sites are designated in Ireland under the EU Habitats Directive, which is transposed into Irish law by S.I. No. 477 of 2011 (European Communities (Birds and Natural Habitats) Regulations 2011).

European sites account for the majority of Ireland's protected areas network with 439 Special Areas of Conservation (SAC) (including candidate SACs) currently protected. The areas chosen as SACs in Ireland cover an area of 16,945 km^2 (of which approximately 42% comprises terrestrial areas) Additionally, there are 165 Special Protection Areas (SPA) covering an area of 5,895 km^2, a number of which overlap to a large degree with SACs.

The basic national designation for conservation sites is the Natural Heritage Area (NHA). Natural Heritage Areas are established in Ireland under the Wildlife Acts 1976 to 2018. There are currently 155 NHAs covering an area of 603 km^2.

Table 2-1 summarises the nature conservation designations in Ireland together with associated legislation.

Table 2-1: Protected Nature Conservation Sites in Ireland

Nature Conservation Site*	Abbreviation	Importance	Originating Directive or Convention	National Legislation/ Statutory Status
Special Area of Conservation/ Candidate Special Area of Conservation	SAC/cSAC	European (Natura 2000)	EU Habitats Directive (92/43/EEC)	European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011)
Special Protection Area/proposed Special Protection Area	SPA/pSPA	European (Natura 2000)	EU Birds Directive (2009/147/EC)	European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011)
Salmonid Water	None	European	EU Freshwater Fish Directive (78/659/EEC) [repealed by EU Water Framework Directive 2000//60/EC]	European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293/1988)
Ramsar Site	None	International	Ramsar Convention on Wetlands of International Importance	
Natural Heritage Area	NHA	National		Wildlife Acts 1976 to 2018
Proposed Natural Heritage Area	pNHA	National		Recognised by Planning and Licensing Authorities, and subject to other limited protections
Statutory Nature Reserve	SNR	National		Wildlife Acts 1976 to 2018
National Park	NP	National		National Parks defined by Government under criteria and standards for National Parks as set by the IUCN
Refuge for Fauna and Flora	None	National		Wildlife Acts 1976 to 2018
Wildfowl Sanctuary	None	National		Wildlife Acts 1976 to 2018

*For more information on these sites consult NPWS (http://www.npws.ie)

2.1.7. Protected Species: Legislation

Consideration must be given in the planning and development of new electricity transmission projects (or in relation to works associated with existing infrastructure) to protected species of flora and fauna.

The NPWS has published a useful updated checklist of protected and threatened species in Ireland (Nelson et al., 2019[17]).

Under national legislation, it is an offence to wilfully disturb the breeding or resting place of a protected animal species under Schedule 5 to the Wildlife Acts (as amended).

It is an offence to wilfully disturb the breeding or resting place of a protected animal species under Schedule 5 to the Wildlife Acts (as amended).

Where species are additionally protected under Annex IV of the Habitats Directive, strict liability protection applies. A person who deliberately captures, kills or disturbs a specimen in the wild is guilty of an offence. Significantly, a person who damages or destroys a breeding or resting place of an Annex IV species is also guilty of an offence, even where not deliberate. Annex IV species are protected wherever they are found, and their presence may not be associated with areas subject to a specific nature designation.

Articles 12 and 13 of the Habitats Directive establish the system of strict protection for Annex IV species, while Article 16 provides for derogations from these provisions under limited circumstances. Articles 12, 13 and 16 of the Habitats Directive are transposed into Irish law by Regulations 51, 52 and 54 of the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended) ('The Birds and Habitats Regulations').

The animal species listed in Annex IV, which occur in Ireland, are:

- Otter (*Lutra lutra*);
- All bat species;
- Kerry slug (*Geomalacus maculosus*);
- Natterjack toad (*Bufo calamita*);
- Four species of sea turtle; and,
- All cetaceans (whales and dolphins).

Seals (which are pinnepids, rather than cetaceans) are not strictly protected under Annex IV.

The plant species listed in Annex IV, which occur in Ireland, are:

- Slender Naiad *Najas flexilis*;
- Yellow Marsh Saxifrage *Saxifraga hirculus*;
- Killarney Fern *Trichomanes speciosum*;

The main legal provisions for the protection of species in Ireland are presented in Table 2-2. Appendix 2 provides links to the respective legislation and species lists. The following sections outline how information on records for protected species can be accessed.

Table 2-2: Protected Species of Flora and Fauna and Annexed Habitats and Species in Ireland

Legislation	Annex/Schedule
EU Birds Directive (2009/147/EC)	All wild birds are protected. Birds under Annex 1 are subject to special measures, including designation of SPAs. **Annex I:** Bird species in danger of extinction; vulnerable to specific changes in their habitat; considered rare because of small populations or restricted local distribution; requiring particular attention for reasons of the specific nature of habitat. Member States must conserve their most suitable territories in number and size as SPAs.
EU Habitats Directive (92/43/EEC)	**Annex I:** Habitats in Annex 1 are considered threatened within the EU territory. A subset of habitats in danger of disappearance is designated priority status, indicated by an asterisk (*).
	Annex II: Animal and plant species of European importance whose conservation requires the designation of SACs.
	Annex IV: Animal and plant species of European importance in need of strict protection.
	Annex V: Animal and plant species whose taking in the wild and exploitation may be subject to management measures.
Wildlife Acts 1976 to 2018 as amended	Animals and birds subject to special protection are listed in Schedules 4 and 5.
Flora Protection Order, 2015	Species subject to special protection are listed in Schedule 1.
Inland Fisheries Acts 1959 to 2017 and Local Government (Water Pollution) Acts 1977 – 1990, as amended	Inland Fisheries Acts 1959 to 2017 and Local Government (Water Pollution) Acts 1977 – 1990, as amended.

2.1.8. Invasive Alien Species: Legislation

In Ireland, Regulations 49 and 50* of the European Communities of the Birds and Habitats Regulations 2011 (as amended) prohibit the introduction and dispersal of certain species of flora and fauna listed in the Third Schedule to the Regulations. Several local authorities have developed local Invasive Species Action Plans.

Regulation 49 has been in operation since 2011, however Regulation 50 did not have affect at the time of writing (www.npws.ie/sites/default/files/files/FAQ%20(Ireland).pdf).

Transmission projects have the potential to introduce and/or disperse invasive species in the course of construction works (including advance works); for instance on plant and/or clothing during site investigation works, vegetation removal, or earthworks. Aquatic invasive species could be introduced (if plant is not decontaminated prior to entering site), or dispersed (e.g. during dewatering of excavations or works to establish temporary water crossings). As such, the occurrence and management of invasive species will be addressed during the ecological impact assessment process for transmission infrastructure projects.

2.1.9. Note on Reintroduced Species

A number of reintroductions of formerly native birds of prey have been carried out on the island of Ireland. These include the reintroduction of Golden Eagle in Co. Donegal (from 2001) and White-tailed Sea Eagle in Co. Kerry (from 2007). In Ireland, Red Kite has been reintroduced in Co. Wicklow (from 2007) and in Fingal, North Dublin (2011), while in Northern Ireland, this species has been reintroduced in Co. Down (from 2008). Although the reintroductions are relatively recent and are still quite localised in Ireland, these species can be expected to extend their current range. In addition, the Golden Eagle Trust is preparing to reintroduce the Osprey (Eco-Restoration Trust (2020)[18]). All of these species are subject to special protection under the Wildlife Acts (as amended), with the Golden Eagle, White-tailed Sea Eagle and Osprey additionally protected at European level under Annex 1 of the EU birds Directive.

2.2. Plans, Policies, and Red lists Relevant to EcIA

2.2.1. Relevant International Plans and Policies

Nature Conservation Sites

Under resolutions 76(17) and 79(9), the Council of Europe has designated, on a non-statutory basis, Biogenetic Reserves are designated by to add to, guard and reinforce the biological diversity of Europe. In Ireland, there are 14 Biogenetic Reserves including two coastal reserves, which are Lough Hyne, Co. Cork, and Ballyteige Burrow, Co. Wexford.

UNESCO Biosphere reserves are ‘learning places for sustainable development’, to understand and manage interactions between social and ecological systems. There are two UNESCO Biosphere Reserves in Ireland, designated by UNESCO under its ‘Man and the Biosphere’ ecological programme; namely Dublin Bay (formerly North Bull Island, extended and renamed in 2015) and Kerry, 1982 (formerly Killarney, renamed and extended in 2017).

The EU Biodiversity Strategy

The EU Biodiversity Strategy to 2020 promoted the *No Net Loss* principle, wherein any biodiversity losses in one geographically or otherwise defined area are balanced by a gain elsewhere provided that this principle does not entail any impairment of existing biodiversity as protected by EU nature legislation. The subsequent EU Biodiversity Strategy to 2030 states an ambition that "*by 2050 all of the world's ecosystems are restored, resilient, and adequately protected. The world should commit to the net-gain principle to give nature back more than it takes*". The EU Biodiversity Strategy for 2030[19] was adopted by the European Commission in 2020. The Strategy should be considered in EcIAs and EIARs, as relevant to transmission projects.

2.2.2. Relevant National Plans and Policies

National Biodiversity Action Plan

The current National Biodiversity Action Plan (NBAP) was published in 2017 and covers the period to 2021 (NPWS 2017). The objectives of the Plan address issues ranging from improving biodiversity considerations in sectoral decision making, increasing awareness and appreciation of biodiversity and ecosystem services, to strengthening the knowledge base for conservation management and sustainable use of biodiversity.

Biodiversity Action Plans at Local Authority Level

Local authorities are required under the Planning and Development Act (as amended) to produce Development Plans every 6 years. Section 10 of the Act requires that a Development Plan include "objectives relating to the conservation and protection of the environment, including, in particular, the natural heritage and the conservation of European sites and any other sites, which may be prescribed".

The 2011-2016 NBP required each local authority to publish a Biodiversity Action Plan, or review existing plans, and the 2017-2021 NBAP requires that these are further updated. The NBAP also requires Local Authorities to review and update policies and objectives for the protection and restoration of biodiversity in their Development Plans. Policies and objectives relating to biodiversity in Development plans and Biodiversity Action Plans should be reviewed, as part of the information gathering for the EcIA, and/or EIAR where required.

Action 1.1.13 of the 2017-2021 NBAP for Ireland requires all public and private sector bodies to move towards no net loss of biodiversity. As such, in the context of transmission projects, applicants should coordinate with EcIA/EIAR authors with the objective of avoiding biodiversity loss. Where this is not achievable, offsetting biodiversity losses should be explored, in consultation with relevant stakeholders.

Non-Statutory Nature Conservation sites

In addition to legally protected NHAs, there are 630 proposed NHAs (pNHAs), which were published on a non-statutory basis in 1995, but have not since been statutorily proposed or designated. Since 1995 a total of 1089 pNHAs have been designated. The pNHAs have no legal protection per se. However planning and licensing authorities recognise the ecological value of pNHAs which are also subject to other forms of protection (e.g. through landowner agreements via agri-environment schemes).

In addition to pNHAs, Local biodiversity areas may be identified by Biodiversity Plans. Ecological assessments should review relevant policies and objectives to identify any protections through spatial planning.

EirGrid Plans Relevant to EcIA

EirGrid's Draft Transmission Development Plan (TDP) 2020-2029 is the operational plan for the development of the Irish transmission network over the ten years from 2020. The TDP, which is updated annually, contains a list of the committed projects as of 01 January 2020. The annual TDP is of relevance to EcIAs of transmission projects in the context of potential in-combination effects with the committed projects therein.

Informed by the TDP, EirGrid's Grid Implementation Plans set out the manner in which grid projects will be developed over a five yearly cycle. EirGrid undertakes Strategic Environmental Assessment (SEA) on its Grid Implementation Plans. The findings of EirGrid's SEA Statement for the latest Grid Implementation Plan 2017-2022 (EirGrid, 2018), and the policies on biodiversity protection within the plan itself (see below), will be of relevance to EcIA/EIAR authors in the context of mitigating potential in-combination effects from other transmission projects.

EirGrid's policy with reference to Biodiversity, under the Grid Implementation Plan 2017-2022* (EirGrid 2018[20]), includes:

ENVP3: That any transmission development project, either individually or in combination with other projects, that has the potential to give rise to significant effect on the integrity of any European (Natura) site(s) shall be subject to Appropriate Assessment (AA) in accordance with Article 6 of the EU Habitats Directives.

ENVP4: To protect flora, fauna and habitats (terrestrial and aquatic) which have been identified in accordance with Articles 12 of the Habitats Directive, the Birds Directive, Wildlife Act 1976 (as amended), the Flora Protection Order (S.I. no. 84 of 1999), the European Communities (Birds and Natural Habitats) Regulations 2011 and the Alien Species Regulation (EU) No 1143/2014. This protection will be afforded at the earliest opportunity in the project development process i.e. option selection.

ENVP5: To promote a pro-active good practice approach to tree and hedgerow management in grid development, with the aim of avoiding in the first instance and minimising the impact of transmission development on existing trees and hedgerows.

ENVP6: To protect and restore (where possible) habitats which function as wildlife corridors, in accordance with Article 10 of the EU Habitats Directive.

2.2.3. Red Lists

The International Union for the Conservation of Nature and Natural Resources (IUCN) use Red List Categories and Criteria to objectively assess and prioritise species for conservation purposes at a global scale. Adopting the IUCNs approach, the NPWS and the Northern Ireland Environment Agency have been working together with national experts and with the National Biological Data Centres North and South to produce regional Red Lists for the island of Ireland. These Red Lists use the IUCN criteria, from Extinct to Least Concern. In Ireland, the Red Lists include many species, particularly numerous amongst vascular plants, bryophytes, and invertebrates, which are rare in a national or international context, but which are not subject to legal protection.

BirdWatch Ireland produce lists of Birds of Conservation Concern (BoCCI) in Ireland on a five yearly cycle; the latest of which is for the period 2014- 2019 (Colhoun and Cummins, 2013[21]). Ecological assessments should consider the potential presence of species of concern identified in Red Lists.

2.3. Other Areas of Biodiversity Value

There are many areas of natural or semi-natural habitat in Ireland that are important for biodiversity but are not covered by any designation. While not formally protected by legislation, such areas may support protected species or examples of protected and/or rare habitats.

The developers of electricity transmission projects should be cognisant of such areas and their respective capacity to support biodiversity. Interconnections between habitats in the vicinity of any new transmission project should also be considered, as these may be affected by fragmentation. Many species (particularly birds, mammals and fish) have large, dynamic territories that extend beyond site boundaries, making them vulnerable to changes in distant or local environmental conditions.

Examples of areas of natural and semi-natural habitat of potentially high ecological value which may occur outside designated sites

- Rivers or stream systems and other wetland areas including lakes, turloughs (not qualifying as Annex 1), large ponds, canals, reed beds and marsh;
- Areas of species-rich grassland;
- Areas of deciduous and mixed woodland;
- Hedgerows, treelines and other wildlife corridors;
- Areas of heath and scrub;
- Bogs and fens (not qualifying as Annex 1 habitat types);
- Upland and mountain habitats;
- Coastal and estuarine habitats (not qualifying as Annex 1 habitat types).

3. Types of Transmission Infrastructure Projects

3. Types of Transmission Infrastructure Projects

3.1. Context

Electricity is transmitted from the point of generation (e.g. power station or wind farm) to an electricity substation via overhead lines or underground cables.

In Ireland, electricity is transmitted at 110 kV, 220 kV and 400 kV (By way of contrast, In Northern Ireland, the transmission system comprises a 110 kV network and a 275 kV network, though the latter is constructed to a 400 kV standard).

This chapter presents an outline of typical structures used for high voltage overhead lines and the work methods utilised during their construction. The details of underground cable installation are also presented, as well as the development and operation of substations.

3.2. Overhead Lines

Overhead transmission lines comprise a *conductor* (aluminium or steel strand), suspended at a defined clearance height between a series of supporting structures; insulators prevent the current from crossing between the conductor and the structure.

Overhead lines can be constructed in *single circuit* or *double circuit* formations. The three phases of single circuit overhead lines are carried in the horizontal plane. Double circuits (wherein two separate circuits are supported on a single structure) generally only occur where two single circuit lines are in close proximity or where a route corridor is very constrained. The three phases of double circuit overhead lines are carried in the vertical plane. Additional earth (shield) wires may also be incorporated above the conductors in order to protect the overhead line from lightning strikes. Optical fibre may also be wrapped around the shield wire; this is used for communication purposes including controlling the power system.

3.2.1. Structures

Conductors are typically supported on steel lattice towers or wooden pole sets. *Intermediate towers* occur along straight sections of an overhead line. *Angle towers* are used where a line changes direction and conductors must be held under tension. *Terminal towers* are generally constructed where an overhead line enters a substation but may also be used where there is an interface between an overhead line and an underground cable.

The design of structures required along an overhead line vary according to the voltage and can be dependent on the local environment in which they are situated as a result of variable terrain, ground conditions, required clearance from other infrastructure and other constraints. Table 3-1 summarises the various structure types utilised in the transmission network on the island of Ireland.

For all transmission lines with earth (shield) wires, there is a requirement to install an earth ring or mat at the base of the structure to ground the structure for safety reasons. The ground around the base of the structure is excavated while the respective tower or pole set is being erected and the earth ring is subsequently installed before completion of works at the site.

Table 3-1: Transmission network structures

Structure	Material & dimensions	Foundation	Spacing
400 kV	Lattice steel structures, concreted into the ground. Height typically ranges from 20 m to 48 m.	Four foundation blocks are excavated, each block ranging in diameter from 2.8 m to 5.3 m depending on the tower design (single or double circuit angle tower or double circuit intermediate tower).	Average span is 350 m depending on local landscape features and topography.
220 kV	Lattice steel structures, concreted into the ground. Height typically ranges from 27 m to 37 m.	Four foundation blocks are excavated, ranging in width from 1.4 m to 3.9 m depending on the tower design (single or double circuit angle tower or double circuit intermediate tower).	Average span is 320 m depending on local landscape features and topography.
110 kV pole set	Wooden pole sets consisting of two wooden poles, 5 m apart and connected near the top with a rolled steel channel. The wooden poles are typically between 16 m and 23 m in height. Where an OHL angle less than 20 degrees is required, a braced pole set may be erected. These comprise a modified version of a standard pole set wherein the space between the poles is reinforced with steel members. Three-pole intermediate pole sets may also be erected in certain cases, comprising a 5 m spacing between poles.	A minimum of 2.3 m of pole is buried underground; no concreting around the base of the poles is carried out under normal ground conditions. Wooden sleepers are affixed to the bases of the pole sets in a narrow (0.8 m) excavation perpendicular with the overhead line alignment; this delivers improved stability. Where ground conditions dictate, stay wires from the pole sets may also be required. This generally involves excavation of four trenches (approximately 2 m x 2 m x 1.8 m – 2 m deep) at a distance of at least 10 m from the pole set, though this distance can often be larger. Pre-cast concrete stay blocks or wooden sleepers are placed at the base of these excavations and stay wires are affixed to them before the excavation is reinstated.	Span between 110 kV structures ranges between 180 and 300 m, depending on local landscape features and topography.
110 kV angle mast	Where a change in conductor direction of more than 20 degrees is required, steel lattice towers are used. These are typically smaller in scale than the higher voltage versions and range in height, typically starting at 15 m and increasing in increments of 3 m extensions, depending on topography (smaller 12 m masts can also be erected in some circumstances).	Concrete foundations are required for all steel towers, and pile foundations may be required in unstable ground. The average foundation block size for each tower leg used in the 110 kV towers is 4 m x 4 m x 3 m.	

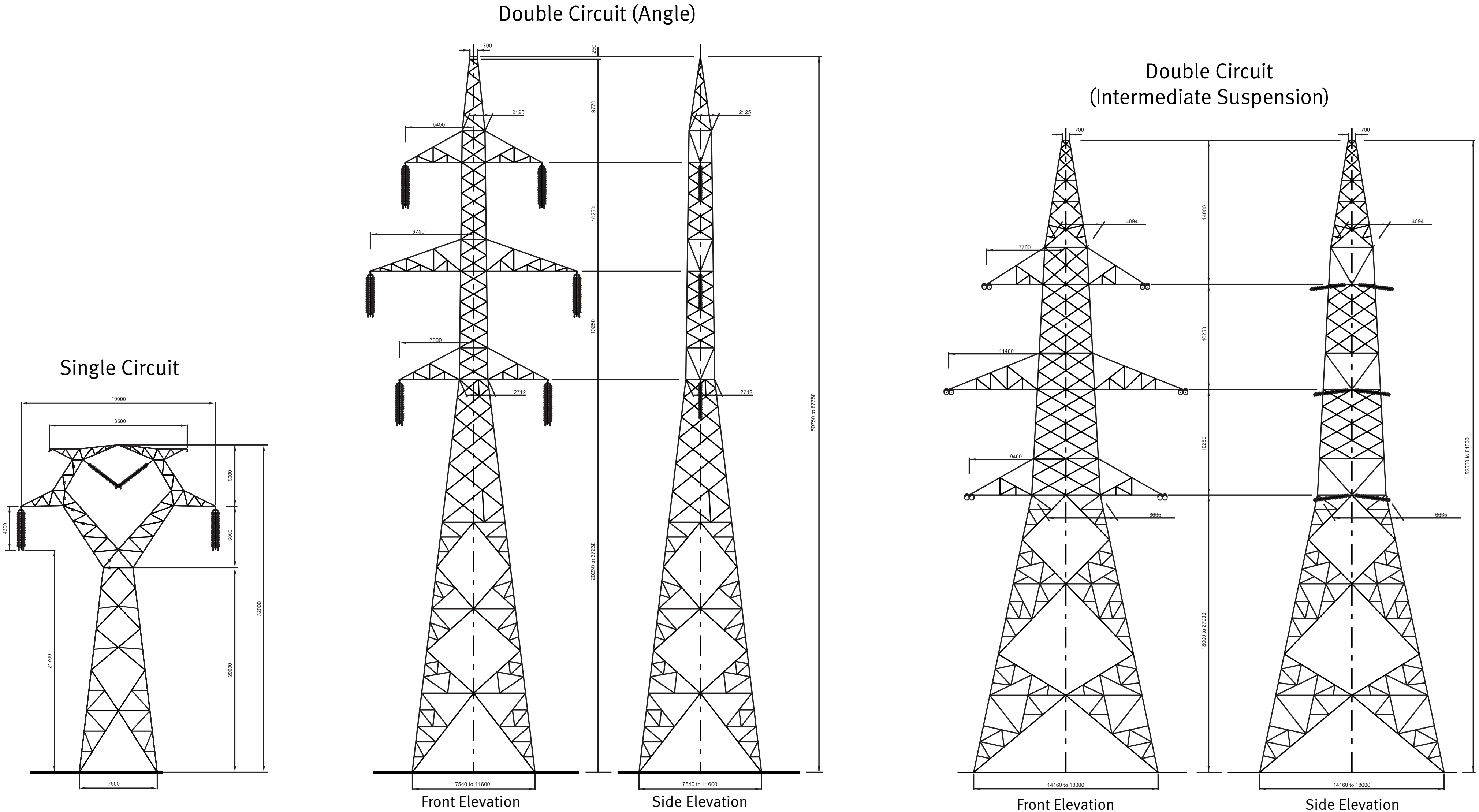


Figure 3.1: Schematic of typical intermediate 400 kV towers (double and single circuits)

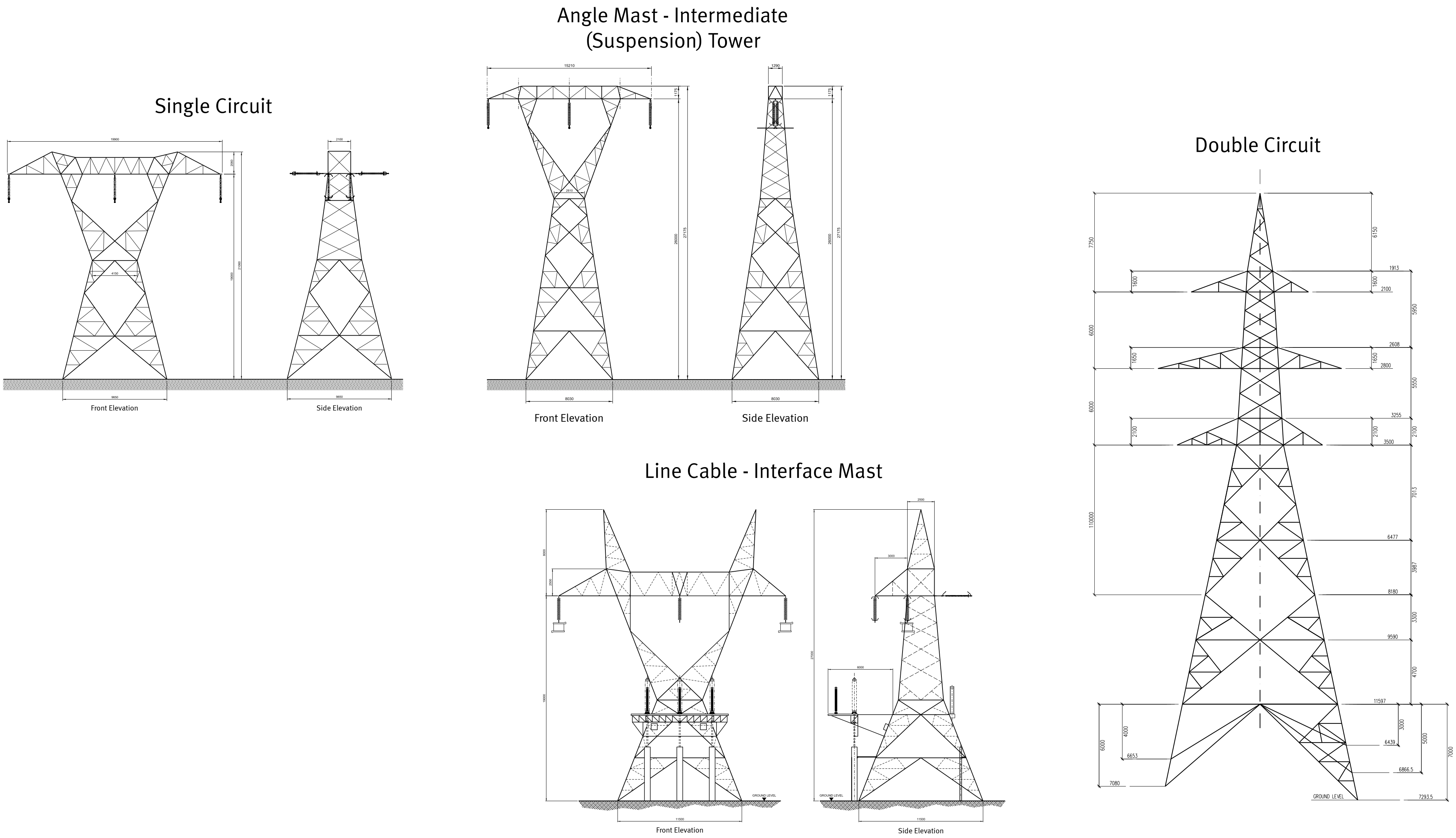


Figure 3.2: Schematic of typical intermediate 220 kV tower (double and single circuits)

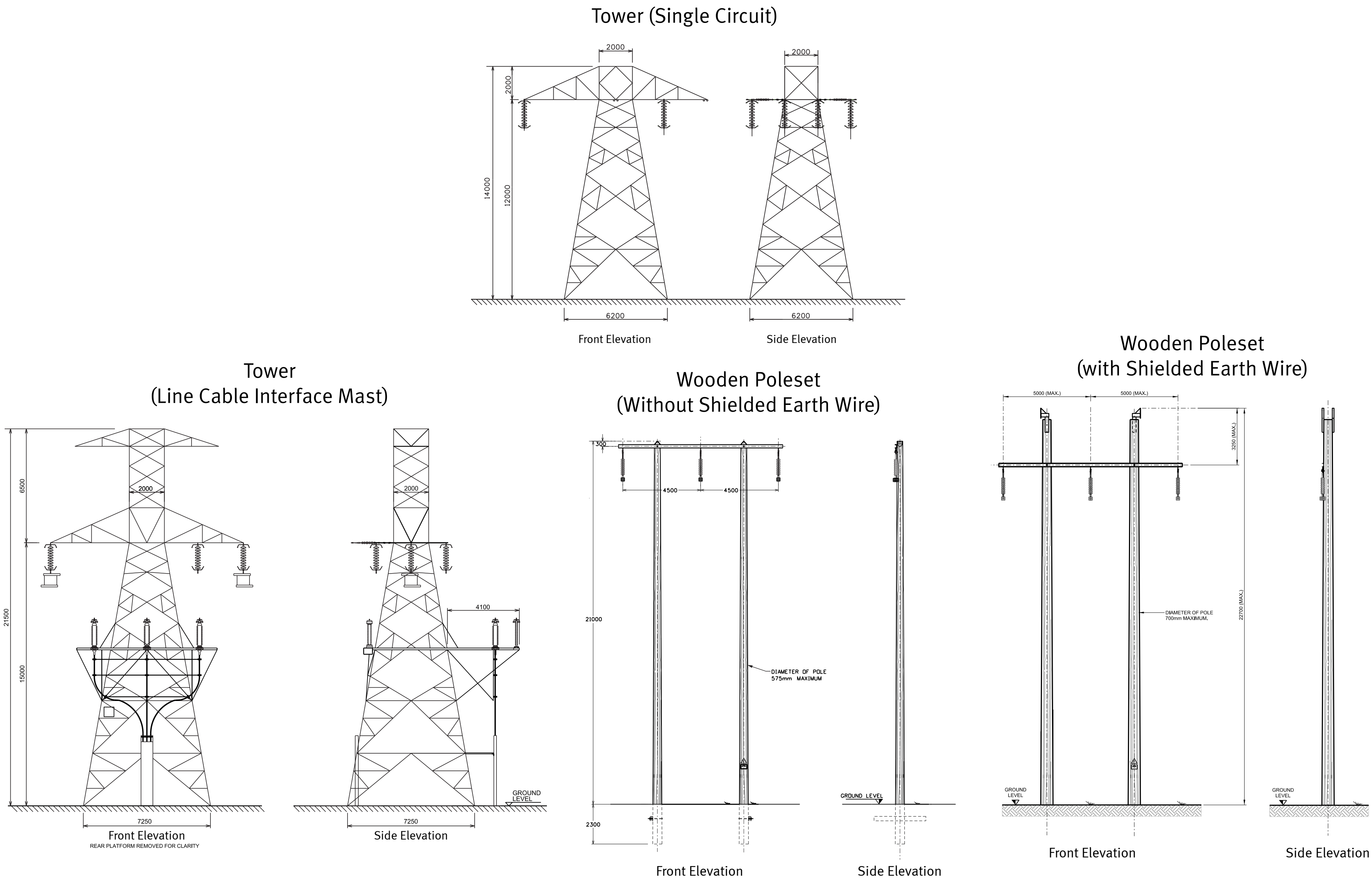


Figure 3.3a: Schematic typical intermediate 110 kV poleset/tower

Tower (Double Circuit)

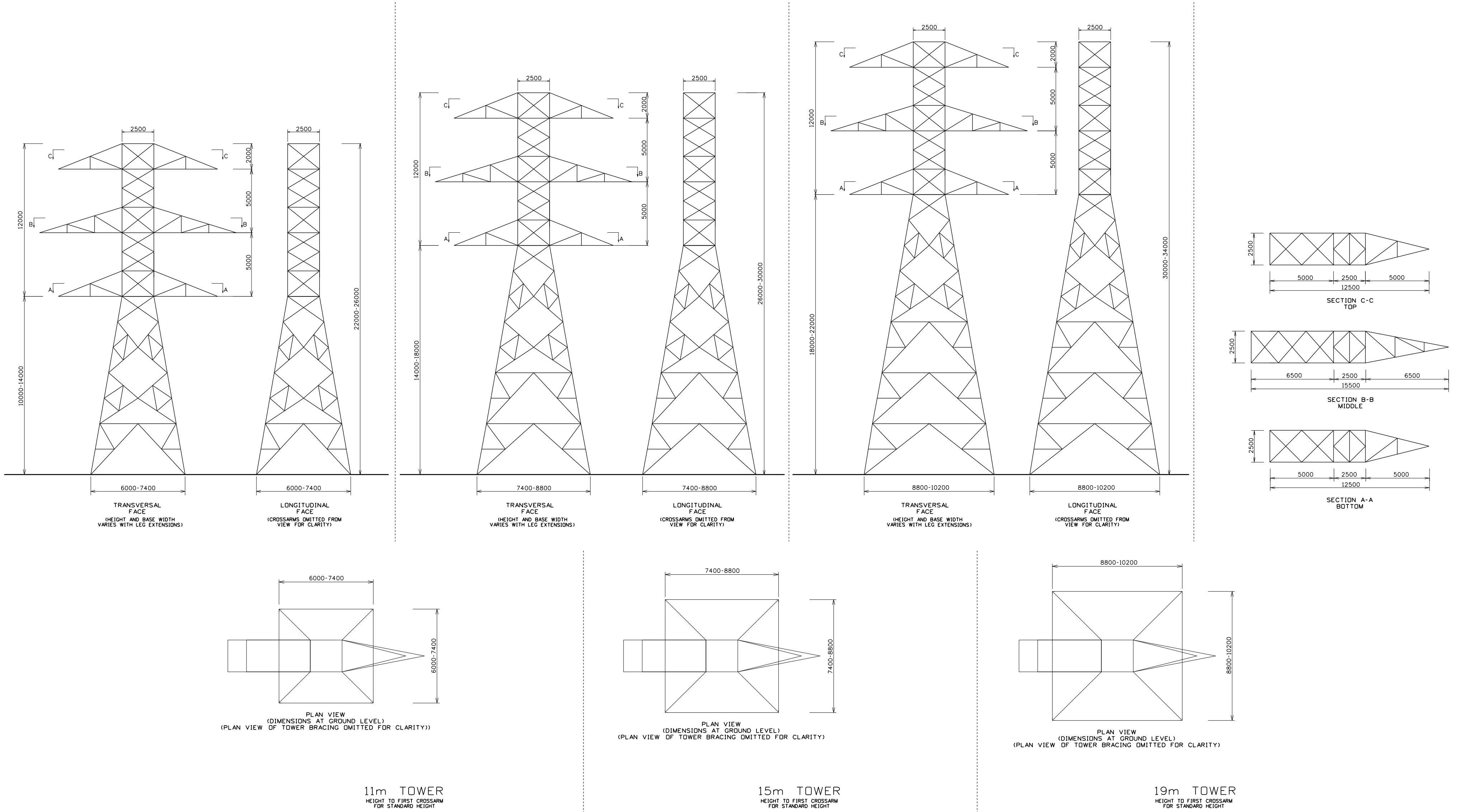


Figure 3.3b: Schematic typical intermediate 110 kV poleset/tower

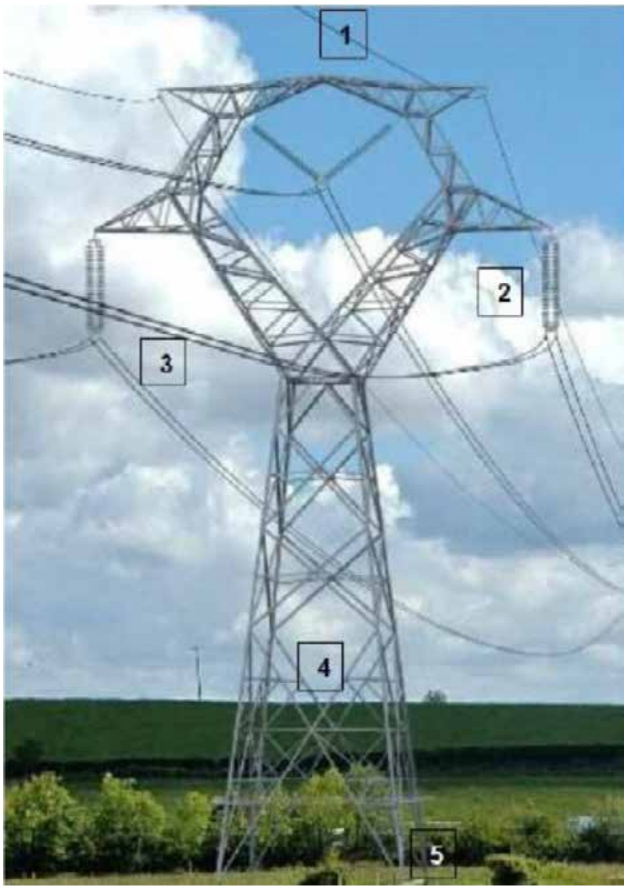


Figure 3.4: Conductor and earth (shield) wire layout on 400 kV tower

1. Earthed Shield Wires
2. Insulators
3. Conductors
4. Tower
5. Concrete foundation for each tower footing

3.2.2. Construction Methods

Transmission line construction, maintenance and decommissioning usually follow a standard sequence of activities. The duration of these activities for 110 kV transmission lines (wood pole support structures) is normally less than for higher voltage lines requiring lattice steel towers. The construction of high voltage transmission lines typically entails the following sequence of events:

1. Preliminary procedures including verification that planning conditions have been satisfied; pre-construction site investigations including an access review and assessment of ground conditions; delineation of on-site working area;
2. Establishment of temporary access routes and laydown/storage areas where necessary;
3. Setting out of tower foundations or pole excavations;
4. Installation of foundations as appropriate;
5. Erection of towers or pole sets;
6. Stringing of conductors and commissioning;
7. Reinstate land; and
8. Remove temporary access.

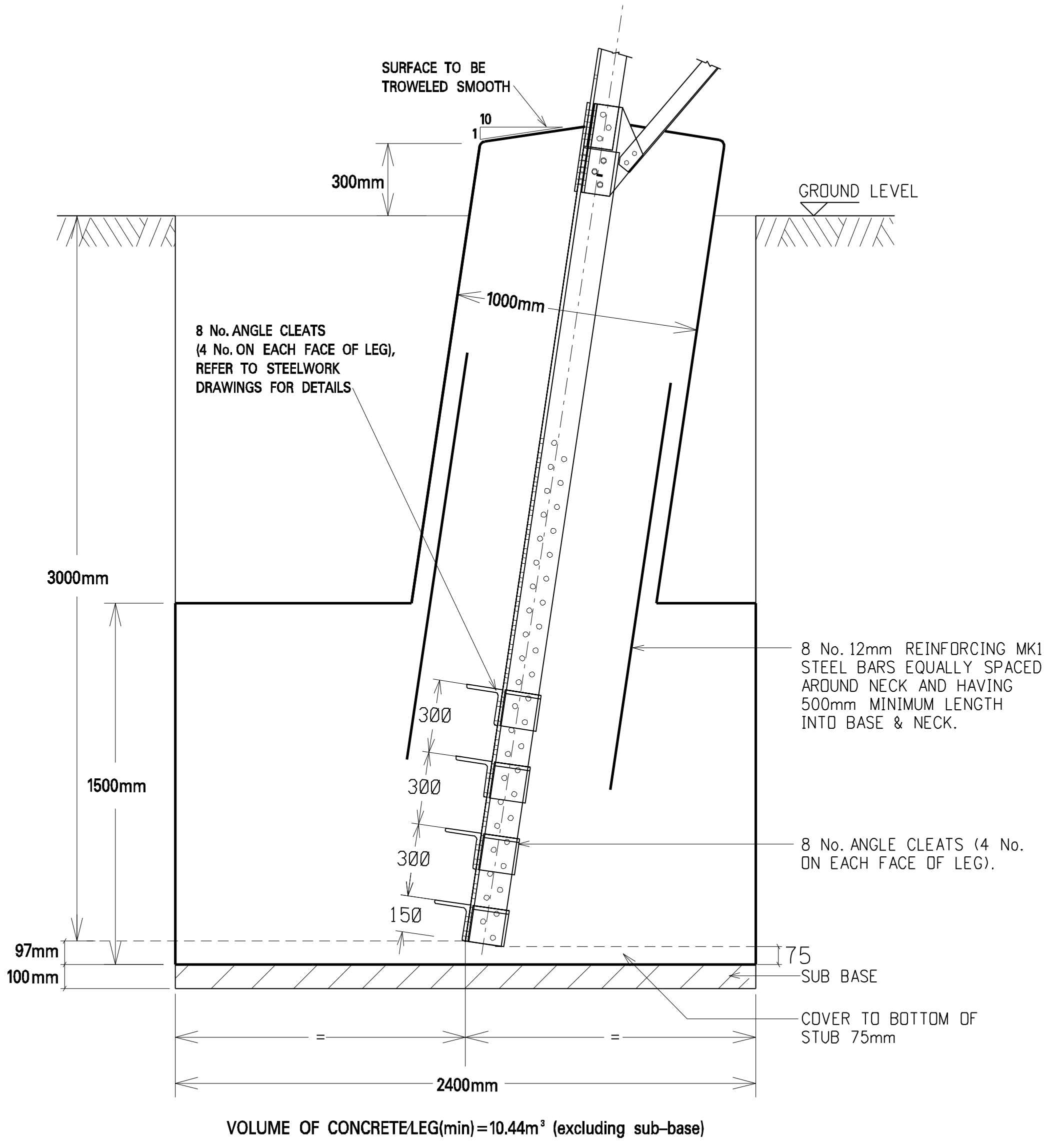


Figure 3.5a: Foundation dimension

Figure 3.5b: Tower foundation during construction

Figure 3.6: Erection of Tower

3.2.3. Construction Methods

To minimise environmental disturbance, access to individual structure locations is generally along the local public road network, with subsequent works access to private land using existing farm entrances and tracks wherever possible. Access routes are typically marked or fenced on site to keep disturbance to a minimum. Specific planning conditions relating to access routes may also apply.

Off-road access is assessed prior to works. In peatland areas, access is achieved by using wide tracked low ground pressure vehicles to minimise damage to ground, and in sensitive areas may be combined with bog mats made from timber (or other preformed matting such as aluminium or Ethylene Propylene Diene Monomer (EPDM) sheets). Where very soft ground is encountered, temporary access tracks may need to be constructed. Generally, temporary roads are constructed using stone; however in certain sensitive situations aluminium road panels may be used.

Stone road construction involves the stripping and preservation of surface turves followed by excavation of the topsoil and storage of this to one side of the track. Geotextile reinforcement is placed on the subsoil surface and approximately 200 mm of stone placed on top and compacted to form the track. Alternatively, in soft bog, a stone or panel road as described above may not be appropriate and in this case timber sleepers can be used.

Where extremely sensitive habitats occur or where access is particularly challenging, materials can be airlifted to the respective work site(s) using a helicopter.

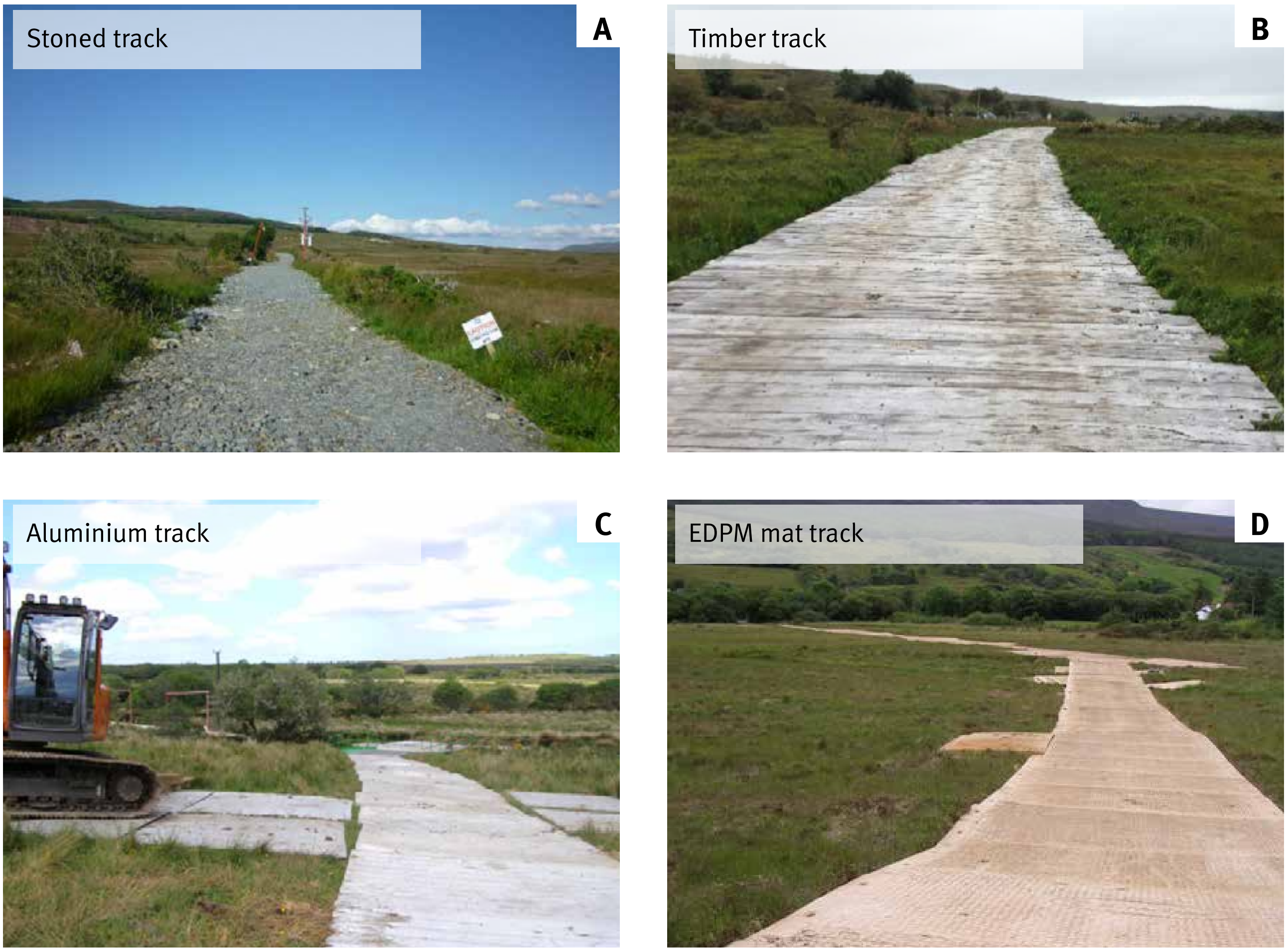


Figure 3.7: Temporary Access routes

3.2.4. Refurbishment and Uprating

Transmission lines are generally low maintenance utility infrastructure. Refurbishment works are generally required for transmission lines that have been in place for over 20 years. Refurbishment works may consist of a major overhaul of equipment, to rebuild or replace parts or components of a transmission asset to restore it to a required functional condition and extend its life. Refurbishment comprises the replacement of individual towers, pole sets, insulators and/or hardware at selected locations and the replacement and/or strengthening of selected angle tower foundations.

Existing transmission lines can also be uprated to increase capacity or strengthen electrical resilience in the system. Uprating involves the replacement of the overhead line/conductor with a more efficient conductor of the same voltage and usually involves the replacement of a significant number of support structures as the new conductor may be heavier than the original.

In general, the work associated with refurbishment and uprating of transmission lines can include some or all of the following:

1. **Fittings replacement** – this involves removal of existing fittings, followed by installation of new fittings. These include smaller scale items such as brackets, insulators and clamps.
2. **Replacement of crossarm and fittings** – this involves removal of crossarm and fittings, followed by installation of new crossarm and fittings (110 kV only).
3. **Replacement of intermediate pole set structures** – this involves removing all associated fittings, stays (where present), cutting and removal of the poles, followed by installation of new poles, stays, crossarm and fittings.
4. **Replacement of steel towers** – this involves the removal of the existing structure and all associated fittings, and usually also the removal of the existing foundations (unless environmental or other constraints require foundations to be retained in-situ), followed by the installation of new foundations and construction of new structure and installation of fittings.
5. **Replacing the conductor** – this involves re-stringing by pulling the conductor between the angle masts, with the main element of this work carried out at angle masts, with some work also carried out at strain and semi-strain locations during conductor stringing (uprating).
6. **Other ancillary works** – such as guard posts for road crossings, diversions of lower voltage lines, erection of temporary structures etc.

In some instances, intrusive site investigation works are required to determine the level of work required as part of an uprate or a line refurbishment. The foundations of existing towers often require assessment. This is typically undertaken using *dynamic probing*, which is a penetration test which provides information on the geo-technical properties of the ground around a structure. In addition, a partial excavation of one or more tower legs may be required to determine the suitability of the existing tower.

Figure 3.8: Examples of refurbishment and uprating activities

3.2.5. Tree Clearance Requirements

The Design Instruction Reference Document 'Tree Clearances from Transmission Lines' (ESB, 2019[22]) outlines a new procedural approach to the determination of tree clearances from transmission lines. Risk arises from both 'grow-in' of vegetation under and adjacent the line, and from falling tree risk. The approach includes a three level classification (Standard, Urgent and Emergency) of risk associated with grow-in vegetation together with corresponding time limits for vegetation cutting based on estimated growth rates.

Where an overhead line crosses agricultural landscapes, routine pollarding/lopping of trees on hedgerows occurs on a rotational basis. The principal exception to this is when lines need to cross woodland or forestry. In that case, a clearway is required, the extent of which depends on the line specification, voltage and other safety considerations.

In considering this, specifications are laid out in the Forest Service *Forestry Standards Manual* (Forest Service, 2015[23]). Section 7 of the Manual deals with ESB corridors in forestry plantations, and states that in such corridors, trees may be grown to a height of no more than 3 m above the ground. Trees exceeding 3 m within such corridors must be cut or lopped by the landowner. In addition, a corridor of 4 m must be left totally clear for ESB maintenance access. Where new lines are routed through a planted area, standard corridor widths are as follows, for different voltages:

- 110 kV: 2 x max tree height + 9 m;
- 220 kV: 2 x max tree height + 16 m; and,
- 400 kV: 2 x max tree height + 22 metres.

It is important to bear in mind that developments involving deforestation may include proposals for ancillary afforestation as a compensatory measure to address the loss of forest cover, and potentially habitat loss occasioned by tree felling. Accordingly, it is important to address the potential EIA and AA requirements for such ancillary afforestation if same is triggered by an EirGrid development.

3.2.6. Summary Table

Table 3-2 outlines the types of structures and equipment typically used during the construction, uprating or refurbishment of overhead transmission lines.

Table 3-2: Summary of works and resources involved in the construction, uprating and refurbishment of overhead line infrastructure

Phase	Works	Summary	Plant required for construction
Construction	400 kV tower construction	**Design:** The height range of towers is generally between 20 m and 52 m depending on topography. The maximum width of the towers at ground level ranges from 7 m to 12 m. The average span between towers is on average approximately 350 m, dependent on local topography. **Foundation:** There are 4 concrete foundations installed per steel structure. Foundation size and type is dependent on ground conditions and tower type, but is typically 2.8 to 5.3 m in width for each foundation pad. The base installation time is approximately one week. A larger footing may be required in the case of weak soils, while pile foundations can be used in the case of deep peat. In the case of rock being encountered at shallow depths, reduced footing size foundations may be required. Shear blocks (i.e. a protective concrete neck around the base of tower legs) are poured once the main foundations are in-situ. **Erection:** Towers are generally constructed using a 'derrick pole' or a mobile crane. The derrick pole methodology is a simple system wherein small sections of steel are lifted into place using the derrick pole and a winch. The derrick pole consists of either a solid or lattice aluminium or steel pole which is held in position using guy ropes anchored to the ground. The crane-based procedure entails the tower being completed in separate sections due to the weight of the differing components. Tower sections are assembled on the ground and subsequently lifted into place.	Transit van 4x4 vehicle Winch tractor Tractor and trailer Crane/Derrick pole Teleporter Chains and other small tools Concrete vibrator Water pump Wheeled/track dumper Excavator Concrete trucks

Table 3-2: Summary of works and resources involved in the construction, uprating and refurbishment of overhead line infrastructure

Phase	Works	Summary	Plant required for construction
Construction	220 kV tower construction	**Design:** The height range of towers is generally between 20 m and 40 m depending on topography. The maximum width of the towers at ground level ranges from 6 m to 12 m. The average span between towers is on average approximately 320 m, dependent on local topography. **Foundation & Erection:** Broadly similar to 400 kV specifications and construction method. There are 4 concrete foundations installed per steel structure. Foundation size and type is dependent on ground conditions and tower type, but is typically 1.4 m to 3.8 m in width for each foundation pad.	As for 400 kV
Construction	110 kV pole set construction	**Design:** The height range of pole sets is generally between 16 m and 23 m depending on topography. The maximum width of the pole sets at ground level ranges from 4 m to 9.8 m. The span between pole sets can range from 180 m to 300 m, dependent on local topography. **Installation:** An excavation of a minimum of 2.3 m for each pole will be carried out using a wheeled or tracked excavator. Each of the two poles are lined up with the excavated holes and the machine operator then drives forward pushing the pole up until the pole is in an almost vertical position. The pole is supported at all times and the holes manually backfilled to a minimum depth of 1 m. After excavation and erection of the pole set, a further excavation 0.8 m deep is necessary. This is a linear excavation perpendicular to the line necessary to install wooden sleepers. These sleepers add additional stability to the pole set and are attached to the pole set using a u-bolt.	Transit van Excavator Winch tractor/pole erector Chains and other small tools

Table 3-2: Summary of works and resources involved in the construction, uprating and refurbishment of overhead line infrastructure

Phase	Works	Summary	Plant required for construction
Construction	110 kV pole set stays	Under certain ground conditions, stay wires may be required at some pole set locations to provide stability to the structure. These wires add stability to the pole and are supported by means of stay blocks and/or timber sleepers. The stay blocks are made of concrete and are buried underground, as are the timber sleepers should they be employed. Stay foundations are installed at a distance of at least 10 m from the pole set, though this distance can often be larger.	As for 110 kV pole set construction
Construction	110 kV angle tower construction	Refer to 220 kV; towers are smaller in scale, with a height range of 18 m to 24 m.	As for 400 kV tower construction
Refurbishment /Uprating	Replace fittings	Fittings, insulators (where required) and equipment can be transported to site without the use of heavy equipment.	(Tracked) Quad bike and/or buggies Chains and other associated tools
Refurbishment /Uprating	Replace crossarm and fittings	Crossarms link the wooden pole sets and the fittings and conductor are attached to the crossarm. They are long heavy metal structures and their removal requires a mobile elevated work platform (MEWP) and tracked excavator to provide a safe working platform.	4 x 4 vehicle (not used within sensitive areas) Mobile elevated work platform (MEWP) (Tracked) quad bike/ buggy Tracked excavator (also used to carry in/ out new/old crossarm) Chains and other associated tools.
Refurbishment /Uprating	Replace intermediate pole set structures	The replacement of wooden pole sets is undertaken in situ with the replacement structures erected immediately adjacent to the original structure. Once the conductor has been removed from the old pole set and moved on the new support, the two original wood poles are cut at ground level and removed from site. Alternatively, the old poles may be fully removed from the ground with the new poles being installed in the same position.	2 no. 360˚ tracked excavator Winch Tractor Quad bike

Table 3-2: Summary of works and resources involved in the construction, uprating and refurbishment of overhead line infrastructure

Phase	Works	Summary	Plant required for construction
Refurbishment /Uprating	Replace angle mast structures	Requires temporary installation of wooden pole sets to accommodate conductor (see above). Excavation and replacement of lattice tower and foundations then proceeds (refer to 400 kV construction).	Refer to 400 kV
Refurbishment /Uprating	Replacing the conductor	Stringing of the conductor is undertaken in sections between end mast and angle mast or between angle masts. Stringing normally requires the placement of puller tensioners outside the span of the line section. A variation of this can occur when the location of the puller tensioner is constrained by environmental or ground conditions. In such cases back stringing is utilised. This is where one puller tensioner is located in the span area rather than outside it. The methodology involves connecting the new conductor to the existing conductor using stringing stockings and pulling out through the section in question. The methodology involves the pulling of a light pilot line (nylon rope) which is normally carried by hand into the stringing wheels. This in turn is used to pull a heavier pilot line (steel rope) which is subsequently used to pull in the conductors from drum stands using specifically designed 'puller-tensioner' machines. The temporary working areas utilised for the stringing equipment are generally 20 m x 20 m. Once the conductor has been pulled into position, one end of the straight is terminated on the appropriate tension fittings and insulator assemblies. The free end of the straight is then placed in temporary clamps (referred to as 'come-alongs') which take the conductor tension. The conductor is then cut from the puller-tensioner and the conductor is sagged using a chain hoist. The conductor is kept clear of all obstacles along the straight by applying sufficient tension. Certain obstacles along a straight have to be guarded such as road/railway crossings and other transmission or distribution lines. Before removal in such cases, the conductor must be terminated at each end before being clamped in on either side of the obstacle crossing. Once the conductor is connected to the angle masts the temporary poles are then removed.	4x4 vehicles Puller - tensioner X 2 Teleporter X 2 Drum stands X 2 Drum carriers X 2 Stringing wheels Conductor drums Compressor & head Transit vans Chains and other small tools Conflict guardings

Table 3-2: Summary of works and resources involved in the construction, uprating and refurbishment of overhead line infrastructure

Phase	Works	Summary	Plant required for construction
Access to works areas	Tower & pole set construction	Excavators are generally tracked to reduce likely damage to and compaction of the ground. In addition a temporary hard standing may be required for machinery and this may require the removal of topsoil.	
Access to works areas	Refurbishment & uprating	Machinery access protocol as for construction above. In the case of replacement of fittings, where no specific machinery is required, works crews access site on quad bikes (tracked on soft ground) or on foot.	
Refurbishment /Uprating	Tower foundations: Shear block re-capping	Removal of minor amount of topsoil (maximum 1m^2) around tower legs. Existing shear block is cleaned and temporary frame with leak proof castings is erected around block itself. New concrete poured into frame, ensuring overlapping with existing concrete the existing concrete will be overlapped with new concrete. Steel shuttering around faces of excavations may be required for support where soils are unstable.	Quad bike/buggy/ jeep Tracked excavator Concrete truck Wheeled/tracked dumper
Refurbishment /Uprating	Tower foundations: Foundation strengthening	Requires the use of stays attached to tower legs while foundation strengthening is undertaken. Soil is excavated from around the existing foundations of each tower leg. The exposed tower legs and original concrete foundations will be scabbled (i.e. a thin surface layer is removed) and reinforced with steel rods into the block and neck components. Steel mesh is inserted into the foundation and concrete is poured up to the top of block level. Once set, the remaining excavation is back-filled and reinstated.	Quad bike/buggy/ jeep Hand held pneumatic drill Tracked excavator Concrete truck Wheeled/tracked dumper

An illustrative guide to the construction of 400 kV/220 kV/110 kV towers is presented in Figure 3.9.

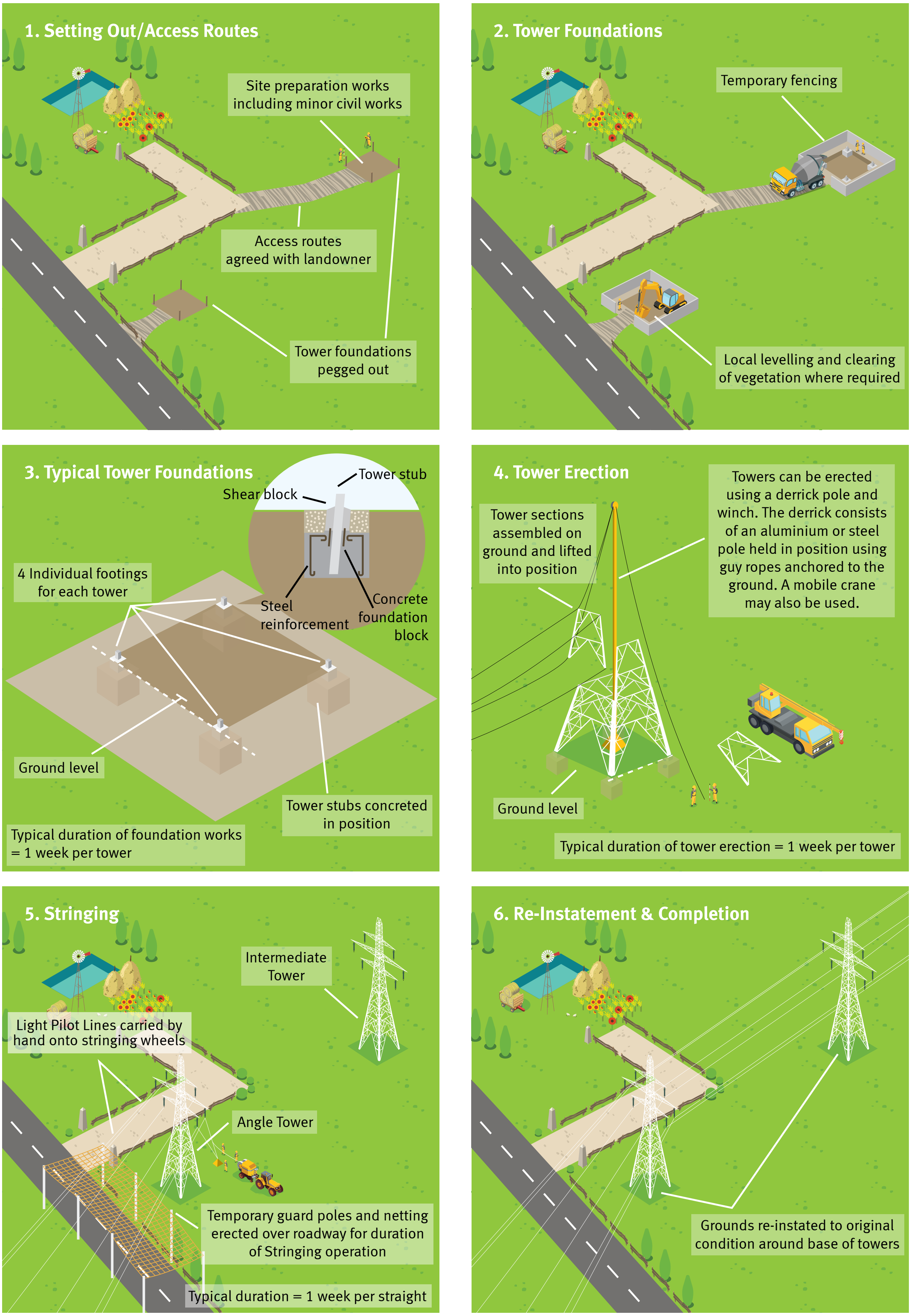


Figure 3.9: Tower construction summary

3.3. Underground Cables

3.3.1. Construction Methods

High voltage (HV) circuits can only be laid underground using special HV cables designed specifically for underground use. The conductors in underground HV cables must be heavily insulated to avoid a short circuit between the conductor and the ground around the cable.

Cables are installed directly into the ground in an excavated trench. Typically, high voltage cable routes are located along public roads and open spaces. In some instances a cable route may be required to cross private open ground.

Transmission cable routes comprise sections of cable that are connected using a cable joint. Cable joints are installed in *joint bays* which are typically concrete structures buried underground, occurring generally every 500 - 700 m along an alignment, and ranging in size up to 6 m long, 2.5 m wide and 1.8 m deep.

Once installed, the road surface is reinstated. Where a cable route is in an open area, it is returned to agricultural/grassland use. Where a cable passes through forested land the route is not replanted with trees to prevent any damage to the cable by tree root growth.

Figure 3.10: Cable duct and joint bay installation

3.3.2. Watercourse Crossings

Where cable routes transect watercourses, specific crossing methods require implementation. In cases where the cable is being trenched along the public road and there is adequate overburden in the deck of the bridge at the point of crossing, it is generally feasible to continue the cable over the bridge without any need for off-road or in-stream works.

Where the above approach cannot be facilitated, the remaining options are open-cut trenching across the bed of the river or trenchless technology wherein a cable duct is installed at a defined depth under the river bed without any requirement for disturbance to the water column or bed substrate.

Open cut crossings are typically achieved by damming and pumping/fluming of the water flow around the trench excavation. As this work involves direct in-stream works, it should be scheduled for the period of July – September to avoid significant aquatic ecology impacts, in line with Inland Fisheries Ireland (IFI) guidelines (IFI 2016[24]).

Open cut trenching requires temporary dewatering of a section of the watercourse via upstream and downstream damming of a defined stretch with sandbags so as to ensure that all works are undertaken 'in the dry'. This should be carried out in line with IFI guidelines and following consultation with IFI regarding method statements, to minimise potential impacts to aquatic species and habitats. It may be necessary to temporarily remove fish under licence from the reaches involved, using electrofishing equipment which should only be undertaken by IFI staff or qualified aquatic ecologists.

Water is diverted from upstream to downstream of the cable crossing location by means of a secure open flume arrangement, or through piping, or in limited circumstances, by means of over pumping. Screening to prevent aquatic organisms entering pumps is a requirement in the case of the latter option. Where concrete ballast is used to prevent cable ducts rising as a result of buoyancy, these should comprise precast concrete.

Following the completion of backfilling, river bed and banks shall be reinstated to match their original profile and substrate material. These works are temporary in nature and are typically limited to 1-2 days.

Horizontal Directional Drilling (HDD) is a trenchless technology, which can be undertaken in a relatively confined area, such as on or adjacent to a public road or parallel to a bridge, therefore minimising the degree of off-road works required at watercourse crossings. Additionally, works do not have to be restricted to the July - September window which applies to the open cut method.

A drilling rig is established at a 'launch pit' on one side of a watercourse, from where it drills along a curved profile under the bed of the watercourse, and subsequently to a 'reception pit' on the far side. A reaming head and toe clamp is then attached to the leading drill rod, which then returns to the drilling rig, widening the bore and pulling the cable duct along in the process. The launch pit for the drilling rig typically requires the temporary installation of a level hardstanding area on a geotextile base; the footprint of this working area can vary from site to site but on average is typically 10 m x 10 m. During drilling, lubricant fluid is pumped into the bore from a bowser/mixing unit which is typically retained within a vehicle on the public road or on level ground set back from the watercourse.

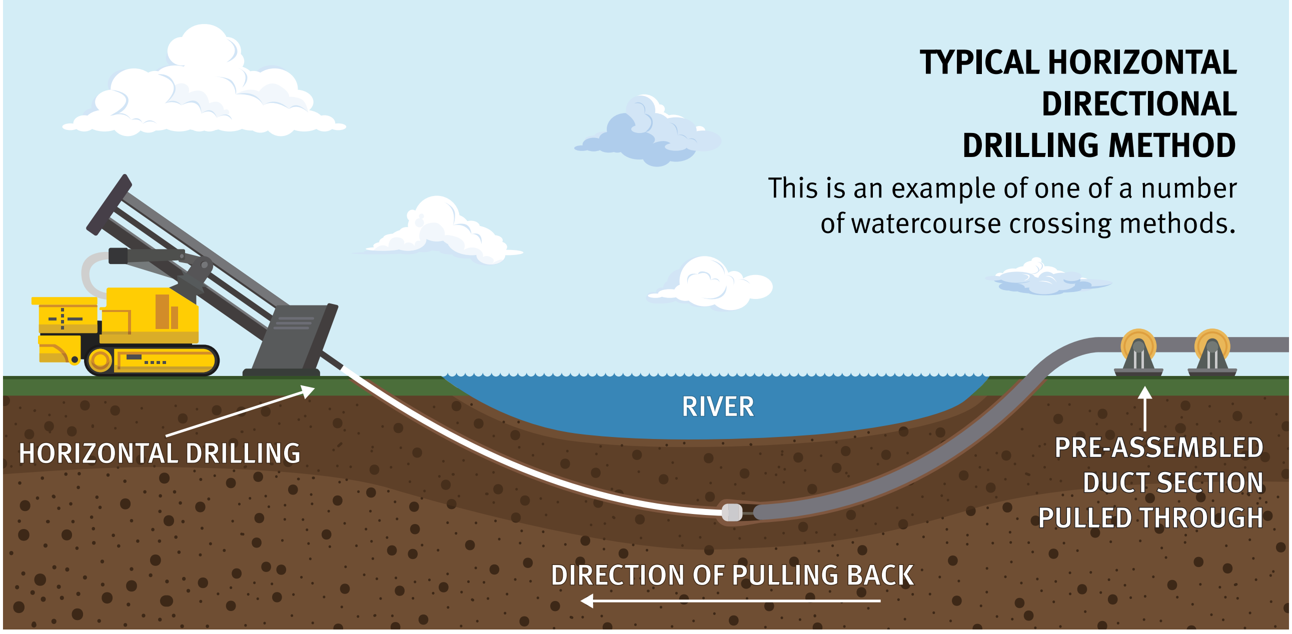


Figure 3.11: Summary of Horizontal Directional Drilling methodology

3.4. Substations

Substations connect two or more transmission lines; they take the electricity from the transmission lines and transform higher to lower voltage, or vice versa. They contain various electrical equipment, including voltage switches, transformers, protection equipment, and associated lines and cabling. The siting of a substation depends on topography; the ground must be suitable to meet technical standards. With regard to earthing requirements and soil stability, substations are usually constructed on reasonably level ground, in areas that are not liable to flooding or crossed by significant watercourses.

An Air Insulated Switchgear (AIS) substation is where the electrical equipment infrastructure is primarily installed outdoors, with the use of natural air as an insulation between circuits. This option requires a relatively large compound footprint (e.g. a typical 400 kV AIS substation compound may occupy up to 4-5 hectares, excluding surrounding access and landscaping).

A Gas Insulated Switchgear (GIS) substation is where gas (Sulphur Hexafluoride – SF_6) is used as the insulation between circuits. This requires the electrical equipment to be contained internally, in buildings typically 11 m – 13 m in height above ground. This allows for a significantly smaller substation footprint (e.g. a GIS substation with the same capacity as the 400 kV AIS substation above would occupy approximately 1 hectare, excluding surrounding access and landscaping).

Both options require the associated provision of access roads off and onto the public road network and the provision of associated electrical equipment and infrastructure (including underground cables). Surface water drainage infrastructure from buildings and other substation elements is also installed. The drainage network of any proposed HV substation is subject to a Sustainable Drainage Systems (SuDS) plan. SuDS techniques proposed in the design ensure that the natural drainage patterns are replicated where possible on site and potential negative impacts from development works in terms of water quality and quantity discharged during the construction or operational stage are minimised.

The engineering design of bunding to prevent discharge to watercourses in the event of a serious accident or fire should also be considered.

Ancillary waste water treatment facilities, palisade fencing around boundaries and other site development and landscaping works also occur during the development of substations. These should therefore be considered significant civil engineering projects.

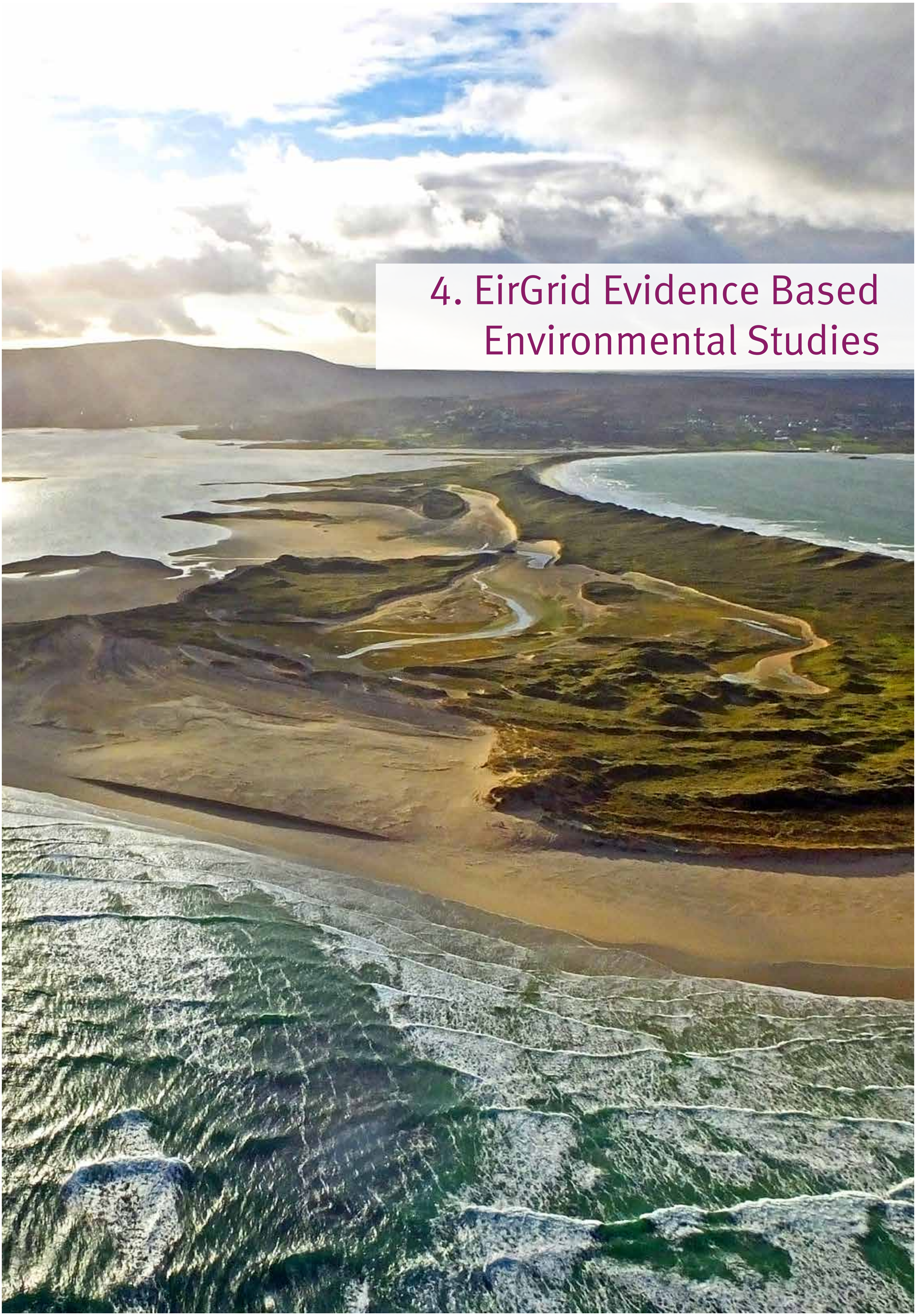
Sulphur Hexafluoride (SF_6) is a widely used gas in the Electricity industry globally and is essential for transmission equipment and switchgear design because of its dielectric, arc quenching, heat transfer and chemical recombination properties. There are three types of substation switchgear on the Irish Transmission system, namely Air Insulated Switchgear (AIS), Gas Insulated Switchgear (GIS) and Mixed Technology Switchgear (MTS).

GIS and MTS use SF_6 as the insulating media, whereas AIS use's either SF_6, Oil or Air as the method for arc extinction. Transmission equipment containing SF_6 is maintained by ESB Networks in accordance with EirGrid maintenance policy and standards.

Figure 3.12: 220 kV Air-insulated substation (AIS)

Figure 3.13: 220 kV Gas-insulated substation

4. EirGrid Evidence Based Environmental Studies



4. EirGrid Evidence Based Environmental Studies

4.1. Overview

EirGrid, together with consultants RPS Group, have prepared a series of independent Evidenced Based Environmental Studies (EBES) examining the actual effects of the construction and operation of transmission infrastructure on environmental and ecological topics in Ireland.

These studies provide benchmarks to facilitate the robust design and assessment of transmission projects with an evidence-based understanding of likely environmental impacts. The studies, while authoritative, are conceived as an ongoing body of work that can be updated to take account of new information and/or developments in understanding arising from practice and research.

The studies involved a comprehensive review of the literature relating to impacts associated with transmission infrastructure, supplemented with field based studies. The field based element of these studies has provided some primary research to supplement the knowledge base in this field. Any potentially significant limitations of the studies are described therein.

The following ecological topics were selected for the EBES as the literature indicated these topics to be most commonly at risk from transmission infrastructure projects.

- *Bats* (2015[4]) EirGrid Evidence Based Environmental Studies: Study 3;
- *Habitats* (2016a[5]) EirGrid Evidence Based Environmental Studies: Study 4;
- *Birds* (2016b[6]) EirGrid Evidence Based Environmental Studies: Study 5;
- *Water Quality & Aquatic Ecology* (2016c[7]) EirGrid Evidence Based Environmental Studies: Study 6.

Each of the studies addressed a number of key questions in order to determine the actual effect of the construction and existence of transmission projects. A variety of sites with different scenarios were selected for survey to ensure the studies considered a representative range of Irish environmental conditions.

The objective of the studies was to produce results that could be used to make recommendations with the aim of improving impact prediction, identifying construction techniques with reduced environmental impact and mitigation measures, helping to minimise impacts of transmission projects.

4.2. Habitats

As part of the habitats study, field surveys looked specifically at the effects of transmission infrastructure on peatland and grassland habitats, as the literature identified these habitats as being the most sensitive and most robust habitats respectively in relation to construction activities in Ireland.

Sensitive habitat types including bogs, heaths and wetlands, tend to be of higher nature conservation value. Construction works can impact upon peatland vegetation through habitat loss, peat compression, vegetation degradation, nutrient enrichment and eco-hydrological regime change. Impacts can be of a long duration and the literature suggests that vegetation may fail to fully recover from development (Holden 2005[25]).

The field based studies were developed based on a standard botanical methodology to collect and analyse data in order to answer the four questions below:

Questions for the Evidence Based Environmental Studies – Habitats

1. Does the vegetation community vary between relevés [i.e. samples] at structures and relevés at a distance from structures?
2. Is species richness reduced close to overhead line structures?
3. Does the length of time since overhead line structure construction affect vegetation community or species richness?
4. Is there a difference between the effect of wooden pole sets and towers (angle masts) on either vegetation community or species richness?

The study examined 17 peatland sites and 5 grassland sites with overhead lines present that had been constructed between 10 and 20 years ago. Botanical surveys were undertaken at the bases of structures (wooden pole sets and steel towers) and at control sites located 50 m from the OHL.

The study examined 17 peatland sites and 5 grassland sites with overhead lines present that had been constructed between 10 and 20 years ago. Botanical surveys were undertaken at the bases of structures (wooden pole sets and steel towers) and at control sites located 50 m from the OHL.

Analysis of the peatland sites showed a statically significant difference in plant community structure and species richness between relevés surveyed adjacent to an overhead line structure and control relevés (located 50 m away). Peatland species including mosses like *Sphagnum spp.*, Cottongrass (*Eriophorum spp.*), Deergrass (*Trichophorum germanicum*) and a lichen (*Cladonia portentosa*) showed a decreased abundance close to the overhead line structures. An increase in other species was found including some sedges (*Carex spp.*), Purple moor-grass (*Molinia caerulea*) and rushes (*Juncus spp.*).

Regarding increased cover of Carnation sedge (*Carex panicea*), Purple moor-grass and Common cottongrass (*E. angustifolium*), the former two are widely distributed species occurring in a broad range of habitats. Similarly, Common cottongrass has the widest distribution of all Cottongrass species, characterising its ability to colonise a greater variety of habitat types and hydrological regimes. The increased relative richness of these species at the site of former construction is likely to indicate them being opportunistic species which have a more rapid growth rate and thereby recolonise faster than species more typically indicative of these habitats, and also their greater tolerance to disturbance and ability to persist in a micro-environment subject to significant disruption of the hydrological regime as would be expected after a construction event to erect transmission infrastructure.

The decreased cover of a number of bryophytes including *Sphagnum spp.* and *Scleropodium purum*, and *Cladonia spp. lichens*, most likely indicates the greater dependency of these species on more stable and specific hydrological regimes, and allied to this is their reduced tolerance to disturbance.

Analysis of grassland sites showed no statically significant difference in plant community structure and species richness between relevés surveyed adjacent to an overhead line structure and control relevés (located 50 m away). However, there was an observed increase in frequency of scrub species and generalist graminoid species adjacent to structures in the grassland sites. This again suggests that species more tolerant to disturbance and with less specific requirements are more likely to persist in a micro-environment subject to significant disruption.

While changes in vegetation community structure and taxon richness were detected in both habitats, they did not indicate a change in broad habitat type categorised by Fossitt (2000[26]); changes were more subtle than this. The study recommended that the survey of high value or Annex I habitats should use vegetation classification based on a more sensitive system. In Ireland, the Irish Vegetation Classification System (IVC) should be adopted for the survey of such habitats (www.biodiversityireland.ie/projects/national-vegetation-database). The IVC has developed significantly since the EBES publication, with many vegetation classifications now complete. The IVC includes the free ERICA web application which assigns vegetation data from relevés to communities.

The study did not reveal any statistically significant difference between vegetation data gathered from sites where construction occurred 10 years previously or less and those sites where construction occurred more than 20 years previously.

The study found that in the absence of mitigation, impacts can have a lasting effect on species composition and habitat structure. Recovery from such damage depends on the severity of damage caused. Impacts in blanket bog, although localised, can be of at least medium term duration (seven to fifteen years).

In severe circumstances such habitat disturbance could lead to rutting, alteration to surface flow patterns, and possible future erosion of the habitat, potentially leading to significant indirect impacts due to hydrological changes.

No difference in vegetation community structure could be attributed to erection of wooden pole sets as opposed to steel towers with any degree of confidence based on data collected at the sites surveyed for the study. Whilst the preparatory works for erecting a steel tower foundation and a wooden pole set differ, the residual effect upon vegetation community structure adjacent to the working footprint remains the same (whilst acknowledging that the quantity of habitat loss differs between these structure types due to the difference in scale of the structure bases).

Key Findings of Evidence Based Environmental Studies – Habitats

- Statistically significant local changes in vegetation community structure and floristic richness were recorded at locations where overhead line structures had been constructed compared with control sites in peatland habitats only.
- Plant communities sampled adjacent to an overhead line structure tended to have increased cover of some graminoid species and reduced relative cover of the bryophyte layer.
- The findings from the field-based research highlight the increased vulnerability and susceptibility of peatland habitats in particular to changes in hydrological regime.
- Analysis of peatland data showed that neither the number of years since construction nor the types of structure had a statistically significant effect on overall plant community structure or plant taxon richness.
- In both the peatland and grassland habitats examined, the changes in community structure and taxon richness detected did not indicate a shift in habitat type as categorised by Fossitt (2000[26]). The study recommends that the survey of high value or Annex I habitats should use vegetation classification based on a more sensitive system, such as the National Vegetation Classification or the provisional vegetation classification system for upland habitats (Perrin and Hodd, 2013[27]).

4.3. Water Quality and Aquatic Ecology

Direct damage to instream habitat is usually avoided on overhead line projects through the careful siting of towers and pole sets and the use of appropriate bridge structures for stream crossings. However, findings from field studies undertaken as part of the evidence based aquatic study (2016c[7]) showed that inadequate delineation of working areas and/or excessive removal of vegetation close to watercourses can result in significant effects on the aquatic environment due to increased sedimentation.

Sediment release was identified in the literature as the most significant risk to water quality and aquatic ecology from transmission and other linear type projects (such as pipelines or roads). This can occur when clearing land for construction through erosion and run-off.

Other pollutants representing a risk come from concrete and hydrocarbons. Concrete is used in tower foundations and culverts and hydrocarbons are found in fuel and lubricants used in construction vehicles and machinery.

As part of the study field surveys were undertaken at six sites along two 110 kV overhead lines under construction. Site selection focused on angle mast structures due to the greater footprint and potential impact associated with the construction of these structures compared with wooden pole sets. The sites were examined before, during and after construction of angle masts. This involved collecting biological, physical and chemical data from watercourses near construction sites. Samples were collected and assessments were made upstream and downstream of construction points; and before and after construction in order to determine impacts.

The field study identified sedimentation as the greatest risk to water quality and aquatic ecology during the construction of transmission projects. The reasons for increased levels in sediment, nutrients, or oxygen levels from samples taken as part of the field studies varied and included construction works near water with limited or no buffer zones, site clearance, damage or alteration to river banks/riparian zones and site flooding.

Physical changes to river banks such as the removal of riparian vegetation were shown to increase the risk of erosion and sediment levels through a reduced ability of the riparian zone to absorb run-off. In an examination of active construction sites near watercourses the study found that the maintenance of bankside vegetation was positively correlated with lower sediment levels. Working areas that are not clearly defined or where excessive vegetation clearance has occurred increased the risk to bankside vegetation potentially leading to increased sedimentation.

The field study showed the importance of mitigation measures such as silt barriers and maintaining buffer zones. A buffer zone of 25-30 meters can prevent sediment and nutrients from entering local watercourses. Storing heavy machinery or materials on the buffer zone should be avoided because compaction of the ground can provide flow paths for sediment and contaminants into local watercourses.

Follow up field surveys found that any post-construction impacts had been reduced. No long-term impacts on water quality or aquatic ecology were found. Results found that most impacts during construction were temporary. However, in sensitive catchments such as a freshwater pearl mussel area, the impacts can be significant and could lead to permanent impacts.

The study also found that other land uses can affect water quality including forestry, natural bank erosion, agricultural drainage and animal poaching and consideration of such pressures is particularly important when assessing in-combination effects.

Key Findings of Evidence Based Environmental Studies – Water Quality and Aquatic Ecology (2016c[7])

- Sediment release is the most significant risk to water quality and aquatic ecology during the construction of transmission projects.
- The reasons for increased sediment, nutrients, or oxygen levels varied and included construction works near water with limited or no buffer zones, site clearance, damage or alteration to river banks/riparian zones and site flooding.
- Field studies found that other land uses can affect water quality including forestry, natural bank erosion, agricultural drainage and animal poaching and consideration of such pressures is particularly important when assessing in-combination effects.
- Most impacts during construction are temporary. However, in sensitive catchments such as a freshwater pearl mussel area, the impacts can be significant and could lead to permanent impacts.
- Field studies showed the importance of mitigation measures such as silt traps and buffer zones. Maintenance of bankside vegetation was positively correlated with lower sediment levels during construction near water courses.
- Pre-construction investigations with the contractor to establish the best access routes to structures in sensitive locations, in-combination with sensitive construction techniques, prevented significant impacts to water quality at one of the high risk sites surveyed. Consideration must also be given to ancillary activities required to facilitate the project such as construction of access routes and the use of material storage areas.
- Importance of clearly defining the working area to avoid physical changes to river banks which were shown to increase the risk of erosion and sediment levels through a reduced ability of the riparian zone to absorb run-off.
- Pre and post construction water quality monitoring of six transmission line construction sites showed no long-term impacts on water quality or aquatic ecology.

4.4. Birds

As part of the bird study, field studies were designed to investigate the significance of impacts on birds due to collision risk by surveying and assessing sections of existing 110 kV, 220 kV and 400 kV transmission lines in Ireland.

The risk of electrocution of birds on transmission lines in Ireland is considered to be extremely low (refer to Section 5.4.2.) and this makes collision the main likely cause of death as a result of OHLs.

Transmission lines tend to have multiple wires at different heights as can be seen. The lines can also have an earth (shield) wire, which protects the line from lightening. It is widely reported that collisions with the earth wires are more frequent, as birds trying to avoid the larger more visible conductor wires fail to see the earth wires (APLIC, 2012[28]: Prinsen *et al.*, 2011[29]; Jenkins *et al.*, 2010[30]; Drewitt and Langston, 2008[31]).

A small number of sites considered to be high risk for bird collision were identified for survey. High risk areas for birds are those close to waterbodies, river valleys and areas with large concentrations of birds. Areas designated as Special Protection Areas (SPAs) for migratory waterfowl are particularly high risk as birds move about regularly in large groups between feeding and roosting areas. Surveys were carried out during the spring passage period when waterfowl migrate between wintering and breeding areas.

Field studies involved searches for bird remains under transmission lines in order to estimate collision rates in areas with relatively large populations of potentially vulnerable bird species. These searches were combined with observations of flight activity to provide an insight into the numbers and behaviour of birds crossing power lines at the study sites.

Results from flight activity studies recorded no collision events between birds and overhead lines during 108 hours of observation at the three study sites in central Ireland. During this time a total of 217 flocks (where a flock ≥ 1 bird) and 1040 birds of target species were observed crossing transmission lines. This is in line with the findings of other studies which indicate that collisions are rare events.

Three near collisions (referred to as flares) were recorded during the field surveys, two of which involved the earth wire on the 400 kV line and the third involved the conducting wires on the 220 kV overhead line (that had no earth wires). Adverse weather conditions did not seem to be a factor on any of these occasions. The species involved were Mute Swan *Cygnus olor*, Mallard *Anas platyrhynchos* and Little Egret *Egretta garzetta*. Ducks, swans and herons have been identified in the literature as bird groups that are vulnerable to collisions with power lines.

The flight activity survey provided new information on bird responses to transmission lines. No collisions were observed, however some avoidance behaviour was noted. At all sites, the majority of birds flew above the power lines. The exception was at the 400 kV site (with the tallest towers), where a third of all birds flew beneath the lines. Very few birds crossed power lines at or near to towers.

Results from the targeted mortality searches at the three high risk sites (110 kV, 220 kV and 400 kV) were broadly in line with collision estimates published in the scientific literature. A limitation of the mortality searches identified in the EBES was that numbers of carcasses were not corrected to account for possible biases. Such biases include scavenger removal (e.g. by foxes), observer efficiency or crippling bias (i.e. birds injured through collision who may succumb at some distance from the point of collision).

The majority of bird remains were of corvids and pigeon species with small numbers of gulls, waders, ducks and passerines. Pigeons and corvids have not been identified as bird species at particular risk of power line collisions. Corvids and pigeons are common and widespread bird species in the Island of Ireland and this is likely to be why their remains were most frequently found under power lines.

The literature suggests that herons, swans, geese, raptors (including owls), gamebirds (grouse and pheasants), waders, rails, crakes and some passerines should be considered as susceptible to collisions with power lines. Field studies did not find any evidence for power line collisions by herons, swans, geese, raptors, or rails. As already stated, the evidence base for the field surveys is subject to limitations associated with possible biases.

Key Findings from the Evidence Based Environmental Studies – Birds (2016b[6])

- Target bird species are those considered to be of conservation concern and at risk of collision with power lines (waterfowl - ducks, geese and swans, waders, raptors, gamebirds, gulls, herons and cormorant).
- The risk of electrocution of birds is considered to be low on electricity transmission structures in Ireland because of the design of poles and pylons and the wide spacing and arrangement of conductors.
- While a significant issue for consideration, collisions with overhead lines are considered to be relatively rare events. Estimated collision rates generated from the survey results for transmission power line sites in the Republic of Ireland broadly fall within the range reported in other studies, while not corrected for possible biases.
- Published studies indicate that mitigation measures such as sensitive routing of overhead lines, line design and line marking with devices have proven to be effective in reducing the level of bird mortality from collisions.

4.5. Bats

The bat study looked at how bats use the landscape, and if electricity transmission infrastructure affects bat activity in Ireland. In relation to Question 1 below the study found very little in the literature related to the possible direct effects of electricity transmission infrastructure on bats.

The literature did however highlight the importance of hedgerows and trees to bats for roosting, feeding and navigation in flight. Overhead lines are typically constructed across agricultural lands as this is the primary land use in Ireland. Construction of overhead lines may impact on hedgerows and trees due to the location of support structures and vegetation clearance under the lines required for safety reasons.

Based on the issues that could be relevant to bat species in Ireland in relation to potential effects of existing electricity transmission infrastructure, the following questions were developed for this Study:

Questions for the Evidence Based Environmental Studies – Bats

1. Does the scientific literature provide evidence that the presence of high voltage overhead transmission lines have an effect on bats? (This includes impacts arising from electromagnetic fields (EMFs), and the risk of collision and electrocution);
2. Does the presence and operation of high voltage overhead transmission lines impact on bat activity in the natural environment?
    - Are bats active in the vicinity of overhead lines?
    - Does the placement of towers in or beside hedgerows and associated hedgerow maintenance (cutting) prevent bat activity along these linear features?

The field study designed to answer Question 2 above, surveyed for the presence of bats at 80 separate sites across Ireland, using a combination of Driven Transect Survey and Passive Monitoring Survey methods. Overhead lines representing each voltage (110 kV, 220 kV and 400 kV) were identified for survey within agricultural areas.

Results from the field studies showed that the placement of high voltage overhead line infrastructure on or adjacent to linear features did not appear to deter bat activity. Evidence of bat presence was recorded at all overhead line sites sampled, irrespective of line voltage.

Also, since there was no sign of an increase in bat activity with increasing distance from the power line, the study provides no evidence that the presence of high voltage power lines are eliciting a deterrent effect on bats. While it cannot be stated definitively whether bats recorded at the study sites were commuting or foraging, their presence at these locations indicated that bat flight was occurring in the vicinity of transmission infrastructure.

A number of bat species exhibit magnetoreception. However, there is no literature showing any evidence that EMF generated by overhead lines disrupts bat magnetoreception. The Irish field study found that there was no significant difference in bat activity recorded immediately under high voltage lines (where EMF levels are highest) when compared with bat activity at increased distances from OHL (where EMF levels are significantly reduced).

The electromagnetic fields emanating from overhead lines are at the 'extremely low frequency' (ELF) end of the electromagnetic spectrum. In Ireland, electricity varies at a power frequency of 50 Hz (i.e. alternating back and forth 50 times per second) producing electric and magnetic fields. Radio frequency (RF) is higher up the electromagnetic spectrum. Radio frequency is the rate of oscillation in the range of 3 - 300 GHz (Bat Conservation Trust, 2011[32]).

The study also found that for most common species bat flight was not prevented by breaks in hedgerow required for the construction of steel lattice towers. Entwistle *et al.* (2001[33]) conclude that a gap of as little as 10 m may deter a bat from its flight path. The lesser horseshoe bat (*Rhinolophus hipposideros*) in particular, avoids flying across open areas (Schofield, 1996[34]). Only 1 of the 10 lesser horseshoe study sites had tree/scrub component loss ≥10 m. No lesser horseshoe bats were recorded at this site.

Bat presence was recorded along "managed" hedgerows (i.e. where hedgerows are regularly cut by a landowner), and "unmanaged" hedgerows (never having been cut). Intensively managed hedgerows surveyed as part of the study may have had reduced insect populations, although it was not possible from the dataset, to determine whether recorded bats were foraging or commuting. Bat activity is strongly correlated with insect density; therefore any reduction in insect density would be expected to result in a concurrent reduction in bat activity (Hayes, 1997[35]; Racey *et al.*, 1985[36]). The removal or cutting of trees in hedgerows may reduce insect availability since certain tree species have strong insect association. It is possible that a reduction in insect density could impact the quality of foraging habitat which would indirectly impact bats. However, tree cutting associated with tower structures generally only occurs beneath the structure, therefore the impact is localised. It does not equate to widespread or landscape-level intensive hedgerow management.

Key Findings of Evidence Based Environmental Studies – Bats (2015[4])

- Bat activity was recorded at all overhead line sites surveyed and there was no evidence of an increase in bat activity with increasing distance from the overhead line of any voltage indicating that the placement of high voltage overhead line infrastructure on or adjacent to linear features does not appear to deter bats. This would also indicate that electromagnetic fields emanating from overhead lines were not impacting bats.
- Bat activity continued along hedgerows where sections of trees up to and equal to a distance of 10 m had been cut under overhead lines indicating that common species of bat were not deterred from crossing gaps of in hedgerows.
- No differences were found in the likelihood of a bat species or bat species group being present depending on hedgerow management regime.
- Tree cutting associated with tower structures generally only occurs beneath the structure, therefore the potential impact on the quality of foraging habitat is expected to be localised.
- The risk to bats of collision and electrocution with transmission lines is considered to be extremely low due to their echolocation abilities and physiology.
- There is a general lack of studies on the potential risks and impacts of collision with overhead powerlines, due to the difficulties in monitoring the death of small animals along such long linear infrastructure (EC 2018b[74]).

5. Potential Impacts of High Voltage Transmission Projects on Ecology and Mitigation Measures

5. Potential Impacts of High Voltage Transmission Projects on Ecology and Mitigation Measures

5.1. Overview

5.1.1. Scope

This chapter identifies the main potential impacts of electricity transmission infrastructure on ecology/biodiversity during the construction, operation and refurbishment of overhead lines, underground cables, substations and ancillary activities. A range of mitigation measures are also identified that have been implemented on transmission projects in Ireland to address these impacts. A schematic visualizing some key interactions between the transmission infrastructure and biodiversity features is shown in Figure 5.1.

The findings from the EirGrid Evidence Based Environmental Studies, presented in Chapter 4, that examined key questions in relation to impacts on *natural and semi-habitats*, *birds*, *bats* and *water quality and aquatic ecology* as a result of transmission infrastructure projects, substantiate many of the impacts described in the literature and discussed in this chapter.

5.1.2. Context

The significance of any effects on the ecological environment depends on the location, extent of development and implementation of effective mitigation. The potential for ecological impacts to occur is greatest during the construction phase of transmission infrastructure projects. This is especially the case for habitats (Soderman, 2006[37]; EcoFys, 2008[38]) and watercourses. However, the operational phase of overhead line projects can have potentially significant impacts on birds in particular, due to the risk of collision with conductors and earth wires. Impacts can also occur during refurbishment or upgrading of existing infrastructure which depending on the extent of the civil works required, can have similar impacts to those potentially occurring during the construction of new projects. Pre-construction site investigation works, although generally minimal compared with construction works, can have potential impacts if undertaken in or adjacent to areas with sensitive habitats or species, such as nesting birds.

To identify potential impacts associated with transmission projects, it is necessary to have knowledge of the various types of transmission infrastructure and the methods and equipment used in the construction of these. A detailed description of various types of transmission infrastructure development is provided in Chapter 3.

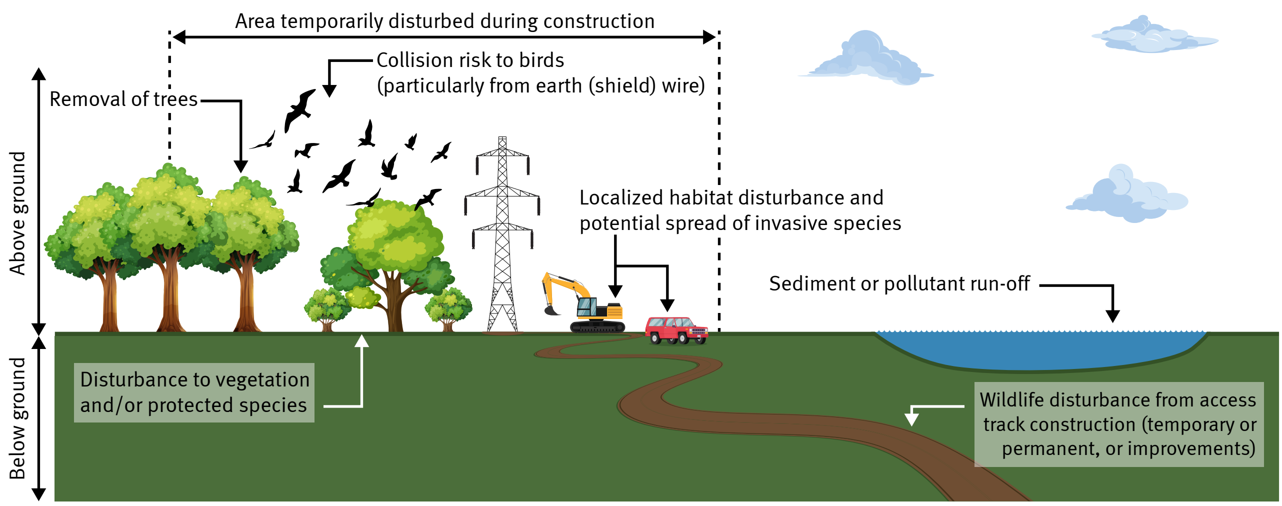


Figure 5.1: Schematic of biodiversity constraints and high voltage transmission projects

This Chapter outlines various mitigation strategies that are based on best practice construction techniques; these have been proven to be effective in minimising or eliminating significant impacts and are standard practice during transmission project construction in Ireland.

Mitigation by avoidance is the best option from the mitigation hierarchy (Section 6.2.6.) and can be achieved through design (careful routing of transmission line or cable to avoid sensitive areas) and through the timing of works (avoiding important breeding seasons for certain species). Mitigation by reduction (e.g. reduced footprint) or remedy (e.g. vegetation reinstatement and/ or reseeding) are the next best options available when considering mitigation strategies.

Faunal groups such as invertebrates (e.g. marsh fritillary butterfly) and mammals (e.g. badger), can also be at risk during the construction of transmission infrastructure projects, mainly due to habitat loss and/or disturbance. These species should be taken into consideration during the multi-disciplinary walkover surveys undertaken as part of the EcIA process and best practice mitigation measures implemented, where required.

5.2. Potential Impacts and Relevant Mitigation Measures for Habitats

The main potential impacts associated with the construction and refurbishment of transmission infrastructure projects on habitats is habitat loss and damage (Soderman, 2006[37]). Construction is the period where most impacts occur. Besides this being the time when the heaviest loads will be in place around structures in the form of construction plant, it is also the time when temporary access and excavation works will be required and hence the time of greatest disturbance to the surrounding area.

In predicting potential impacts on habitats, previous or existing land management measures such as past drainage, peat cutting, or agricultural management must be taken into account as this may act in-combination with the project and may affect vegetation recovery rates.

5.2.1. Direct Habitat Loss

Overhead line projects have overall a very small physical footprint in terms of actual habitat removal compared to other linear projects such as road construction. Habitat removal for overhead line construction is generally limited to the areas around the base of towers and pole sets and along access routes. It is considered that the laying of underground cables has the potential to have a greater impact on habitats, as the area of habitat removal and disturbance is greater in order to facilitate trenching. However, UGCs are generally laid in public roads and therefore tend to avoid high value habitats.

Construction of steel lattice towers results in the direct loss of habitat within the footprint of the tower foundations, and potentially also in the immediately adjoining works area (up to approximately 5 m^2). Installation of wooden pole sets results in a very small amount of habitat loss, approximately 0.5 m^2 per wooden pole can occur at each pole set location.

Overhead lines routed through forestry require a permanent wayleave corridor for maintenance and safety requirements, which results in long term habitat loss. There will also be a change of habitat from woodland to scrub underneath the power lines at these locations.

During the construction of either underground cables or overhead lines, field boundaries may be altered or removed to accommodate access or trench digging (EcoFys, 2008[38]). Depending on the habitat, permanent habitat clearance may be required along sections of the corridor for underground cable projects for technical reasons. This loss may only be temporary depending on the habitat (trees and hedgerows cannot be reinstated over underground cables).

5.2.2. Habitat Damage and Disturbance

Movements of machinery and personnel during construction can cause compaction and damage to surface vegetation leading to the degradation of habitat quality. The storage of excavated material can also have the same effect on surface vegetation.

Wetland and peatland habitats depend on specific hydrological conditions and are particularly vulnerable to disturbance. For example, peat soils can be locally destabilised during pole and tower construction, the laying of access track, and conductor stringing due to the presence of heavy machinery.

The EirGrid evidence based habitats study showed that some habitats are more sensitive to disturbance than others. The study found that damage to peatlands can have significant long-term impacts and that the habitat may not recover from damage.

5.2.3. Spread of Invasive Species

Invasive species can have a major negative impact on native biodiversity (Stokes *et al.*, 2006[39]; EEA, 2010[40]). When non-native species become invasive, they can transform ecosystems and threaten native and endangered species (DAISIE, 2009[41]).

The most prominent negative effect of invasive species, in terms of ecology, is competition with native biota and alteration of habitats (Stokes *et al.*, 2006[39]).

Habitat removal, in particular for a road or utility corridor, can encourage the spread of invasive species by the creation of edge effects, and the direct introduction of non-native plant species by transfer of vector material on construction vehicles or equipment. In a study of non-native species along transport corridors, Hansen & Clevanger (2005[42]) found that transport corridors can encourage the invasion of non-native species.

As underground cable projects tend to be located along the public road network, often in the roadside verge, the potential to spread invasive species which may be present is very high. This is especially true for species such as Japanese knotweed (*Fallopia japonica*) which is easily spread if disturbed.

In Ireland, Japanese knotweed *Fallopia japonica*, giant knotweed *Fallopia sachalinensis* and related invasive hybrids are known to spread 'vegetatively', primarily following dispersal of underground stem or 'rhizome' fragments, and from stem sections, where suitable conditions are present (very moist, well-lit soils with high nutrient availability) (Fennell et al. 2018[43]).

Figure 5.2: Japanese knotweed in close proximity to transmission infrastructure

5.2.4. Mitigation of Impacts on Habitats

Significant negative impacts can be avoided or reduced through the careful routing of an overhead line or underground cable, planning of access routes to working areas and management of construction activities.

Route selection

Where feasible, overhead line routes are planned to cross habitat types of lower ecological sensitivity and conservation status. This avoids more significant negative environmental impacts and associated complex planning and legal issues. Good ground conditions are also preferred for ease of construction. Underground cable routes tend to be located in existing roads and tracks, where possible.

New build projects are planned taking habitat value and sensitivity into account. However, it is not always feasible to completely avoid higher value habitats. This is particularly true when connecting onshore renewable energy projects to the transmission network, as the later tend to be located in upland habitats. Land access also plays a significant role in where infrastructure can be located. Machinery access routes to structure locations should also follow the same principles. The following measures are usually implemented during construction to avoid, reduce and ameliorate impacts on sensitive habitats.

Figure 5.3: Typical habitat traversed by transmission infrastructure

Ground protection measures

The location of access routes should be selected on the basis of minimising potential impacts on sensitive habitats and watercourses. Access is generally arranged with the landowner and must obviously take into account any ecological issues.

Various options for access route construction and ground protection measures should be developed following ecological field surveys. These should consider the scale of works being proposed with the sensitivity and character of the ecological receptors. The following options should be considered for access where habitats are sensitive and where ground conditions are challenging:

- The use of bog mats which may include the following designs - EPDM (ethylene propylene diene monomer) an extremely durable synthetic rubber, wood, or aluminium, as appropriate, although it is considered that EPDM type bog mats are likely to provide the best level of protection in very wet areas.
- The provision of stone surface over geotextile may be required temporarily at locations where heavy machinery is required and the surface is too uneven for effective bog matting. Temporary stone road construction involves the excavation of the topsoil and storage of this to one side. Geotextile reinforcement is placed on the subsoil surface and approximately 200 mm of stone placed on top and compacted to form the track.
- Occasionally on particularly sensitive habitats or where access is challenging, materials including structures (towers, clear span bridges etc.), can be air lifted into site using a helicopter. This avoids the need for access roads.
- Wide tracked, low ground bearing machinery should be used in locations with soft ground conditions such as peatlands.

Figure 5.4: Wide-tracked low ground bearing machine

Preservation of surface vegetation

Where excavations are being undertaken for structures or underground cables the following procedures should be employed:

- Surface vegetation should be carefully removed in turves (i.e. intact block of vegetation and soil) before excavations and stored (vegetated side up) for later reinstatement. This will help the habitat recover after construction and prevent silt run-off from exposed soils.
- In sensitive habitats turves should be stored on bog mats temporarily and not directly on other surface vegetation.

Timing and scheduling of works

Certain construction activities, especially those involving excavation of soil, should be avoided during or just after periods of heavy rainfall.

Avoid unnecessary visits to structures. During the construction phase, work should be scheduled, and machinery managed, to ensure that access is limited to the minimum required trips per construction location. Repeatedly driving over the same ground may cause damage.

Preventing spread of invasive species

The following measures reduce the risk of the spread of alien species:

- Any sections of habitat along public roads or watercourses which may be disturbed to facilitate an overhead line or underground cable route should be surveyed during pre-planning and pre-construction surveys to ensure invasive species are identified and adequate measures put in place in advance of any site clearance works. This also applies to development sites for substations and site compounds.
- The requirements of IFI should be adhered to, with respect to the protocols developed for the control of the spread of alien invasive species to the aquatic environment.
- All vehicles should be cleaned thoroughly before entering a new construction site and in areas with infestations vehicles will require regular inspections and cleaning with disinfectant.

There is a significant volume of guidance available on the treatment and control of invasive species, including the recent technical guidance, and standard published by Transport Infrastructure Ireland (TII, 2020a[44], TII 2020,b[45]).

Figure 5.5: Habitat protection measures implemented during poleset construction

5.3. Potential Impacts and Relevant Mitigation for Water Quality and Aquatic Ecology

A number of potential impacts on water quality and aquatic species may result from the construction and maintenance of transmission lines and their corridors (CIGRE, 2003[46], IFI 2016[24]). Linear construction projects such as transmission lines and underground cables often pose a more significant risk to the aquatic environment than construction operations limited to one site. An OHL or UGC project may require a large number of watercourse crossings, through varied environments, topography, soil types, geology and habitats, each requiring differing water management techniques (CIRIA 2006a[47]).

5.3.1. Sedimentation

Excavation works related to the installation of overhead line structures and underground cables, and the associated storage of excavated spoil material, can pose a significant risk for sediment release into surface water drainage channels, streams and rivers. Ground damage from construction vehicles and machinery can also cause rutting and increased erosion of soils. Access tracks used during construction may affect surface run-off patterns, creating alternative flow paths, promoting erosion and localised flooding. Hydrological connectivity is a key factor which affects the risk of erosion and subsequent delivery of sediment to a waterbody.

The clearance and harvesting of trees is required where a transmission line crosses an area of commercial (or non-commercial) forestry. A corridor within the plantation is felled to accommodate the transmission line and provide the required safety clearance for the overhead line. The main potential impacts of forestry clearance on a water catchment and water quality relate to increased sedimentation, nutrient enrichment and flow regime changes (Moorkens *et al.*, 2013[48]).

Some of the key concerns with elevated levels of sediment include the impact on spawning fish, through issues including the sedimentation of spawning gravels, clogging of fish gills and reduction in dissolved oxygen (Acornley & Sear, 1999[49]; Sear *et al.*, 2008[50]; Collins *et al.*, 2011[51]).

The freshwater pearl mussel (*Margaritifera margaritifera*) requires very high quality rivers with clean river beds and waters with very low levels of nutrients. Direct ingestion of silt by adult mussels can lead to rapid death. However, if the mussels clam-up as a response to a siltation episode, and siltation is prolonged, they die from oxygen starvation over a period of several days (Moorkens *et al.*, 2007[52]).

5.3.2. Hydrocarbons and Cement

Hydrocarbons

Hydrocarbons are products made from crude oil such as machinery fuels and lubricants. Leaks of these contaminants into watercourses can have serious impacts on aquatic species, particularly fish.

Oil spillage and leaks are a common source of hydrocarbon contamination of groundwater and surface water (Manoli and Samara, 1999[53]). A pollution event can occur as a result of poorly maintained vehicles and machinery including portable generators and accidental spillage during re-fuelling of same.

When hydrocarbons are released into the environment as a result of accidental spillages, there may be some fractions that float on top of the water, forming a thin surface film. Other heavier fractions may sink through the water column and accumulate in the sediment at the bottom of the waterbody, which may affect bottom feeding fish and organisms

The release of hydrocarbons into the aquatic environment can result in chronic impacts upon water dependent species. The potential impacts include disruption to neurosensors, abnormal behaviour and development issues as well as direct impacts upon fertility. Oil spills can reduce the capacity of a water body to exchange oxygen as well as result in oil coating the gills of aquatic species causing lesions on respiratory surfaces. This can result in significant respiratory difficulties for aquatic organisms. Benthic invertebrates can be adversely affected if fractions of hydrocarbons settle and accumulate in sediments. This can result in the mortality of populations and prevent future colonisation (Bhattacharyya *et al.*, 2003[54]).

Cement and Concrete

Concrete and cement are used in tower foundations and culverts. During the installation of steel lattice tower foundations there is a requirement to have concrete brought to site. If unmanaged, cement and concrete can cause serious pollution to both surface and groundwater due to the highly alkali and corrosive properties of fresh concrete (Setunge *et al.*, 2009[55]; EA, 2011[56]). Concrete wash water is a particularly severe pollutant, as it typically has a high pH (11-12) coupled with extremely high suspended sediment content (Sealey *et al.*, 2001[57]; EA, 2011[56]).

In the freshwater environment, pH levels which are elevated beyond natural conditions can have significant impacts upon water bodies (Setunge *et al.*, 2009[55]). In general, the optimum pH levels in the freshwater environment for fish species is 5.50 - 9.00, as originally required for designated waters by the Freshwater Fish Directive (Directive 2006/44/EC, Annex I).

Indeed, there is no definite pH range within which fish will be unharmed; however, there is a gradual deterioration as pH values extend outside the typical range (EIFAC, 1969[58]). Freshwater pearl mussel can be adversely affected by elevated pH levels, for examples in areas where liming (i.e. agricultural treatment of soil to improve fertility) is undertaken, as the increased availability of calcium means they grow at a much faster rate (Killeen *et al.*, 1998[59]), and suffer reduced reproduction periods, which is contrary to their life strategy (Comfort, 1957[60]; Ross, 1988[61]).

5.3.3. Disturbance of Riparian Habitat and Fisheries Habitat

Heavy machinery operation in river channels and on river banks can disturb fisheries habitat and also the habitat of protected aquatic species such as white-clawed freshwater crayfish (*Austropotamobius pallipes*), lamprey species, otter (*Lutra lutra*), kingfisher (*Alcedo atthis*), and bats (in bridge structures).

5.3.4. Instream Works for Underground Cable Installation

Existing road bridges over watercourses cannot always accommodate high voltage cables and in such cases it will be necessary to pass through or underneath the watercourse depending on the size and sensitivity of the stream, river or canal. Trenchless techniques although they avoid direct impact to the instream habitat, require substantial working areas either side of the watercourse and the use of heavy machinery (see below). Where watercourses do not contain important fishery habitat open cut trenching may be a better option.

Instream works should only take place between July and September, outside the salmon spawning period from October to June, unless otherwise agreed with Inland Fisheries Ireland. (IFI, 2016[24])

Horizontal Directional Drilling (HDD)

Crossing of larger watercourses where ducting cannot be accommodated over the bridge deck or within the road structure is generally carried out using a trenchless technique where the cable ducting passes below the river bed. The most common trenchless technique used for cable ducting is horizontal directional drilling (HDD).

Aspects of HDD which could give rise to potential impacts include the following:

i. Site access and ground preparation at the HDD launch and reception pits (and along access routes) could act as sources of silt wash-out to watercourses depending on ground conditions, slope and weather.

ii. Handling of drill arisings: Spills of drill arisings from any aspect of the handling process could be washed off the site and into watercourses with potential adverse impacts on aquatic life.

iii. Drilling fluid blow-out (also referred to as frac-out): If the drilling process encounters fractured rock there is a possibility that drilling fluid could be forced up through these fissures to the surface and into watercourses along with any associated drill arisings, with potentially adverse consequences for aquatic life. The most frequently used drilling fluid used for HDD is a slurry of bentonite clay which is very high in suspended solids.

iv. Site reinstatement: Inadequately managed HDD site de-commissioning and re-instatement could lead to silt wash-out reaching watercourses.

Open cut trenching

Crossings of smaller ditches and drains may be carried out by open-cut trenching, facilitated by damming and over-pumping or fluming.

Aspects of open cut trenching which could give rise to potential impacts include the following:

i. Site access and ground preparation: Heavy vehicle activity at and approaching crossing points could give rise to localised soil and bank damage; this would result in solids washing into watercourses during heavy rainfall.

ii. In-stream habitat damage: Excavation of the cable trench and damming the watercourse will result in the potential removal and/or silting of coarse bed material (boulders, cobbles, and gravel) which are important habitat elements required both for fish and invertebrates in watercourses.

iii. Watercourse damming: Damming of the watercourse may result in the release of solids to the watercourse depending on the materials being used and the sequencing and approach taken. Where unsuitable clay or soil are used to make the dam, the likelihood of solids escape will be higher.

iv. De-watering of watercourse crossing excavation: De-watering of excavations at the crossing may give rise to increase in stream solids if returned to the stream without treatment. Any fish trapped between dams would be directly affected by de-watering.

v. Over-pumping: Water discharged downstream from the pumping-over operation has the potential to cause erosion of the riverbed at the discharge point below the downstream dam giving rise to habitat damage to the stream bed and solids erosion.

vi. Site reinstatement: Incorrect sequencing of substrate reinstatement could significantly alter localised bed material structure within a watercourse.

5.3.5. Invasive Species in Riparian/ Aquatic Habitats

5.3.5.1. Plants

Works on watercourse banks have the potential to spread a number of invasive species scheduled to the Birds and Habitats Regulations, whose invasive material could be dispersed a significant distance downstream.

Some species spread by seed. Himalayan balsam (Impatiens balsaminifera) which is commonly found on riverbanks, has seed heads which may explode upon contact with a machine or human). Works disturbing these plants will disperse speed, e.g. which may be carried to new sites on vehicle treads, clothing, or downstream via watercourses.

Some true aquatic plants are also invasive. The scheduled invasive Nuttall's waterweed (Elodea nuttallii) spreads by plant fragments; and instream works may disperse this species downstream, and/or to other catchments if carried there, attached to plant or machinery.

5.3.5.2. Crayfish plague

Crayfish plague is the most serious disease to affect freshwater crayfish (Oidtmann et al., 2002[62]) including Ireland's only native species, the white-clawed freshwater crayfish. This species is a Qualifying Interest of numerous SACs in Ireland, and a nationally protected species under the Wildlife Acts (see Section 2.1.7). Ireland holds the largest population of the White-clawed Crayfish that remains in Europe. All individuals infected with the plague die.

Instream works in infected catchments (e.g. for open-cut trenching) present a risk of infecting new rivers or catchments.

A national map showing infected catchments is available online from the NBDC, and should be consulted for the latest known distribution of infected rivers.

5.3.6. Mitigation of Impacts on Water Quality/Aquatic Ecology

Two guidelines in particular have become industry standards for construction works in the vicinity of watercourses in Ireland - Inland Fisheries Ireland (2016[24]) *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*, the Construction Industry Research and Information Association (CIRIA 2001[63], 2006a[47], 2006b[64]),

A range of potential policy and management measures which may be adapted to mitigate forestry risks to water quality are available (Moorkens *et al.*, 2013[48]), including Forest Management Plans and Codes of Practice for aspects of forestry operations provided by Coillte Ireland.

The following mitigation measures are considered best practice during construction of transmission infrastructure projects:

5.3.6.1. Measures to Prevent Sedimentation

When developing mitigation measures to tackle sediment losses, it is important to have a comprehensive understanding of the source-pathway-receptor model. This model shows that a contaminant only presents a risk where a pollutant linkage connects all three essential elements (EA, 2004[65]).

Field studies undertaken as part of the EirGrid EBES: *Water Quality and Aquatic Ecology* (2016[7]) showed the importance of implementing mitigation measures such as silt barriers and buffer zones to prevent sedimentation.

Buffer zones

Clearly defined working areas are essential to ensure there is a sufficiently large buffer zone between the working area and nearby watercourses. A vegetated buffer zone of 25-30 m can stop sediment and nutrients from entering local watercourses. Storing heavy machinery or materials in the buffer zone should be avoided because compaction of the ground can provide flow paths for sediment and contaminants into local watercourses.

Functional buffer zones are areas immediately alongside a watercourse which contain no artificial drainage. As a result, the area imposes a sponge-like effect on surface water which may otherwise have drained rapidly directly into the channel. The gradual release of the water into the channel also increases its availability to the existing vegetation within the buffer zone, allowing for increased uptake of nutrients from the surface water, and hence decreases in the resultant nutrient load in the channel (Moorkens *et al.*, 2013[48]).

Silt control measures

Silt fences, silt traps and check dams are used to control silt generated from construction activities on site and prevent it gaining access to surface drainage which could convey silt to larger streams and water courses causing damage to the ecology and protected species. Silt control measures must be installed correctly and monitored regularly to ensure their effectiveness.

De-watering of excavations

De-watering of tower foundation excavations may be necessary and if so may require the use of proprietary portable sedimentation tanks to treat silt laden water prior to discharge to surface waters.

Revegetating exposed soils

Any ground damage should be remediated by, for example rolling, rotavating and re-seeding, or any alternatives as deemed necessary. Where this occurs on semi-natural or natural habitat, consultation with the relevant conservation agency should be undertaken.

Timing of works

Construction processes that pose a risk of activating sediment laden runoff, such as excavation, should be halted during periods of extreme rainfall. A review of all work practices for periods of heavy rainfall should be undertaken. The magnitude of rainfall which would prompt a review will depend on local conditions.

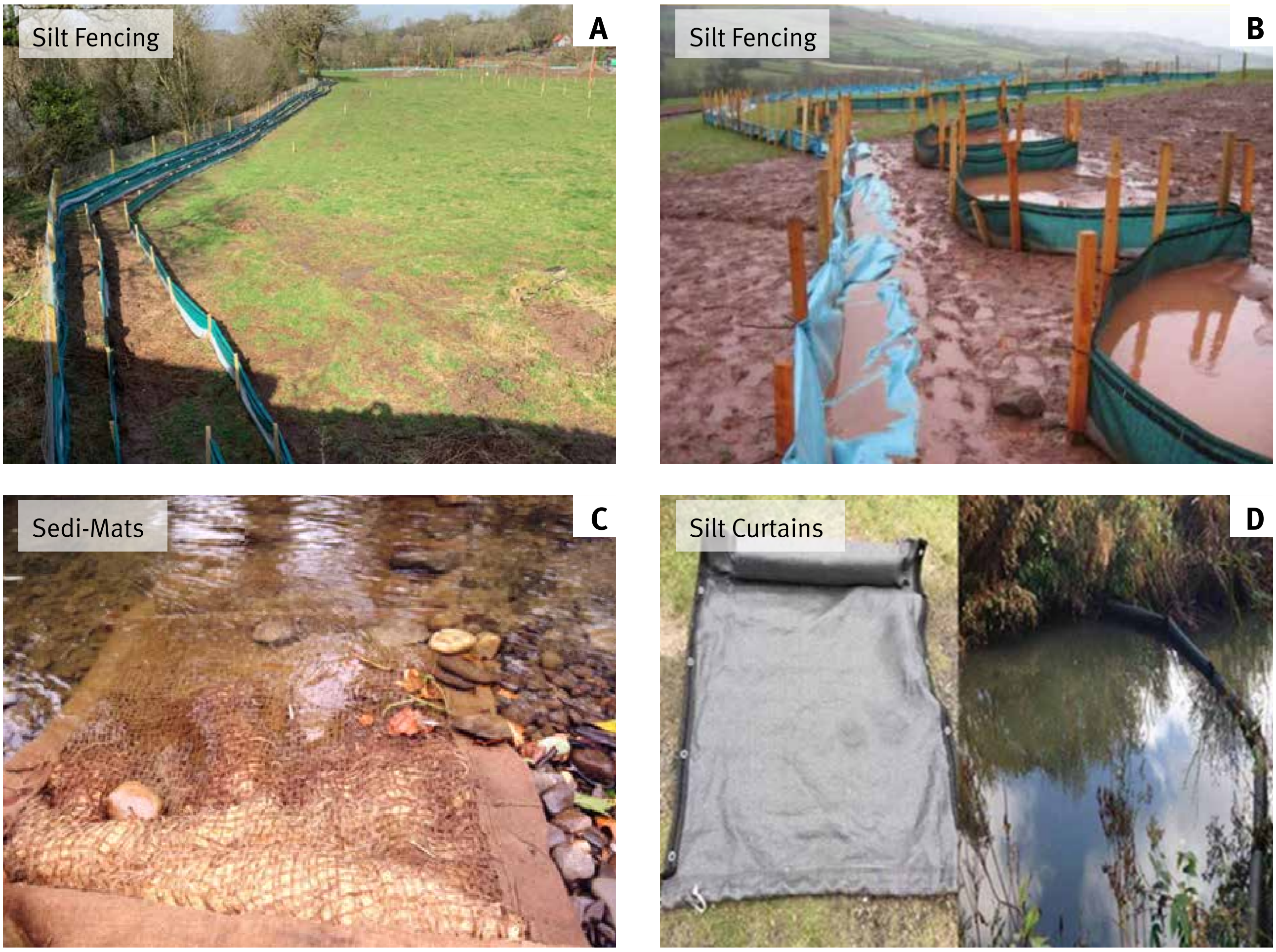


Figure 5.5: Silt Fencing (a & b), Sedi-Mats (c) and Silt Curtains (d)

5.3.6.2. Mitigation to Prevent Pollution from Hydrocarbons and Cement

Fuel, hydraulic oils and lubricants should be stored in designated bunded areas in accordance with established best practice guidelines. Re-fuelling of construction equipment and the addition of hydraulic oil or lubricants to vehicles/ equipment will take place in designated bunded areas away from drains and other watercourses. Spill-kits and hydrocarbon absorbent packs should be stored in the cabin of vehicles working near watercourse and operators must be fully trained in the use of this equipment

The preferred method for delivering concrete during construction is to dispatch the concrete directly from the concrete truck into the foundation or trench excavation. This allows for the most environmentally suitable management of the concrete as it is contained within the concrete truck until it arrives directly at the point of use. This method may not always be possible or desirable in sensitive locations. Concrete may need to be transferred from the concrete truck to a smaller dumper truck where access is difficult.

One of the most important aspects of managing concreting operations on site is the washout and clean-up of plant and equipment used for pouring concrete. A dedicated concrete washout area should be provided at the site compound and maintained regularly.

5.3.6.3. Mitigation to Avoid Damage to Instream Habitats and Species

Fish and their spawning grounds are protected under the Inland Fisheries Acts 1959 to 2017 and Local Government (Water Pollution) Acts 1977 – 1990, as amended. The appropriate "window" for instream works can vary depending on the nature of the fishery concerned and the existence of other factors such as catchment or sub-catchment Bye Laws and Regulations. To protect aquatic species and habitats, instream works should normally only be carried out during the period July to September (except in exceptional circumstances and in agreement with Inland Fisheries Ireland) (IFI, 2016[24]).

The design and choice of temporary crossing structures must provide for passage of fish and macroinvertebrates, the requirements to protect important fish habitat e.g. spawning and overwintering areas, as well as preventing erosion and sediment. Clear span 'bridge type' is the preferred structure option for temporary crossings of fisheries water. Clear span bridges are not always a feasible option due to space or access difficulties or due to size of the watercourse. Where a bridge cannot be used, a bottomless culvert is the best option for maintaining natural stream channel characteristics and having the least impact on habitat (IFI, 2016[24]).

Where important fisheries rivers are required to be crossed during the construction of an underground cable project, the option of using a trench less technique such as HDD (Sections 3.3.2. and 5.3.4.) will help avoid impacts to instream habitats and species. Where HDD is employed, Silt fences should be of an appropriate specification and be correctly installed and maintained during works. HDD works do not have to be restricted to the July - September window which applies to the open cut method. Specific non-toxic drilling lubricants are available for use under sensitive watercourses.

5.3.6.4. Mitigation: Biosecurity for Aquatic Habitats

Mitigation for Crayfish Plague

According to the NBDC, the single most effective action is to use the 'Check, Clean, Dry protocol' which should be done routinely before and after visiting a river or lake.

This protocol requires that all equipment is allowed to thoroughly DRY-out then dry for further 48 hours.

If drying out equipment is not feasible equipment should be either:

- Power Steam washed at a suitably high temperature (at least above 65 degrees)– via use of mobile steam power washers or use of nearby power washers at Service stations as an alternative;
- Disinfect everything using an approved disinfectant such as Milton (follow product label), Virkon Aquatic (3mg/L), Proxitane (30mg/L) or an iodine-based product for 15 minutes. Items difficult to soak can be sprayed or wiped down with disinfectant. Engine coolant water or residual water in boats/kayaks should be drained and where possible flushed out with disinfectant.

Mitigation for Other Aquatic Species

A number of other aquatic species are scheduled to the Birds and Natural Habitats regulations, including aquatic plants, molluscs and crustaceans. Ecological assessments should consider the potential presence of any such species, and require biosecurity protocols to attach to instream works where species are present, or (on a precautionary principle) where presence is unknown. Information on the distribution, identification, biology, and vector pathways are available for all of these species online from the NBDC.

It is perhaps worth noting that one of the most common aquatic invasive species Canadian Pondweed *Elodea Canadensis*, was removed from the third schedule to the Birds and Natural Habitats Regulations by S.I. 355/2015. All other *Elodea* spp. remain scheduled to the regulations.

Figure 5.7: Examples of clear-span structures over watercourses

5.4. Potential Impacts and Relevant Mitigation for Birds

The main potential impact on birds from transmission infrastructure is mortality caused by collision with overhead lines. This is the most widely cited and researched area related to birds and transmission infrastructure as it can result in significant effects on bird populations where rare or protected species are at risk.

Other potential impacts on birds due to transmission infrastructure include electrocution and displacement.

5.4.1. Risk of Collision

Collision with overhead lines (earth wire or conductors) is the main potential threat posed by transmission lines to birds in Ireland. In relation to morphology and behaviour, studies indicate that risk factors for collision include poor flight manoeuvrability, blind spots in the visual field or poor acuity, flying at night or in low light levels, flocking behaviour, and the amount of time spent flying at collision risk height with overhead lines.

While a significant issue for consideration, collisions with transmission lines are considered to be relatively rare events. Most studies conclude that mortality from collisions is unlikely to affect bird populations. However, where rare or protected species occur, impacts could be significant (EirGrid EBES, 2016b[6]). The results of the field based study undertaken as part of the EirGrid EBES for Birds, found that collision rates estimated for transmission line sites in the Republic of Ireland broadly fall within the range reported in other studies covered by the EBES literature review.

5.4.2. Risk of Electrocution

Electrocution of birds occurs when they make simultaneous contact with the energised and grounded sections of an overhead line, or between two phase conductors. This may occur when a bird is landing or taking off and the wings bridge the gap between wires, when a bird, nesting material or prey bridges the gap between the wires and a grounded pole or pylon, or (rarely) when a bird touches only one conductor (Prinsen *et al.*, 2011a[29]).

The risk of electrocution of birds is considered to be low on electricity transmission structures in Ireland because of the design of poles and pylons and the wide spacing and arrangement of conductors. New transmission lines to be constructed in Ireland in the future will be at 110 kV, 220 kV, and 400 kV. Conductor spacing for 110 kV lines is 4.5 m, which is almost double the wing span of the largest Irish bird species such as Mute Swan and White-tailed Sea Eagle. In addition, the design of structures is such that contact between conducting wires and grounded components is not possible (EirGrid EBES, 2016b[6]).

Studies worldwide indicate that it is only on lower voltage distribution lines that conducting wires and/or earthed components are placed sufficiently closely for even larger birds to touch two wires simultaneously, and larger bird species are most at risk of electrocution because they are most likely to bridge the gap between conducting wires (EirGrid EBES, 2016b[6]).

5.4.3. Risk of Displacement or Loss of Habitat Quality in Breeding and Wintering Areas

Some bird species may be displaced from suitable habitat by the proximity of electricity transmission lines, which can act as a partial barrier to movement. Indirect loss of breeding or wintering habitats for bird species of conservation concern in Ireland (Colhoun & Cummins, 2013[21]) may occur if they do not use traditional feeding or roosting sites after installation of a new transmission line. There is also the possibility of loss of breeding habitat for ground-nesting waders and raptors requiring a large display area (EirGrid, 2016b[6]).

Construction of new transmission lines in Ireland may have some limited effects in reducing the density of breeding birds or limiting the use of areas close to overhead lines by foraging birds such as wintering geese. No studies have been found that suggest wide scale displacement effects that might affect any species at a population scale. Nevertheless it is recommended that consideration is given to potential impacts should transmission lines be proposed in areas which are important for wintering geese, in particular Greenland White-fronted Geese (*Anser albifrons flavirostris*) which show high site fidelity in wintering areas (Wilson *et al.*, 1991[66]).

Bird species which inhabit open environments might show avoidance of tall structures such as overhead lines (this could result from avoidance of pylons or poles and/or the wires) because of perceived predation risk. For example raptors and other predatory birds perch on tall objects to survey hunting areas (Pruett *et al.*, 2009[67]; Hagen and Giesen, 2005[68]; Shroeber and Robb, 1993[69]).

5.4.4. Mitigation of Impacts on Birds

Published studies indicate that mitigation measures such as sensitive routing of overhead lines, line design and line marking have proven to be effective in reducing the level of bird mortality from both electrocution and collisions. However, it is generally not feasible to mitigate impacts on birds along the full extent of a national transmission network. Therefore, a strategic approach is most appropriate, prioritising potentially problematic sections of transmission lines based on environmental factors associated with high risk areas and the distribution of species of conservation concern (EirGrid EBES, 2016b[6]).

Avoidance – Avoidance of important bird areas is a primary factor in the early planning stages for all new transmission lines, in particular areas which support concentrations of species such as waterfowl which are vulnerable to collisions. These factors are considered under Environment generally (and biodiversity specifically) during Step 4 of the EirGrid Development Framework (See Section 6.4).

Transmission line design – The placement and orientation of overhead lines relative to bird flight lines is an important factor affecting collision risk. Overhead lines which cross migratory flight paths or regular daily commuting routes used by birds pose a higher risk than those running parallel to flight paths (EirGrid EBES, 2016b[6]).

Structural aspects are important also, including the diameter of conductors and earth wires and the number and configuration of conductors (APLIC 2012[28]). Although there are too few studies from which to draw conclusions, it is considered by researchers that minimising the vertical aspect of multiple transmission wires ('bunching' them in a horizontal plane) reduces the height of the collision risk zone for birds (APLIC, 2012[28]).

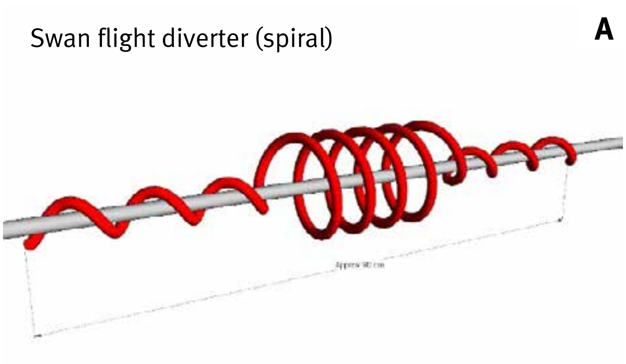
Line marking – Fitting transmission lines with devices to make them more visible to flying birds is widely used to mitigate bird collisions at high risk sites. A meta-analysis of experimental studies (confined to studies with flight frequency data as well as corpse searches) found an overall mortality reduction of 78% at marked compared with unmarked wires (Barrientos *et al.*, 2011[70]).

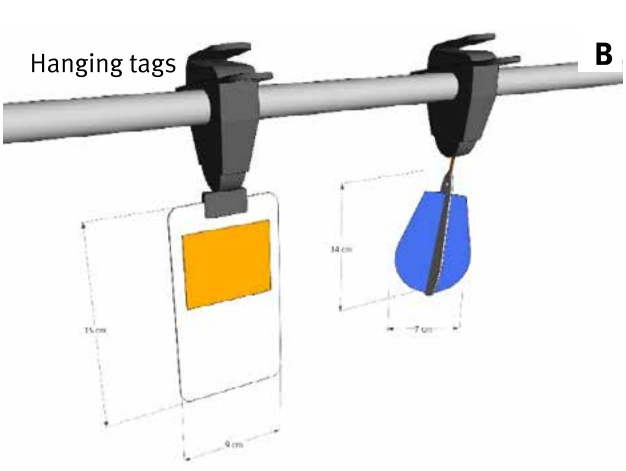
Modification of habitat – Modifying habitats in areas close to overhead lines can reduce collision risk. For example, planting trees which will grow above the height of overhead lines may force birds to gain sufficient altitude to clear the trees and the line; although this is obviously a long-term strategy which may require alternative mitigation before trees mature (APLIC, 2012[28]).

Underground cabling – Where transmission lines are required in areas of particularly high risk for avian collision undergrounding of the transmission line may be considered (APLIC, 2012[28]). It is recognised that this is not always feasible from an energy security perspective and is difficult at high voltages. It is also considerably more expensive than overhead lines and may result in increased impacts on other environmental receptors (Prinsen *et al.*, 2012[71]).

Timing of works – In order to avoid disturbance to nesting birds, construction and maintenance activities may be undertaken outside of the bird breeding season or (where not feasible) the line may be sited beyond disturbance distances of sensitive species. Other mitigation options can include:

- Use of visual screening potentially including noise attenuating materials for non-breeding birds;
- Sequencing vegetation removal outside the bird breeding season, in advance of main construction activities scheduled during the breeding season.





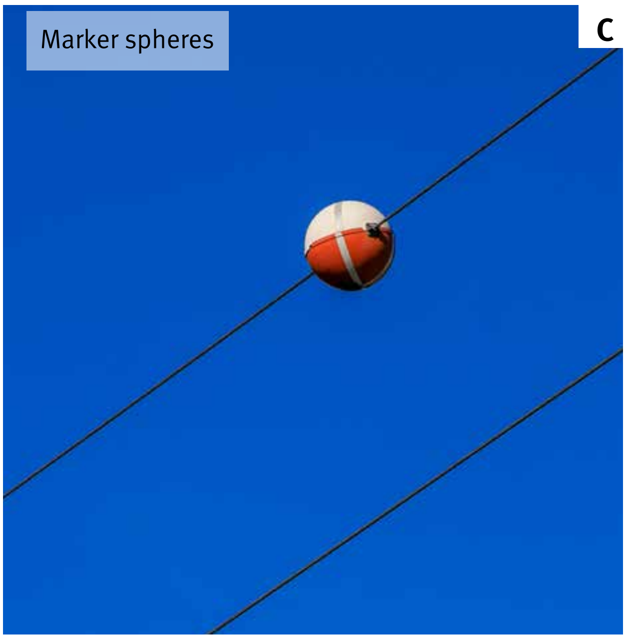


Figure 5.8: Examples of bird flight diverters

5.5. Potential Impacts and Relevant Mitigation for Bats

In general, transmission infrastructure projects have limited potential for significant impacts on bats. The key potential impacts on bats associated with the construction of transmission projects are loss of roost sites (typically trees), and foraging and/or commuting habitat arising from clearance of vegetation to accommodate transmission infrastructure (see Section 3.2.5.) .

The findings from the evidence-based bat study (presented in Section 4.5.) indicate that the physical presence of transmission overhead line infrastructure in the landscape does not act as a deterrent to bat activity.

The study also found no differences in the likelihood of a bat species or species group (where groups are: 'Lesser Horseshoe', '*Myotis*', 'Brown Long-eared', 'Leisler's', 'Pipistrelle') being present depending on hedgerow management regime.

The only published information identified at the time of the EBES found bat collisions with manmade structures pertains to wind turbines. The evidence-based study concluded that collision with overhead lines is considered to be a very low risk for most Irish bat species, since their echolocation capabilities should allow them to detect support structures and lines.

Electrocution caused by interaction with electricity transmission infrastructure is not possible for the Irish bat fauna. For example, conductor spacing on 110 kV overhead lines (the smallest transmission line) is a minimum of 1.1 m, and is generally 4.5 m in the field. The largest Irish bat (Leisler's bat *Nyctalus leisleri*) has a maximum wingspan of only 34 cm which would prevent it from making phase to phase contact resulting in electrocution.

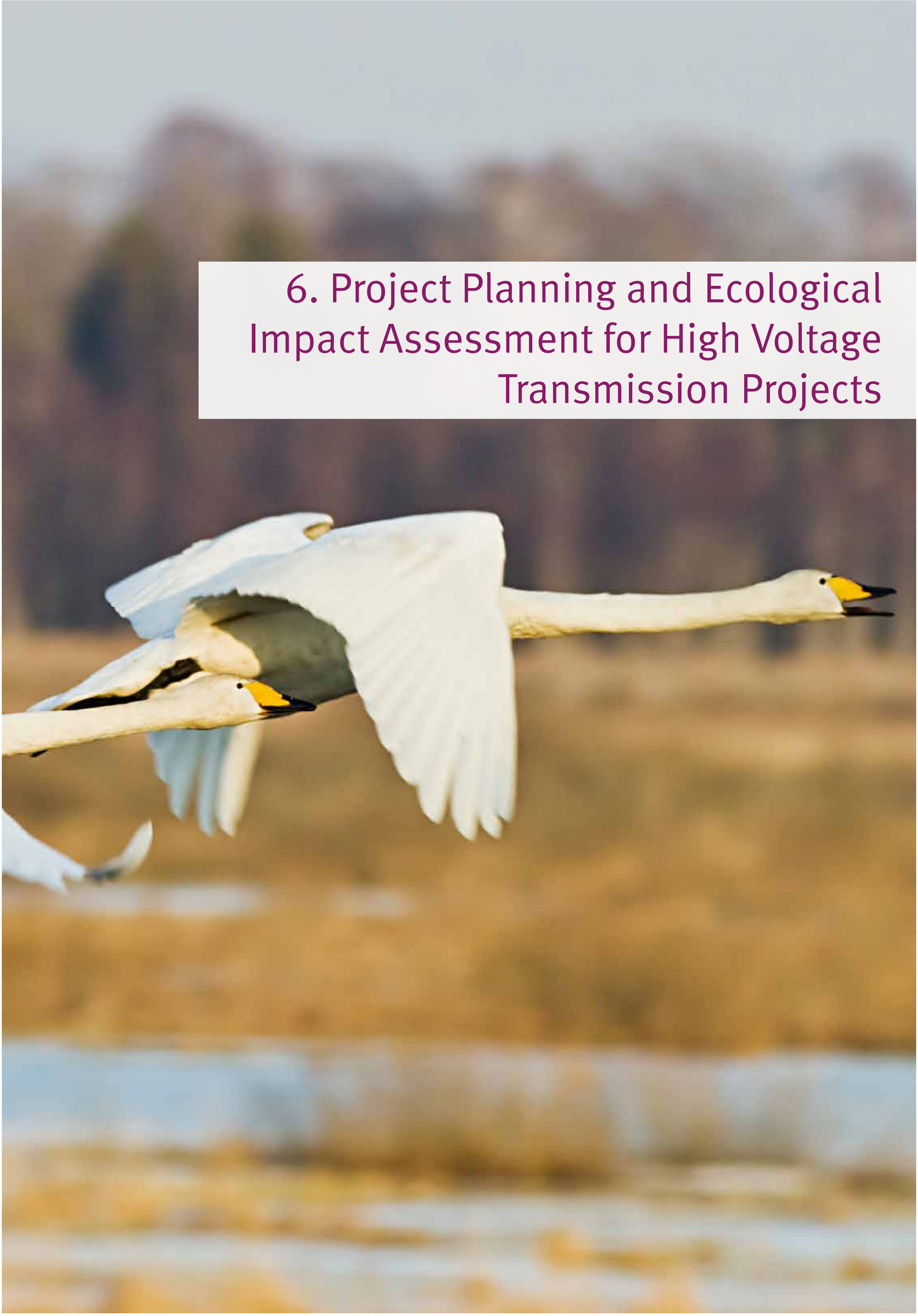
5.5.1. Mitigation of Impacts on Bats

Overall the potential for significant impacts on bats, due to the construction and operation of transmission infrastructure is considered to be low. The following mitigation measures should be considered:

An experienced ecologist or bat specialist must be engaged prior to and during construction where there is potential risk of disturbance to bats.

- As far as possible, mitigation by avoidance will best serve bats. Placing towers adjacent to, rather than on hedgerows will be inevitably better in the short term for bats and biodiversity in general, particularly hedgerows with moderate to high ecological and/or connectivity value (Foulkes *et al.*, 2013[72]).
- Where avoidance is not possible, minimise as far as practicable the length/volume of woody vegetation clearance.
- Trees with the potential for bat roosts must be identified and assessed at planning stage (and equally on exempted development projects). Pre-construction surveys must be undertaken prior to felling, having regard for relevant guidance (including Collins, 2016[73], and Bat Tree Habitat Key, 2018[74]). A suitably experienced ecologist or bat specialist should be engaged prior to and during construction where trees are to be removed. Where a tree roost is confirmed, the ecologist must first obtain and discharge a licence(s) in consultation with the NPWS, as appropriate. Relevant guidelines should be followed in relation to tree felling timing and techniques, including Guidelines for the Treatment of Bats during the Construction of National Road Schemes (NRA 2005[75]). A derogation licence to disturb or destroy a bat roost may not be granted by the NPWS in all cases, having regard for the criteria in Regulation 54 of the Birds and Natural Habitats Regulations.
- Allowing the regeneration of scrub under newly constructed overhead lines could benefit a range of bat species and offset biodiversity loss. Vegetation growth under overhead lines may not exceed 3 m in height in accordance with ESB policy.
- Supplementary planting as a mitigation measure to provide biodiversity gain may be considered (with landowners' agreement) where remnants of native semi-natural woodland or disconnected hedgerow networks occur in the wider area along a proposed overhead line corridor.

6. Project Planning and Ecological Impact Assessment for High Voltage Transmission Projects



6. Project Planning and Ecological Impact Assessment for High Voltage Transmission Projects

6.1. EirGrid's Six-Step Project Development Process

Grid development can be categorised into two types of project – new build projects and upgrade/refurbishment projects. When planning for and developing the grid, EirGrid Group generally considers all practical technology options with a view to minimising the need for new infrastructure.

EirGrid and SONI have developed separate but similar project development processes to explore options and make documented decisions when considering grid development. The respective processes ensure that the same steps are followed for every project.

At each step of the EirGrid process, decisions are made that narrow the focus for the choices required in the next step. It should be noted that the process allows for numerous opportunities for public engagement and consultation. An integral part of the process is ensuring that potential ecological impacts, such as those discussed in Chapters 4 and 5, are considered in all decision making. The principles of avoidance, mitigation, compensation and enhancement, known as the 'mitigation hierarchy' (see 6.2.2.), are central to the EcIA process and therefore influence the planning and design of transmission projects.

This chapter provides guidance on how to best implement and integrate EcIA during the development process for high voltage transmission projects. EcIA can be applied to projects of varying scales; the level of detail required will be proportionate to the scale of the development and its potential impacts.

Upgrade and refurbishment projects in general will have less significant impacts on ecology than new build projects.

The level of ecological consideration for each of the six-steps in the EirGrid project development process is described in detail in Sections 6.3. – 6.6. The approach to EcIA followed at steps 3 to 5 of the framework were informed by the project management phases the *Transport Infrastructure Ireland Project Management Guidelines* (TII, 2017[76]) – Step 3: Constraints Study, Step 4: Route Corridor Assessment Study and Step 5: Environmental Impact Assessment. In general the evaluation of ecological features and investigation of potential impacts will be undertaken in increasing detail as the transmission project is refined. Other disciplines such as cultural heritage, soils and geology, hydrology and water also feed into these multidisciplinary studies, informing the project decision making process.

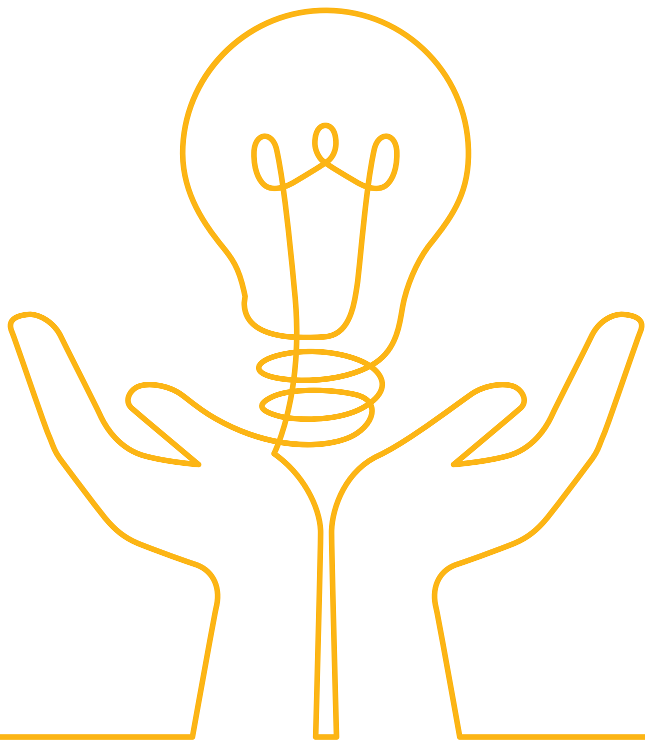


Table 6-1: Level of ecological consideration for each of the six steps in the EirGrid project development process

EirGrid Six-Step project development process	Ecological requirements	Appropriate Assessment requirements
Step 1 How do we identify the future needs of the electricity grid?	Technical studies - no ecological or other environmental requirements at this stage.	
Step 2 What technologies can meet these needs?	High level environmental appraisal of wider study area including ecology.	
Step 3 What's the best option and what area may be affected?	**Constraints Study:** Identification of ecological constraints (largely desk based) and input to enhanced performance matrix (environmental) and report.	Identification of European sites to inform Screening for Appropriate Assessment.
Step 4 Where exactly should we build?	**Route Corridor Assessment:** Ecology assessment in Step 4 Report presenting potential corridors/sites and best performing solution. Ecological assessment for EIA Screening (EIA Directive Annex II projects); where sufficient information available.	Identification of European sites and ex-situ implications to inform Screening for Appropriate Assessment.
Step 5 The planning process.	Ecological assessment for EIA Screening (EIA Directive Annex II projects). Ecological Impact Assessment in Environmental Impact Assessment Report (EIAR) for EIA projects. Biodiversity chapter (including EcIA) within EirGrid Planning and Environmental Considerations Report (PECR) for non-EIA projects.	Screening for Appropriate Assessment/preparation of a Natura Impact Statement for Appropriate Assessment if required.
Step 6 Construction, energisation and benefit sharing.	Full integration of mitigation into contractor's Construction Environmental Management Plan (CEMP). Ecological Clerk of Works as required. Implementation of any planning conditions potentially including ecological monitoring.	Implementation of any mitigation and monitoring measures detailed in AA process.

6.2. The Key Principles Underpinning EcIA

6.2.1. EcIA Process

The Ecological Impact Assessment should consider the significant ecological effects of a project in the light of relevant legislation, biodiversity and planning policy. A scientifically rigorous and transparent approach to EcIA is essential. EcIA should be undertaken by qualified professionals with an appropriate level of experience in ecological survey and impact assessment who are recognised by a relevant professional body such as the Charted Institute for Ecology and Environmental Management (CIEEM) (CIEEM, 2018[3]).

The EcIA process and principles outlined below are relevant to all developments that may impact on ecological features ('habitats, species and ecosystems').

An EcIA report (or the biodiversity chapter of an EIAR or PECR) should clearly and simply describe the significant effects of any project so that all interested parties understand the implications of what is proposed (CIEEM, 2018[3]).

Table 6-1: Stages in the EcIA Process (based on CIEEM, 2018[3])

Stage	Description
Scoping	Determining the matters to be addressed in the EcIA, including consultation to ensure the most effective input to defining the scope. Scoping is an ongoing process – the scope of the EcIA may be modified following further ecological survey/research and during impact assessment. Scoping in this instance refers to informal scoping as part of EcIA process and not formal EIA scoping for EIA projects.
Establishing the baseline	Collecting information and describing the ecological conditions in the absence of the proposed project, to inform the assessment of impacts.
Important ecological features	Identifying important ecological features (habitats, species and ecosystems, including ecosystem function and processes) that may be affected, with reference to a geographical context in which they are considered important.
Impact assessment	An assessment of whether important ecological features will be subject to impacts and characterisation of these impacts and their effects. Assessment of residual ecological impacts of the project remaining after mitigation and the significance of their effects, including cumulative effects.
Avoidance, mitigation, compensation and enhancement	Incorporating measures to avoid, reduce and/or compensate ecological impacts, and the provision of ecological enhancements. Monitoring impacts of the development and evaluation of the success of proposed mitigation, compensation and enhancement measures.
Reporting	The final EcIA report (or for EIARs, the Biodiversity chapter) should clearly set out all the ecological information necessary for a robust decision to be made.

6.2.2. Consultation

Consultation with statutory and non-statutory bodies is an important part of the EcIA process. A list of statutory and non-statutory bodies for Ireland is provided in the box following this section. Consultation should be an on-going process continuing through all stages of project development once the project need has been established (Step 1) and a short-list of technological options has been made (Step 2).

Early consultation provides an opportunity to agree the scope of the assessment. In addition to identifying issues, many organisations and agencies hold ecological data and records, which should be considered for assessment. Engagement with consultees on a regular basis will help to refine the proposal, especially where significant issues arise and mitigation measures are required (CIEEM, 2018[3]).

Information provided to consultees should clearly define the nature and stage of the project and include location maps identifying all aspects of the development. The reason for consulting with the organisation should be clearly stated along with any specific information requirements (NPWS Circular Letter 2/07). Applications or consultations with the Development Applications Unit (DAU) of the DHLGH should, as requested by the DAU, be accompanied by a cover letter describing the relevant legislation, applicable deadlines, and all necessary details of the development application (https://www.npws.ie/development-consultations).

Summary of statutory and non-statutory bodies that may be consulted by EirGrid regarding ecology for transmission projects, where required.

In Ireland, the statutory consultation process for developments requiring planning permission is managed by the local authorities, or in cases of strategic infrastructure development (or following appeal), by An Bord Pleanála. The following statutory consultees are provided for by the respective Planning and Development Acts and Regulations (as amended):

- National Parks and Wildlife Service (NPWS) of DHLGH. Pre-planning consultations with NPWS should be initiated through the DAU.
- Inland Fisheries Ireland.
- An Taisce.

The following consultees relevant to ecology may also be consulted, such as:

- Bat Conservation Ireland.
- BirdWatch Ireland (Head office and local branches).
- Botanical Society of Britain & Ireland.
- Heritage Officers and Biodiversity Officers of the relevant local authorities (if responses have not been received via statutory consultation).
- Irish Peatland Conservation Council.
- Irish Raptor Study Group.
- Irish Whooper Swan Study Group.
- The Hen Harrier Project.
- Waterways Ireland.

6.2.3. Establishing the Baseline

Ecological baseline conditions are those existing in the absence of proposed activities. The impact assessment determines how the conditions will change in relation to this baseline to facilitate a clear understanding of the effects of a project.

During scoping for EcIA, spatial and temporal limits (or 'zones of Influence') need to be established for obtaining the necessary baseline information and a clear rationale presented. Variation in populations, habitats or ecosystems over time in the absence of the project should always be considered. This may require more than one year or one season of data to give an accurate reflection of the situation. In many cases this may be determined from historical information, knowledge of general trends and management activities etc. and an understanding of how each feature/resource might respond.

The spatial extent of baseline studies should be flexible to accommodate different needs. For example, impacts on part of an ecosystem, habitat or population may have implications for the whole ecosystem, habitat or population so that a larger study area may be needed. Vulnerability of different habitats and species may vary greatly depending on the type of project.

Data used to establish baseline conditions can be obtained from a range of sources, including desktop and field sources.

Information Sources for Establishing the Baseline

Information on records of rare and protected species can be obtained from a variety of online resources including the National Parks and Wildlife Service NPWS (see www.npws.ie) and Ireland's National Biodiversity Data Centre (NBDC); ranging from individual records to large scale surveys. A variety of county-level rare plant and habitat survey data is available via the Heritage Council map viewer (www.heritagemaps.ie). More sensitive data relating to rare and threatened species can be requested on a case by case basis from the NPWS Scientific Unit. NPWS notes that datasets it is in possession of may be limited in terms of quality or comprehensiveness.

Summary bird distribution data gathered as part of the Irish Wetland Bird Survey (I–WeBS) can be downloaded from the Birdwatch Ireland website (www.birdwatchireland.ie); Birdwatch Ireland also hold a range of other bird data sets. Additional desktop data may be available from a variety of other non-statutory conservation bodies, subject to available resources.

NPWS also publishes reports and spatial data relating specifically to species listed in the respective Annexes to the EU Habitats and Birds Directives (Article 17 and Article 12 reporting respectively). The reports and associated data are synchronised and based on a 6-year reporting cycle.

Spatial datasets of known distributions of European protected species and habitats are available in Conservation Objectives spatial datasets (within European sites only), and in other national survey datasets (both inside and outside European sites, e.g. for petrifying springs, semi-natural grasslands, and semi-natural woodlands). Recommended survey methods are reported in the NPWS' Irish Wildlife Manuals series, and related documents.

Further information on the aforementioned lists and data resources is presented in Appendix 2.

Standard survey methods should be used to ensure that the data collected are robust and results can be easily interpreted and compared with those from other investigations. Details of how methods have been tailored to meet the needs of the study should be included. If survey methods vary from accepted good practice this should be explained and justified (CIEEM, 2018[3]).

6.2.4. Evaluation of Ecological Features

A standard scheme for assessing the ecological importance of sites was developed and published by Nairn and Fossitt (2004[77]) and subsequently adopted by the National Roads Authority (2009[75]; since renamed Transport Infrastructure Ireland) in its *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (Revision 2) (Appendix 1). The scheme has been widely used in ecological assessments for road schemes and other linear developments such as pipelines.

As electricity transmission line and underground cable projects are also linear developments through the landscape, it is recommended that the same scheme be used in the assessment of impacts of electricity transmission development on ecological sites. In addition, as this evaluation scheme has been published and tested, it affords a degree of consistency between various ecological assessments for electrical transmission projects.

It should be noted that the emphasis is on identification and evaluation of areas defined as 'ecological sites' i.e. comprising of various habitat types that make up a discrete area or site as opposed to an evaluation of individual habitats or species.

The following geographic frame of reference should be used when determining value of ecological features:

- International importance.
- National importance.
- County importance (or vice-county in the case of plant or insect species).
- Local importance (higher value).
- Local importance (lower value).

The evaluation of features at the lower end of the geographic scale will require some understanding of the distribution and abundance of that feature on a county or local level. All ecological features should be valued and selected by competent experts. It is important to note that key ecological features are, fundamentally, the significant ecological elements for consideration in the ecology assessment, rather than all ecological features. Key ecological features are features that are evaluated as being of Local Importance (Higher Value) or greater (up to International Importance). In accordance with the NRA Scheme, ecological sites of below 'Local Importance (higher value)' should not be selected as 'key ecological features' for which impact assessment is required during subsequent stages of the process.

The NRA evaluation scheme has application through the various project planning and design stages. However, it may not suffice in all situations e.g. when determining the significance of impacts on a specific habitat type or species. Other guidelines that provide evaluation and other criteria relevant to Ireland include the CIEEM guidelines (CIEEM, 2018[3]).

6.2.5. Impact Assessment

The assessment of impacts should be undertaken in relation to the baseline conditions within the study area that are expected to occur if the development were not to take place (IEEM, 2006[78]).

The assessment should include potential impacts on each ecological feature determined as 'important' for all project phases, e.g. construction, operation and decommissioning; such features are variously referred to as "key ecological receptors" (NRA, 2009[75]) and "important ecological features" (CIEEM, 2018[3]). It should consider direct, indirect, secondary and cumulative impacts and whether the impacts and their effects are short, medium, long-term, permanent, temporary, reversible, irreversible, positive and/or negative.

The significant effects must be assessed in the context of the predicted baseline conditions within the zone(s) of influence during the lifetime of the development. Information may be required from other specialists as impacts may relate to noise, air quality, hydrology, water quality etc. Liaison with other disciplines will enable more robust predictions for project-related bio-physical changes and assessment of their ecological implications (CIEEM, 2018[3]).

Quantifying impacts on ecological sites, habitats and species should be based on a standard approach (CIEEM, 2018[3] and EPA, 2017[11]).

The European Commission (2018b[79]) has published a guidance document intended to present an overview of the implications of energy infrastructure proposals on European sites and EU protected species and habitats as well as providing guidance on ensuring electricity transmission infrastructure is fully compliant with EU environmental policy and legislation.

6.2.6. Mitigation

Mitigation is the design of measures which aim to minimise or even eliminate the negative impacts that are likely to arise as a result of a particular project or scheme (EC, 2007[80]). The mitigation hierarchy is an important tool for assessing potential impacts and measures which may require implementation, and also highlights the need to focus on the avoidance and minimising aspects of mitigation, as offsetting[iv] and compensation measures can prove more complex and expensive. The hierarchy below from CIEEM (2018) is, viewed as a whole, comparable to the terms adopted in the new EIA Directive, as shown in the box below (CIEEM, 2018[3]).

Mitigation Hierarchy adapted from CIEEM, 2018)
Avoidance
Seek options that avoid harm to ecological features (for example, by locating project on an alternative site).
Mitigation
Negative effects should be avoided or minimised through mitigation measures, either through the design of the project or subsequent measures that can be guaranteed – for example, through a condition or planning obligation.
Compensation
Where there are significant residual adverse ecological effects despite the mitigation proposed, these should be offset by appropriate compensatory measures.
Enhancement
Seek to provide net benefits for biodiversity over and above requirements for avoidance, mitigation or compensation.

Within the mitigation section of the EcIA or Biodiversity chapter for the EIAR, it should be made clear how the measures will act to avoid or reduce impacts on ecological sites/habitats/species.

Following case law forbidding (at AA Screening stage), mitigation measures intended to avoid or reduce harmful effects on European sites, the reasons and intent behind mitigation measures must be carefully considered in all relevant reports (including the Construction Environmental Management Plan (CEMP); see Section 6.6.1.). Proposals for mitigation in the EcIA/EIAR or CEMP must not contradict statements regarding mitigation undertaken during the AA process.

Where mitigation is appropriate, evidence of the known effectiveness of respective mitigation measures should be provided. In these cases, a timeframe for implementation of mitigation measures should also be outlined.

Mitigation conflicts should also be considered. In some cases, mitigation may create direct impacts in other areas (e.g. potential damage to sensitive vegetation from installation of silt fencing proposed to mitigate siltation risk). Similarly, conflicting seasonal considerations should be identified (e.g. timing the removal of riparian vegetation to the winter period to avoid nesting bird disturbance may have an unintended consequence of raising siltation risk in a freshwater pearl mussel catchment, by exposing soils during the months with heavier rainfall). Where such conflicts arise, refined or amended mitigation may be required, potentially informed by further surveys.

Consultants must give careful consideration to the wording of undertakings to mitigate; to ensure that they clearly result in actions that can be readily identified by monitoring and acted upon by enforcement procedures (EPA, 2017[11])

Refer to Chapter 5 for examples of standard mitigation measures which can be implemented during the construction and operation of transmission infrastructure projects, where required.

iv Note that, following European and Irish case law, offsetting under the Habitats and Birds Directives may be seen as compensation not mitigation, with very different implications for decision-making

6.2.7. Enhancement

Policies at International and Irish level advocating for *No Net Loss* of biodiversity, and/or net gain of biodiversity from development have already been identified in Section 2.2. CIEEM state that enhancement of biodiversity should be an objective of all projects (CIEEM, 2018[3]). EirGrid encourages consultants to explore practical, cost-effective and evidence-based biodiversity enhancement measures as part of the EcIA process. Such measures will only be appropriate and implementable in site-specific locations, and with the agreement of relevant stakeholders. Consultants should engage with EirGrid as early as possible (i.e. Step 3 or 4), to identify if any such site-specific enhancement opportunities are potentially feasible on a given project.

6.3. Steps 1-3

Steps 1 and 2 in the project development process are concerned with identifying the need for a project and developing a short list of possible technology options. While Step 2 includes some high level environmental analysis, it is generally undertaken in-house by EirGrid and includes a desktop based analysis of designated sites for nature conservation and other sensitive ecological features. Therefore, for the purposes of these guidelines, no further consideration is given to ecology in Steps 1 and 2.

Once the project need has been established and a number of technology options shortlisted, the project enters Step 3 of the process where these options are assessed as part of a wider Constraints Study to determine the best performing solution (technology and corresponding study area).

Step 3 - Constraints Study: Ecology Objectives

- Identify ecological constraints within the study area;
- Facilitate consultation with stakeholders on study area and constraints; and
- Evaluate and identify ecological constraints to be avoided at the next stage of the process.

The ecological element of the constraints study is primarily a desk review of information available on biodiversity within a defined study area. This step is used to identify potential issues or constraints that could restrict the options within the study area. A list of relevant ecological data sources is provided in Appendix 2.

Step 3 is the optimum stage at which to identify key significant environmental constraints, including nature conservation sites, high value habitat types (e.g. Annex I) and areas important for species outside of designated sites with the aim of avoiding them at the next stage of the development process.

Ecological constraints outside the given study area (but within the potential zone of influence) should also be considered, for example where there are ecological or hydrological links beyond the study area.

The aim at this stage is to establish an initial understanding of the baseline ecological conditions and the potential significant effects that could arise as a result of the project.

Consultation with statutory and non-statutory stakeholders as described in Section 6.2.2. may be initiated at this stage.

During this stage of the development process EirGrid may engage at local level with members of the public, landowners and local representatives from potential project areas. This can help identify local knowledge of important areas for biodiversity and also which locations for new infrastructure are preferred by local people.

The information collected on ecological constraints within the study area will inform the ecology section of the Constraints Study prepared in this Step to assist decision-making at the end of Step 3. The Constraints Study should include a brief overview of the existing environment and ecological interests of the study area, including topography and landscape features, the main land uses, nature conservation sites, the main habitats of conservation value and the main surface water or drainage features. The legal status of all ecological constraints should be clearly identified. A description of the project or project options will be included in this report.

Step 3- Constraints Study– Ecology Reporting

- Description of the existing environment, including land uses.
- Methodology – sources of data compiled at desk study, preliminary field surveys undertaken as necessary, evaluation criteria used to assess ecological features.
- Ecological constraints identified with brief description including the legal protection of sites, habitats and species.
- Ecological constraints map.

Ecological constraints should be identified on digital mapping overlaying the study area for ease of reference. Other constraints can then be added as required. A map (scale 1:50,000 or larger depending on the size and scale of the project) showing ecological constraints within and in close proximity to the study area (with identifying site codes and site names), the main surface waters referred to in the text and the general locations of rare or protected species should accompany the constraints report and mapping.

Preliminary Ecological Appraisal (PEA)

PEA may also be utilised to inform the baseline establishment during the EcIA process. In effect, a PEA is a rapid assessment of the ecological features present, or potentially present, within a site and its surrounding area (the zone(s) of influence in relation to a specific project (usually a proposed development)).

The Preliminary Ecological Appraisal Guidelines published by CIEEM (2017b[81]) outline the objectives of PEA and the approaches used therein.

PEA is normally used to inform an EcIA but may also inform scoping for EIA or an assessment of likely compliance with statutory obligations for developments which do not require planning consent, or developments proceeding under Permitted Development Rights or other consented operations (such as Exempted Development in Ireland) (CIEEM 2017[81]).

In summary, a PEA typically comprises a desk study and a walkover survey, the key objectives of which are to:

- Identify the likely ecological constraints associated with a project (e.g. site-specific constraints along an OHL route);
- Identify any additional surveys that may be required to inform an Ecological Impact Assessment (EcIA);
- Identify any mitigation measures likely to be required; and
- Identify the opportunities offered by a project to deliver ecological enhancement.

Checklists of items to be considered at each of the project stages have been included for information purposes. These lists should not be seen as exhaustive.

Checklist of items for Ecology Section of Constraints Study (NRA, 2009[75])

1. List and map all Nature Conservation Sites including proposed and candidate sites within study area – SAC, SPAs, NHAs (and pNHAs), nature reserves etc. including a summary of the key information related to the respective sites.
2. List and map all Nature Conservation Sites within an appropriate distance of the study area, including a summary of the key information related to the respective sites.
3. Documented bird sites (Irish Wetland Bird Surveys (I-WeBS) or other data e.g. Important Bird Areas).
4. Documented locations of rare and protected species (outside of Nature Conservation Sites).
5. Documented watercourses and associated fisheries value (i.e. salmonid status).
6. List other sites of ecological importance identified from aerial photography.
7. Note major ecological features to be avoided.
8. Highlight any issues for special attention in later phases.
9. Preparation of ecology section and map detailing all ecological constraints within the study area.

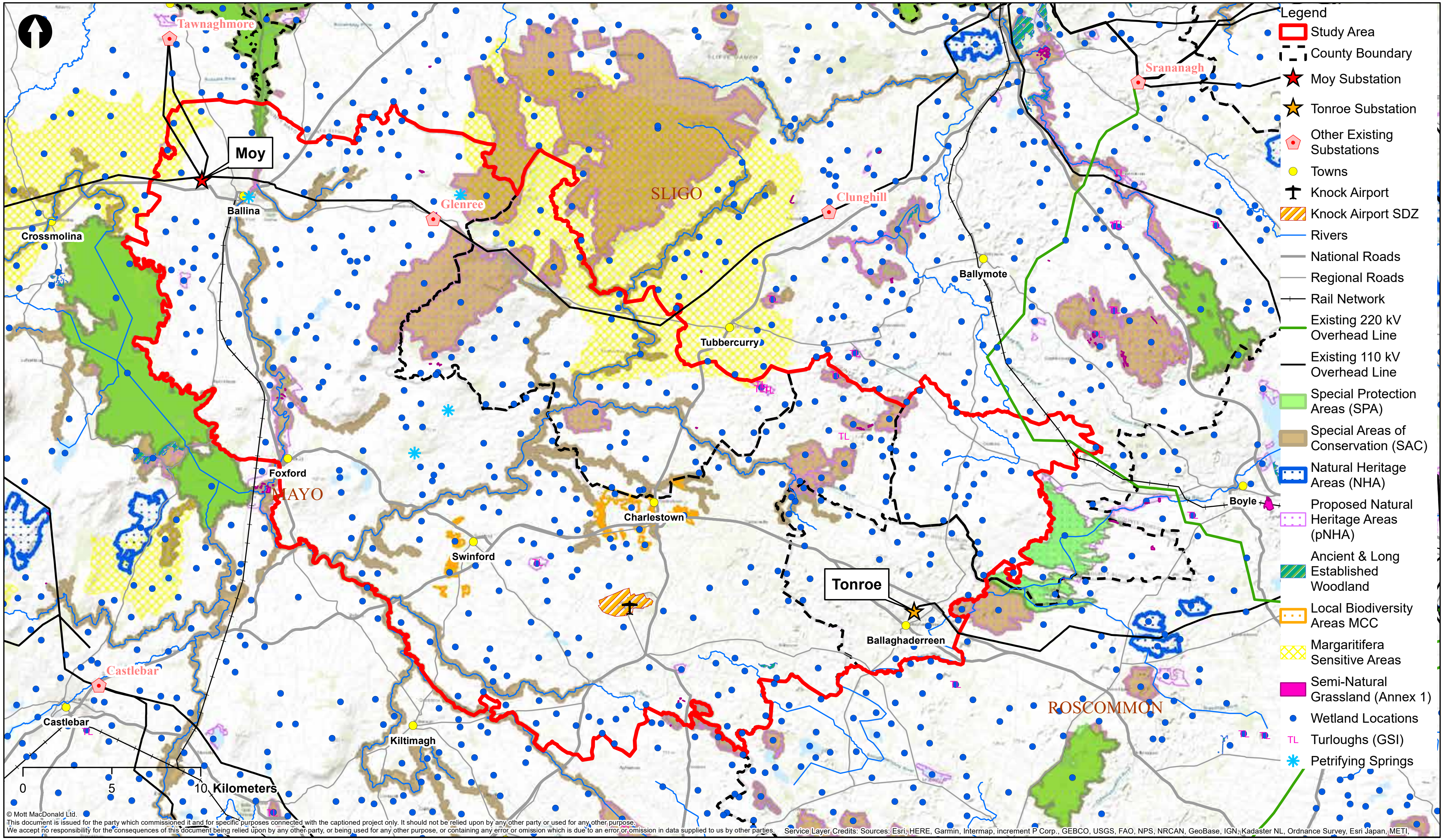


Figure 3.1: Schematic of typical intermediate 400 kV towers (double and single circuits)

6.4. Step 4: Where Exactly Should We Build?

Following the process of identifying environmental and other constraints within the study area, a number of potential route corridors or sites are identified by the project team for the analysis and appraisal assessment in Step 4 of the Project Development Process.

During this step a best performing solution (least constrained) will be identified following a Route Corridor Assessment (RCA). This will inform the Step 4 Reporting and the resulting preferred corridor or site will comprise the project proposal which will form the basis of any planning application (or consideration of exempted development) prepared at the next step of the process.

Step 4 - Route Corridor Assessment: Ecology Objectives

- Identify ecological sites and features of interest for each route corridor.
- Verification field surveys (if required).
- Assess level of potential impacts on ecological features.
- Undertake comparative evaluation of route corridor options (matrix table).
- Identify least constrained corridor (preferred route corridor).

The ecology element of the RCA involves a combination of desk study and field survey to identify, map, describe and evaluate sites of known or potential ecological value along each of the route corridor options and a broad assessment of the likely impacts of a proposed OHL, UGC or substation located within those wider corridors.

Ecological sites are identified from various sources such as recent aerial photography. Field surveys may be required to verify the results of the desk study and ensure that sufficient data is available to enable decisions to be made on the choice of route corridors. The width of the corridors will vary depending on the scale of the project and will be determined on a case by case basis. For example a 500 m wide corridor may be indicated for a 110 kV project with up to 1 km corridor considered for a 400 kV project. The width of the corridor will also be dependent on the habitats and species present in the area.

Species-specific surveys may also need to be commenced as part of the route corridor selection process, particularly where issues relating to bird species have been identified in the constraints study. It should be noted that surveys for protected species may require several seasons of data collection and licensing.

Further consultation with statutory agencies, including NPWS should be undertaken presenting the proposed corridors and seeking any additional feedback.

RCA typically involves a comparative evaluation of route corridor options. The objective of the assessment is to evaluate and compare the alternative options, taking account of engineering, environmental and cost considerations. The potential ecological impacts associated with each of the options are identified so that those with unacceptably high levels of impact can be avoided.

The RCA process will include initial Screening for Appropriate Assessment and a comparative assessment between these options. Screening should be undertaken without inclusion of mitigation, unless potential impacts can clearly be avoided through the modification or redesign of the plan or project, in which case the screening is repeated on the altered design (DoEHLG, 2009[15]).

It is important that the RCA stage is as detailed and rigorous as is necessary and/or appropriate, depending on the environmental sensitivities that arise. If any of the proposed corridors impact on a European site, it is important that consideration is given to whether route options can reasonably be foreseen to pass the tests that a competent or pubic authority must apply under Article 6(3). If there are risks of adverse effects on a European site that cannot be comprehensively mitigated against from the final project on its own or in combination with other plans and projects, the consideration of alternatives becomes critically important in pursuing an IROPI case under the tests of Article 6(4) (refer to Section 2.1.2.).

The assessment of likely impacts should take into account the ecological value (rating) of sites as per the NRA evaluation scheme described in Section 6.2.4. The levels of impact assigned to particular corridors make the assumption that standard mitigation measures will be implemented and this should be clearly stated. However, at this stage, site-specific mitigation measures are normally excluded in the assessment of impacts of the project.

The process of selecting a least constrained corridor for a proposed OHL or UGC typically involves a comparative evaluation of a number of corridors so that alternative options can be evaluated and compared.

The results of the assessment should include a map of sites, areas and species of ecological value (updated from the constraints study), including important areas for bird populations and significant watercourses and wetlands that are likely to be impacted by the proposed transmission corridor options.

Step 4 Report: Ecology Content

- Proposed project should be described adequately and in non-technical language.
- Brief overview of the existing environment and ecological interests of the study area.
- Methodology - statement of how and when the study was carried out, including data and information sources and all consultations. Field survey techniques should be clearly described and any limitations in the methodology or approach should be highlighted.
- Details of the site evaluation scheme used and impact assessment criteria should also be presented.
- Ecological constraints identified with brief description including the legal protection of sites, habitats and species.
- Comparative evaluation of corridor options presented in a matrix format.
- Identification of preferred corridor.

Ecology Checklist for Route Corridor Assessment (adapted from NRA, 2009[75])

1. Define ecological sites from aerial photography (noting even improved grassland may be important as ex-situ wetland bird habitats).
2. List nature conservation sites within appropriate distance of the route corridors.
3. Field visits (at appropriate times) to affected sites/features of ecological significance.
4. Brief description and evaluation of ecological sites/features likely to be affected.
5. Consult NPWS with regard to protected species and sites.
6. Consult BirdWatch Ireland with regard to important bird sites.
7. Consult Inland Fisheries Ireland on fisheries waters.
8. Assess likely significance of impacts on affected sites and features.
9. Prepare impact matrix of sites/overhead line and underground cable routes.
10. Assessment of cumulative impacts with other environmental disciplines.
11. Prepare final report and drawings.

6.5. Step 5: The Planning Process

Where a project requires planning permission, such as for a new overhead transmission line or substation, EirGrid will submit a planning application to the planning authority – either the relevant Planning Authority or An Bord Pleanála (Ireland).

All EIA Directive Annex I projects require EIA (refer to Section 2.1.1.). Screening for EIA is required for Annex II projects. Once the requirement for EIA has been established, scoping for EIA is undertaken prior to the preparation of the EIAR.

The findings of an EIAR are material considerations in the planning process and other consent regimes. The competent authority must be provided with all the information needed to assess and evaluate the likely significant environmental effects of a project.

The competent authority has the duty to consider and assess the environmental information before it reaches a decision regarding the granting of consent (CIEEM, 2018[3]).

As noted in Section 2.1.1. it is EirGrid practice to also submit a PECR with planning applications for non-EIA development. This will include a chapter on Biodiversity/Ecology, typically following the structure and content of an Ecological Impact Assessment.

In tandem with the ecological impact assessment process (alone or as part of an EIAR), the process of Appropriate Assessment must be conducted. Where a transmission project, alone or in combination with other plans or projects is likely to have significant effects on European sites, or if the risks of such effects cannot be excluded, Appropriate Assessment is required under the EU Habitats Directive (refer to Section 2.1.2.). This is required even in a scenario where a project proposal is not subject to a planning application i.e. comprises exempted development.

6.5.1. EIA Screening for Annex II Projects

Where EIA Directive Annex II projects are proposed the developer is required to submit specific information as set out in Annex IIA of the EIA Directive to the competent authority and the criteria set out in Annex III of the EIA Directive are to be taken into account when compiling the required information (refer to Section 2.1.1.). With regard to sub-threshold development, Article 103 of the Planning & Development Regulations (2001) allows the Planning Authority to request an EIAR for sub-threshold development within a European site or an area designated under the Wildlife Acts 1976 to 2018 (as amended). EirGrid takes cognisance of this provision when preparing planning applications for sub-threshold development.

The information includes inter alia a description of the project, the environmental sensitivity of affected locations, a description of likely significant effects (to the extent of information available) on soil, land, water and biodiversity resources and the cumulative impacts with other existing or approved projects.

6.5.2. Scoping for EIA

Once an indicative route or site has been identified the scope of the EIAR can be developed. In cases where EIA is required the scope should include the nature and detail of the information to be contained in the EIAR report. Scoping may be a formal or informal process, but should at least define the likely areas of potential impact and the appropriate methods by which to evaluate them prior to the commencement of detailed data collection or assessment (EPA, 2017[11]).

Scoping is an ongoing process – the scope of the EIA process will be modified following further ecological survey/research and during impact assessment, and consultee feedback (CIEEM, 2018[3]).

It also allows for landowner engagement, which opens the way for requesting access onto lands for survey. Based on information gathered in the previous EirGrid Project Development steps it may be necessary to undertake or begin more specialised targeted surveys at a pre-EIAR stage so that the data can be collected for the EIAR and that unnecessary delays are avoided. This may be the case for species with seasonal cycles such as breeding or wintering birds or habitat and flora survey.

6.5.3. Article 6(3) Assessments

In accordance with Article 6(3) of the Habitats Directive as transposed by national legislation, the proposed development will be screened for potentially significant effects on European sites (refer to Section 2.1.2.).

The screening process identifies the potential for likely significant effects on any European site(s) arising from implementation of a proposed plan or project. If the effects are deemed to be significant, or if the likelihood of effects cannot be excluded on the basis of objective information, then the process must proceed to the next stage of the Appropriate Assessment process which is the preparation of a Natura Impact Statement (NIS) in Ireland (DoEHLG 2009[15]).

6.5.4. Undertaking EcIA

6.5.4.1. Introduction

Step 5 of the Project Development Process involves the formal ecological impact assessment which will inform the Biodiversity Chapter of the EIAR or be submitted as a stand-alone report (or as a chapter of an Environmental Report) for non-EIA development.

The objective of the EcIA for a proposed high voltage transmission project is to identify, quantify and qualify the likely significant impacts on biodiversity that would arise during the construction, operation and decommissioning of that infrastructure. Significant impacts are those which by their character, magnitude, duration or intensity alter a sensitive aspect of the environment. The report should be prepared based on the final proposal for the overhead line, cable route or substation locations. It should include detailed mitigation measures and list residual impacts that remain after mitigation.

A formal EIAR should be prepared in accordance with the requirements of Article 5 of the EIA Directive, applicable national legislation, and the EPA Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, 2017[11]).

The EcIA should be prepared in accordance with international good practice and guidelines including CIEEM's Guidelines for Ecological Impact Assessment (2018[3]).

The EcIA builds on the information collated during Steps 3 and 4 of the EirGrid project development process and should follow the process as set out in the following sections.

6.5.4.2. Consultation

Further consultation with statutory agencies, including NPWS should be undertaken to keep them appraised of the proposed project route or site and to seek any additional feedback (refer to Section 6.2.2.).

6.5.4.3. Establishing the baseline

The baseline ecology in the area of the proposed transmission project and associated ancillary development (including temporary works) needs to be described in the EcIA to a standard which allows for defensible and robust impact predictions to be made. The description will utilise information and reports from the previous steps of the process and will usually involve new survey work and habitat mapping to generate up-to-date and site-specific data on biodiversity within the potential zone of influence of the transmission project. The description of existing ecology in terms of habitats and species is the foundation for the entire ecological impact assessment process as a prediction of change is only as effective as the baseline information collected.

A significant amount of background ecological information will have been collected in the preceding steps of the transmission project development (Steps 3 and 4). The following should be considered in describing the ecological baseline and for making a plan for detailed field survey of the project study area:

- A review of all desktop information gathered from earlier steps in the project; an overview of the development in relation to the surrounding landscape, interpretation of recent aerial photographs at an appropriate scale, preparatory work for field survey including identification of likely important ecological sites and areas for mammals, birds, fish etc.
- A review and collation of information obtained from consultees both statutory and non-statutory; e.g. the sourcing of local information, the knowledge of local naturalists or county recorders of the Botanical Society of the British Isles. Biodiversity data resources are listed in Appendix 2.
- A review of scientific literature and key references appropriate to the study area and the species or habitats that may be affected.
- The collection of other relevant information on other similar projects/activities in the general area e.g. ecological assessments, EIARs, AAs, and SEAs prepared for other projects or plans.
- The baseline desk studies and field surveys and assessments of terrestrial and aquatic environments. Having robust baseline data is not only essential in determining potential impacts but also to enable monitoring to verify if significant residual impacts beyond those predicated have arisen.

Baseline field surveys

Further field survey(s) (habitats, mammal and bird survey) of ecological sites and features of interest should be carried out at this stage, to build on the data collected in Steps 3 and 4. The dates of these survey(s) should be specified and any limitations to survey noted (including, for example, refusal of landowners to grant access for walk-over surveys).

Surveys should be conducted using standard methodologies (refer to box below). Where the multidisciplinary survey identifies the need for further detailed survey for protected species of flora and/or fauna, the NRA guidance document Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (NRA, 2008[82]) should be consulted.

Recommended survey methods

Habitats – Survey methods should employ the Heritage Council's Best Practice Guidance for Habitat Survey and Mapping (Smith *et al.*, 2011). For Ireland, NPWS endorses the utilisation of the Irish Vegetation Classification (IVC), supported by data analysis using the ERICA habitat assessment software package. Survey methodologies for various habitats are also outlined in the respective Irish Wildlife Manuals available on the NPWS website. The level of survey effort will reflect the nature of the habitats within the study area. Where sites of high conservation value (e.g. those comprising habitats listed in the EU Habitats Directive) are likely to be significantly affected by the transmission project, they may require more detailed biological description and classification.

Birds – The level of survey effort will depend on the known populations of birds in an area or the potential value of the habitats in the study area for birds. The survey should be undertaken by a qualified and experienced ornithologist and conducted according to standard, published methodologies and at the appropriate time of year (see Bibby *et al.*, 2000[83], Gilbert *et al.* 1998[84]). More than one year of data may be required for species with low reproductive rates (e.g. hen harrier, eagles), and/or in the event of extreme weather (e.g. for whooper swans if favoured wetlands are frozen).

Mammals – The field survey should include an assessment of mammal activity in the zone of influence of the route of the power line or cable and also of associated ancillary services (e.g. access roads, storage areas and site compounds) by recording the presence of mammal signs (such as tracks, droppings, feeding signs, etc.) and identifying potential or confirmed breeding or resting sites.

Water quality – In terms of aquatic and riparian habitats where these features occur within the study area they should be adequately described and assessed. Where a river or stream is to be crossed by the construction of a temporary feature (bridge or culvert), the in-stream and riparian habitats should be assessed at the crossing point and for an appropriate distance downstream of the crossing. It may be necessary to collect data on water quality if little is known of the biological status of the respective rivers and streams in the study area (McGarrigle *et al.*, 2002[85]). If this is the case, physico-chemical sampling should be included as part of the ecological survey.

Specialist surveys should also be carried out at this stage where considered necessary particularly of bird usage and flight patterns (if required), protected species such as bats, otter and rare plants.

Restricted land access for baseline surveys

In some cases permission to access lands along a route or within the site of a proposed project, in order to undertake ecological baseline survey work to inform the EcIA, may not be granted by landowners. In all such instances a comprehensive description and evaluation of the baseline ecology likely to be impacted will need to be based on a combination of different survey approaches including:

- Desk-based assessments of existing published data sources. Comprehensive and detailed published data sources are available, including Geographical Information System (GIS) data resources.
- Visual surveys undertaken from public roads and in the case of OHL projects, all locations where the alignment crosses public roads combined with desktop sources (GIS and aerial photo analysis) enabling consideration, identification and confirmation of habitat types and where possible, dominant species composition.
- LiDAR (Light Detection and Ranging) imagery and other GIS datasets (including the subsoils dataset (Meehan 2004[86]), aerial mapping, Ordnance Survey Ireland (OSI) Discovery mapping (including contours), OSI 1:5000 vector mapping, and where relevant historical six inch OSI mapping) can be used to assist in identifying habitats along the proposed development route where walkover or visual surveys were not possible.
- Standard survey methodologies for may need to be tailored to the local environment to ensure the collection of quality data (e.g. for bird vantage point surveys, roving surveys may be required in lieu of fixed vantage points, if in a flat landscape without elevated viewpoints).

6.5.4.4. Evaluation of ecological features

As per Section 6.2.4.

6.5.4.5. Impact assessment

As per Section 6.2.5.

6.5.4.6. Mitigation, Monitoring, and Enhancement Measures

As per Section 6.2.6 and 6.2.7.

6.5.4.7. Reporting

Where EIA is required, the Biodiversity chapter will be presented in a way that fits the overall style and structure of the EIAR.

The EIA Directive requires that difficulties such as technical deficiencies, lack of information or knowledge encountered in compiling the EIAR be described.

Report structure for EIAR should have regard for best practice guidelines (EPA, 2017[11]).

Contents of Chapters of EIAR (EPA, 2017[11])

To assist assessment and increase clarity and the systematic organisation of information in an EIAR; it is good practice to separately describe the:

i. Key alternatives considered.

ii. Proposed project.

iii. Receiving environment.

iv. Likely significant effects.

v. Mitigation and monitoring measures.

vi. Residual effects.

vii. A non-technical summary must also be provided.

In practice the descriptions of items (iii) to (vi) above are usually addressed under each individual environmental factor (e.g. Biodiversity) along with the description of project details which are particularly relevant to that factor (or topic).

EcIA reports should be tailored to suit individual circumstances and different formats are acceptable. However, it is important that the structure and content of EcIA reports are standardised (CIEEM, 2018[3]). An EcIA checklist has been provided by CIEEM (CIEEM 2019[87]).

Checklist of items for EcIA (modified and adapted from NRA 2009[75] and CIEEM 2019[87])

1. Pre-application advice from statutory and non-statutory consultees (where received), fully addressed.
2. Scope, structure, and content of EcIA is in accordance with published good practice.
3. All ecologists and surveyors hold appropriate licences (where relevant) and/or have necessary competencies to carry out work undertaken.
4. Desk study included, and up-to-date, to collate all background and published information on biodiversity within the study area.
5. Multidisciplinary survey(s) (habitats, mammal and bird survey) of ecological sites and features are adequate and up-to-date. The dates of these survey(s) should be specified.
6. Specialist surveys are adequate and up-to-date: particularly of bird usage and flight patterns (if required), protected and invasive species, and high value habitats.
7. Biological assessment included of watercourses crossed by the project (where appropriate).
8. Limitations to surveys correctly identified (including, for example, refusal of landowners to grant access for surveys), and implications explained. Limitations to include technical difficulty or a matter that affected the availability of data. Any deviations from good practice methods or guidelines identified and justified.
9. Potential impacts assessed on a site basis (ecological sites).
10. Potential impacts assessed based on clearly defined proposals, for construction (including temporary works such as access and storage), operation, maintenance/upgrading and decommissioning (Where relevant).
11. Potential impacts before mitigation listed [noting considerations around mitigation and AA; see Section 6.2.6. of these Guidelines].

12. Site-specific mitigation measures identified follow the mitigation hierarchy, and mitigation implementation clearly described.
13. Residual impacts after mitigation listed (including cumulative effects, based on a worst-case scenario) , and geographic scale of residual impact significance clearly stated.
14. Post-construction monitoring proposals clearly identified as necessary, to include adaptive management triggers (as required). Frequency of reporting and statutory and/or non-statutory recipients for monitoring reports clearly identified.
15. Overview map of the route corridor or site included, in addition to detailed mapping (as appropriate) showing principal habitats and species impacted.
16. Final report prepared in line with best practice guidance. Justifiable conclusions presented, based on sound professional judgement. Significance of effects stated on designated sites, protected species, and high value ecological habitats, including justified scale of significance of such effects.

6.6. Step 6: Construction, Energisation and Benefit Sharing

EirGrid Group design and develop the electricity transmission grid but ESB Networks construct new grid infrastructure and maintain existing infrastructure in their role as Transmission Asset Owner. The construction stage can take between 6 to 36 months depending on the scale/complexity of a project.

Conditions, planning conditions and legal agreements (including Environmental Compliance Agreements required as part of those planning permissions) are often imposed to secure and enforce the implementation of mitigation, compensation and enhancement measures outlined in an EIAR/EcIA report. These obligations can be enforced by the relevant planning authority (CIEEM, 2018[3]).

In accordance with established good practice, site specific pre-construction ecological (and other environmental) verification surveys (and baseline monitoring where required) must be carried out by appropriately qualified ecologists, prior to actual construction works being carried out. The specifications for such surveys and monitoring nature are outlined in the EIAR or PECR, AA reporting, and consent documentation.

Applications should be made to the competent authority for any derogation licences which may be required (e.g. for protected species surveys) prior to construction.

6.6.1. Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) can be a useful means of drawing together mitigation, compensation, enhancement, management and monitoring proposals, which have been assessed prior to development consent being granted (CIEEM, 2018[3]). Although not required under current legislation, the preparation of a CEMP is often required as a condition of planning and as best practice should be considered for all high voltage electricity transmission projects.

It serves as a practical link between the EIAR/PECR report and AA requirements and the implementation of mitigation measures by the contracted construction company. The CEMP should form part of the construction contract and there should be a requirement under the contract to report on the implementation of the CEMP during project construction. All parties should understand the actions they need to take during the implementation stages of a project. In this regard, it should be noted that EirGrid as TSO maintains an oversight role of compliance with mitigation measures through its Client Engineer function.

In preparing such a management plan, provisions of Circular Letter PD 2/07 and NPWS 1/07 Compliance Conditions in respect of Developments requiring - (1) Environmental Impact Assessment (EIA); or (2) having potential impacts on European sites should be considered. Specifically, the preparation of such a plan cannot be used to compensate for an inadequate EIAR or to develop mitigation measures not considered in the EIAR. It is also important to note that the CEMP may not introduce changes from the permitted project. Changes may invalidate assessments undertaken.

Separate environmental management plans may be required for a transmission project's 1) construction stage and 2) ongoing maintenance and operation stage. Important elements of these plans is informing and training project and construction personnel in the environmental management of the project, and the monitoring of quality control programmes to achieve the project goal (CIGRE, 1999[88]). So-called toolbox talks to construction staff, by ecological experts may be beneficial in this regard.

6.6.2. Ecological Monitoring

Monitoring is the taking of repeated observations or measurements to evaluate changes in condition and progress toward meeting a management objective (Elzinga *et al.* 2001[89]).

The type of parameters to be monitored shall be proportionate to the nature, location and size of the project and the significance of its effects on the environment.

Monitoring should be secured through a planning condition or obligation built into legal agreements, which the proponent must implement fully. Monitoring may be used to determine:

- Whether the mitigation measures have been implemented as agreed;
- The success/effectiveness of the mitigation measures;
- Early warning of proposed measures which are not proving effective; and
- How to remedy the situation should any of the implemented measures fail e.g. Due to lack of management.

It is vital that monitoring has clear indicators of success or failure, set against a suitable baseline. Monitoring needs to have clear aims and objectives to specifically determine the success of the measures, both in the short-term and longer-term (CIEEM, 2018[3]).

6.6.3. Ecological Clerk of Works or Project Ecologist

Depending on the scale of the project and sensitivity of the receiving environment, the pre-construction and construction phase of the project may require supervision and monitoring by a suitably qualified ecologist, who will be required to be fully appraised of all mitigation measures included in the EIAR or EcIA (typically within a PECR), AA reports (Screening and/or Natura Impact Statement) and the reasons why they are to be applied. This matter must be given active consideration for all large scale projects where there are ecological sensitivities. The presence of a suitably qualified ecologist is in many cases a vital element in ensuring that all mitigation, compensation and monitoring measures are fully and effectively implemented.

The supervising ecologist may be required to develop and advise upon site specific mitigation measures (e.g. silt control methodologies) and prepare and deliver environmental site induction and training to construction personnel, in liaison with the Resident Engineer. The supervising ecologist will also carry out supervision of works during the construction phase of the project, together with any preconstruction and construction phase ecological monitoring that may be required.

Where a project Ecologist or Ecological Clerk of Works (ECoW) has been this person should be involved from the start of construction process.

If monitoring indicates the mitigation approach specified in the planning documents is inadequate, the supervising ecologist may need to recommend a different approach (so-called adaptive management) to modify or supplement the mitigation proposed, In certain cases, where appropriate, works may need to be stopped, until appropriate mitigation is in place, and demonstrated to be functioning correctly.

6.7. Collection and Sharing of Ecological Data

Target 7.2 of the current NBAP requires Irish governmental departments and the NBDC to contribute data and information to European and international networks to support conservation research and policy.

To support the above policy and EirGrid's own biodiversity commitments under its Corporate Social Responsibility strategy, EirGrid advocates that Ecological Consultants working on transmission projects submit relevant ecological records (particularly rare and protected species) to the NBDC. Relevant permissions may be required from project applicants as appropriate. Information on data standards, and an Excel record template is available online (https://www.biodiversityireland.ie/national-standards/). Raptor nesting records should be submitted to the Irish Raptor Study Group (http://irsg.ie/), who can provide a record form in excel format. Non-breeding records of hen harrier or other raptor roost sites should be submitted to the Irish Hen Harrier Winter Survey (http://www.ihhws.ie/).

EirGrid welcomes records of confirmed or suspected bird strikes with transmission line infrastructure, to be submitted to info@EirGrid.com. The availability of bird strike data will allow EirGrid to continually review the evidence-base for negative interactions of birds with overhead lines, in conjunction with its international partners in the Renewables Grid Initiative, and the International Council on Large Electric Systems (CIGRE), and as part of EirGrid's ongoing SEA monitoring of environmental impacts from its projects.

6.8. Outcomes of Project Development Process

The stepped approach taken by EirGrid Group described herein clearly demonstrates a focus on EcIA as a key part of the project development process. This ensures that biodiversity influences decision-making at all stages of project development, from identification of technology options to meet a specific need, through construction, energisation, and into the operational phase. Information gathered from monitoring can subsequently be used to further improve future mitigation strategies.

This approach delivers a suite of benefits, as it can:

a. shape project development in accordance with an evidence based approach to ecology;

b. minimise potential ecological impact of grid development projects;

c. increase and improve engagement with prescribed bodies; and

d. offer opportunities to learn and innovate on an ongoing basis.

The implementation of the 6 step project development process will assist EirGrid Group in its commitment to complying with policy and legislation relating to ecology and biodiversity in Ireland. The incorporation of environmental (and ecological) assessment into the 6 step process also fulfils EirGrid's statutory duty to have due regard for the environment, and facilitates the development of projects in an environmentally sensitive manner whilst delivering the sustainable development of the transmission grid in Ireland.

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Glossary & Appendices

Glossary

Alternatives
Options that may have been considered during the conception of a project, these include alternative locations, alternative designs and alternative processes.

Appropriate Assessment
An assessment to determine whether a plan or project, alone or together with other plans and projects, is likely to have significant effect(s) on a European site(s). This is in view of best scientific knowledge and the conservation objectives of the site(s). see European sites.

Baseline Survey
A survey to establish the current state of environmental characteristics.

Biodiversity
'The variability among living organisms from all sources, including, inter alia, terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems.'

Bog Mat
Temporary ground mat used to provide access for tracked vehicles to areas with difficult ground conditions; typically made from timber, or other preformed matting such as aluminium or Ethylene Propylene Diene Monomer (EPDM) sheets.

Buffer Zone
A setback distance/exclusion area between an ecological feature and an item of infrastructure or works area.

Bund
Containment around an area where potential pollutants are used or stored, typically consisting of four walls and a base. For bunds to be effective, they must be of sufficient size to contain the volume of any likely leak and be impervious to pollutants.

Cable
See Underground Cable (UGC).

Circuit
The overhead line or underground cable linking two substations.

Commissioning
The activities occurring after the construction of a project that occur before it becomes fully operational. On large or complex projects, this can include extended periods of testing, certification and calibration, for instance.

Competent Authority (CA)
An organisation or individual who is responsible under statute for a particular matter such as determining an application for consent for a project, carrying out Appropriate Assessment or carrying out Environmental Impact Assessment. See Public Authority.

Corridor
The planned general area along which an electricity line or cable will be located. This is a broad region that EirGrid use to select a specific route.

Decommissioning
The final closing down, and putting into a state of safety of a development, project or process when it has come to the end of its useful life.

Derrick Pole
A derrick is a lifting device composed at minimum of one guyed mast which may be articulated over a load by adjusting its guys.

De-watering
Pumping of water from an excavation or trench.

Developer
The persons or organisations carrying or intending to carry out a project.

Development
A project involving works [including construction and/or demolition] or change of use of an area or site.

Displacement
Geographic changes in local distribution or occurrence of a species arising from disturbance or barrier effects.

Distribution Network
This is the lower voltage network (10 kV, 20 kV, 38 kV), owned and operated in Ireland by ESB Networks. It delivers power from the transmission network to households and businesses.

Ecological Impact Assessment
Non-statutory process of defining, quantifying and evaluating the potential impacts of defined actions on ecosystems or their components.

Ecology
The study of the relationships between living organisms and between organisms and their environment (especially animal and plant communities), their energy flows and their interactions with their surroundings.

Ecosystem
An interacting community of independent organisms and the environment they inhabit.

Effect
A change resulting from the implementation of a project.

Environmental Impact Assessment – EIA
The process of examining the anticipated environmental effects of proposed project.

Environmental Impact Assessment Report – EIAR
A report or statement of the effects, if any, which the proposed project, if carried out, would have on the environment. This was previously known as an Environmental Impact Statement in the Republic of Ireland.

European site
See Natura 2000 site.

Fauna
A collective term for all kinds of animals.

Flora
A collective term for all kinds of plants; including both higher or vascular plants (including flowering plants) and lower plants (including mosses, liverworts, and lichens).

Flume
Piping installation by which surface water may be temporarily re-directed around a works area without the requirement for over-pumping.

Grid infrastructure
The physical structures which make up the transmission grid. These include the cables and lines used to transmit electricity, the pylons that hold the lines, and the substations used to convert the electrical current and raise or lower the voltage of that current.

Grid (or National Grid)
See Transmission Network.

Habitat
'A habitat is described as the area in which an organism or group of organisms lives, and is defined by the living (biotic) and non-living (abiotic) components of the environment. The latter includes physical, chemical and geographical factors, in addition to human impact or management.'

Horizontal Directional Drilling (HDD)
A trenchless technology utilised to minimise disturbance to physical obstacles such as rivers or roads during the laying of underground ducts.

Impact
Change resulting from the implementation of a project.

Infrastructure
This refers to the structures and facilities of a region or country, such as buildings, roads, bridges and the electrical grid (see also Grid infrastructure).

Interconnector
A high voltage transmission line connecting the national electricity networks of two countries.

Invasive Alien Species
Animals and plants that are introduced accidentally or deliberately into a natural environment where they are not normally found, with serious negative consequences for their new environment.

Joint Bay
Underground concrete structures which encase cable joints occurring generally every 500–700 m along a cable route.

Kilovolt (kV)
Operating voltage of electricity transmission equipment. One kilovolt is equal to one thousand volts. The highest voltage on the Irish transmission system is 400 kV.

Land-use
The human activities which take place within a given area of space.

Likely Effects (or Likely Impacts)
The effects that are specifically predicted to take place - based on an understanding of the interaction of the proposed project and the receiving environment. (See also Potential Effects and Residual Effects.)

Local Sites for Nature Conservation
'Non-statutory' sites of nature conservation value that have been identified 'locally' (i.e. excluding SACs, SPAs, ASSIs, NHAs and Ramsar sites). Local Nature Reserves are included as they are a designation made by the Local Authority rather than statutory conservation agencies. These may be called Wildlife Sites, Local Nature Conservation Sites, or Biodiversity Areas.

Methodology
The specific approach or techniques used to analyse impacts or describe environments.

Mitigation Measures
Measures designed to avoid, reduce, remedy or offset impacts. Measures intended to avoid or reduce harmful effects on European sites cannot be relied upon in Appropriate Assessment Screening.

Monitoring
The observation, measurement and evaluation of environmental data to follow changes over a period of time, to assess the efficiency of control measures. This is typically a repetitive and continued process carried out during construction, operation or decommissioning of a project. The purpose of monitoring is to determine if adaptive management is needed, whereby mitigation measures or amended to ensure mitigation success (e.g. in response in unforeseen weather or other factors)

European sites (Natura 2000 Sites)
European sites (formerly "Natura 2000 sites") are protected for flora and fauna of European importance. They comprise SACs, designated under the Habitats Directive and SPAs, designated under the Birds Directive. Candidate SACs (cSACs) have the same protection as SACs until they are formally designated. There are no candidate or proposed SPAs in Ireland.

Line
Short for Overhead Line; an overhead circuit.

Natura Impact Statement/Report (NIS/NIR)
A statutory term to describe the report which determines the adverse effect(s), if any, of a plan (typically reported in a NIR) or project (always reported in a NIS) on a European site (s), and other information required to enable a competent authority to carry out an Appropriate Assessment.

Natura 2000 Site
See European site.

Nature Conservation Site
Area of high ecological value that has been legally protected for conservation, these comprise European sites (SACs and SPAs) and nationally protected sites (NHAs, pNHAs, and Nature Reserves).

NGO
Non-Governmental Organisation.

NHA (Natural Heritage Area)
An area designated under the Irish Wildlife Act 1976 and Wildlife (Amendment) Act 2000 which is considered important for the habitats present or which holds species of plants and animals whose habitat needs protection. Proposed NHAs (pNHAs) have not been statutorily proposed or designated, but are recognised by Planning and Licensing Authorities, and subject to other limited protections

No Net Loss
Concept wherein losses resulting from human activities must be balanced by gains. When gains are at least equivalent to the losses, the principle of "No Net Loss" is respected.

Operator
Under the terms of the Environmental Liability Directive, any natural or legal, private or public person who operates or controls the occupational activity or, where this is provided for in national legislation, to whom decisive economic power over the technical functioning of such an activity has been delegated, including the holder of a permit or authorisation for such an activity or the person registering or notifying such an activity.

Pathway
The route by which an effect is conveyed between a source and a receptor.

Pole set
110 kV transmission infrastructure consisting of two wooden poles connected near the top with a rolled steel channel (crossarm).

Precautionary Principle
The principle that the absence of complete information should not preclude action to mitigate the risk of significant harm to the environment. In a case where information is incomplete, then the assessment should assume that impacts will occur.

Priority Habitat (EU)
A sub-set of Habitats Directive Annex I habitat types which are considered to be particularly vulnerable and are mainly, or exclusively, found within the European Union. There are no Habitats Directive Annex II Priority species in Ireland.

Public Authority
Term under the EC (Bird and Natural Habitat Regulations) 2011-2015 for organisation or individual responsible for carrying out Appropriate Assessment Screening and/or AA, for exempted development projects, activities, or land-use plans not provided for under planning legislation. Compare Competent Authority, which is the comparable term for projects and plans provided for under planning legislation.

Raptor
Bird of prey that depends on other animal species for food.

Receptor
Any element in the environment which may be subject to impacts.

Residual Effect (or Residual Impact)
The effect/impact after mitigation.

Riparian
The edge of streams or rivers.

Route
The path that a line or cable takes as it moves across the landscape from its start to its end point.

SAC (Special Area of Conservation)
See European site.

Site Investigation
Works carried out in order to determine the engineering properties of soil and rock and how they will interact with a planned development or other associated activities.

Source
The activity or place from which an effect originates.

SPA (Special Protection Area)
See European site.

Span
Intervening distance between towers or pole sets along an overhead line.

Species Diversity
A measure of species richness and the relative abundance of species.

Stakeholder
A person, interest group or organisation that has an interest or concern in something.

Statutory Consultees
An organisation or authority stipulated by legislation to be notified by a Competent Authority, Public Authority, or developer in relation to a consent application(s).

Stays
Wires affixed to wooden sleepers; or pre-cast concrete blocks installed underground adjacent to polesets. Stays act as a support to a pole set, particularly in challenging ground conditions.

Substation
A set of electrical equipment used to interlink circuits and change the voltage being sent down a line or cable.

Surface Water
Natural water bodies such as streams, lakes and rivers; and artificial features, such as ditches, canals and impoundments which are visible on the surface of the earth.

Tower
Lattice Steel structure which support the conductor.

Transmission network
A high-voltage network operating at 400 kV, 220 kV and 110 kV in the Republic of Ireland. The high-voltage allows delivery of bulk power over long distances with minimal power loss.

Transmission Network or Grid
This is the network of around 6,800 km of high-voltage power lines, cables and substations across the Republic of Ireland. It links generators of electricity to the distribution network and supplies large demand customers. In the Republic of Ireland it is operated by EirGrid.

Underground Cable (UGC)
Insulated conductor specifically designed for installation in a trench.

Voltage
Voltage is a measure of the potential strength of the flow of electricity – similar to 'pressure' in a water system. Voltage is the measure of electrical charge or potential between two points (in an electrical field) such as between the positive and negative ends of a battery. The greater the voltage, the greater the potential flow of electrical current.

Zone of Influence
The area(s) over which ecological features may be affected by the biophysical changes caused by the proposed project and associated activities.

Appendices

Appendix 1: Criteria for Valuation and Impact Significance

The Draft EPA *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (2017) presents criteria for assessing impact significance.

The likely significant effects of projects on the environment must be considered in relation to a set of criteria identified in the Directive. To ensure sufficient information has been provided in this regard, the Environmental Impact Assessment Report (EIAR) should aim to answer the types of questions included in the right-hand column in relation to each of the criteria.

Criteria	Detailed Questions: Determine whether EIAR has:
a. Magnitude and spatial extent of the effects	• Clarified the size and scale of the effects? • Indicated the spatial extent of the effects (will some, much or all the areas be affected)? • Identified the receptors which will be affected, indicating their sensitivity and significance?
b. Nature of the effects	• Clarified which part of the environment will be affected and how significantly? • Identified the aspect of the environment affected? • Described whether the effect is positive, neutral or negative?
c. Transboundary nature of the effects	• Indicated the spatial extent of the transboundary effects (will some, much or all of the jurisdiction be affected)?
d. Intensity and complexity of the effects	• Quantified the amount or intensity by which the character/quality of any environmental factor will change? • Described the degree of change; (i.e. Imperceptible, slight or significant)? • Identified the significance of the effect [profound or insignificant]
e. Probability of the effects	• Established the level of certainty of the assessment's findings? • Highlighted consequence that cannot be determined?
f. Expected onset, duration, frequency and reversibility of the effects	• Stated whether the effects will be continuous, intermittent or occasional? • Indicated whether the effects will be temporary, short, medium or long-term? • Highlighted irreversible effects?
g. Cumulation of the effects with the effects of other existing and/or approved projects	• Described cumulative effects? • Considered cumulative effects due to cumulation of effects with those of other projects that are existing or are approved but not yet built or operational?
h. Possibility of effectively reducing the effects	• Indicated whether the effects can be mitigated? • Stated whether compensation is available, possible or acceptable?

NRA Examples of Ecological Valuation at different geographical scales (NRA, 2009)

International Importance	• 'European site' including Special Area of Conservation (SAC), Site of Community Importance • (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation. • Proposed Special Protection Area (pSPA). • Site fulfilling criteria for designation as a 'European site' (see Annex III of the Habitats Directive, as amended). • Features essential to maintaining the coherence of the Natura 2000 Network. • Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. • Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or Species of animal and plants listed in Annex II and/or IV of the Habitats Directive. • Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971). • World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972). • Biosphere Reserve (UNESCO Man & The Biosphere Programme). • Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979). • Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979). • Biogenetic Reserve under the Council of Europe. • European Diploma Site under the Council of Europe. • Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).
National Importance	• Site designated or proposed as a Natural Heritage Area (NHA). • Statutory Nature Reserve. • Refuge for Fauna and Flora protected under the Wildlife Acts. • National Park. • Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park. • Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. • Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Direct.
County Importance	• Area of Special Amenity. • Area subject to a Tree Preservation Order. • Area of High Amenity, or equivalent, designated under the County Development Plan. • Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. • Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. • County important populations of species or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP, if this has been prepared.

NRA Examples of Ecological Valuation at different geographical scales (NRA, 2009)

County Importance	• Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. • Sites containing habitats/species rare or undergoing a decline in quality or extent at a national level.
Local Importance (higher value)	• Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared; • Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. • Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; • Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance	• Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; • Sites or features containing non-native species that are of some importance in maintaining habitat links.

Appendix 2: Sources of Biodiversity Information

The following sources of information and data may assist in the EcIA process. However, it should not be considered an exhaustive resource and practitioners should ensure that all relevant and up-to-date data and evidence has been considered as part of any impact assessment.

Feature	Description	Hyperlink
EU Protected Habitats & Species *See also Habitat and Species Datasets*	Habitats protected under the Habitats Directive (Article 17 reporting – NPWS).	www.npws.ie/article-17-reports-0
	Species protected under the Habitats Directive (Article 17 reporting – NPWS).	www.npws.ie/article-17-reports-0
	Species protected under the Birds Directive (Article 12 reporting – NPWS).	www.npws.ie/status-and-trends-ireland%E2%80%99s-bird-species-%E2%80%93-article-12-reporting
Protected & Rare Species *See also Habitat and Species Datasets*	Species protected under the Wildlife Act 1976 (as amended).	www.npws.ie/legislation/irish-law/wildlife-act-1976 www.irishstatutebook.ie/eli/1976/act/39/enacted/en/print *Note: The Law Reform Commission produces pdf Revised Acts incorporating all known legislative revisions up to a stated date.* https://revisedacts.lawreform.ie/eli/1976/act/39/front/revised/en/html
	Species protected under the Flora (Protection) Order, 2015.	www.irishstatutebook.ie/eli/2015/si/356/made/en/print
Red Lists	IUCN Red Lists prioritise species for conservation purposes at a global scale. NPWS produces irregular regional Red Lists for the island of Ireland.	www.npws.ie/publications/red-lists
Birds of Conservation Concern (BoCCI)	BirdWatch Ireland produces lists of Birds of Conservation Concern (BoCCI) in Ireland very five years. Birds on the Red List birds are those of highest conservation concern, Amber List birds are of medium conservation concern.	www.birdwatchireland.ie/Ourwork/SurveysProjects/BirdsofConservationConcern/tabid/178/Default.aspx
Threat Response Plans	Threat Response Plans are prepared in response to the requirement to establish a system of strict protection for species listed in Annex IV of the Habitats Directive.	www.npws.ie/publications/species-action-plans
Irish Wildlife Manuals	A series of contract reports and guidelines relating to the conservation management of habitats and species in Ireland.	www.npws.ie/publications/irish-wildlife-manuals

Feature	Description	Hyperlink
Nature Conservation Sites	Online map viewer (including some species data)	http://webgis.npws.ie/npwsviewer/
	Boundary data downloads	www.npws.ie/maps-and-data/designated-site-data
	Site synopses, conservation objectives and backing documents	www.npws.ie/protected-sites
Habitat and Species Datasets	National species mapping	www.npws.ie/maps-and-data/habitat-and-species-data
	National habitat mapping	www.npws.ie/maps-and-data/habitat-and-species-data
	Data requests to NPWS (Sensitive data access)	www.npws.ie/maps-and-data/sensitive-data-access
	National Biodiversity Data Centre (NBDC)	www.biodiversityireland.ie
Water quality	EPA Geoportal	http://gis.epa.ie/Envision
	EPA Water Quality dataset downloads	http://gis.epa.ie/GetData/Download
Fisheries	Inland Fisheries Ireland (IFI) lake and river survey reports	www.inlandfisheries.ie & www.wfdfish.ie
Birds	Irish Wetland Bird (IWeBS) Survey site summaries & trends	www.birdwatchireland.ie/?tabid=111
	Data requests to Birdwatch Ireland	www.surveymonkey.com/s/3KVQWZ9
	BTO Bird Atlas	https://app.bto.org/mapstore/StoreServlet
Soils and subsoils	Geological Survey Ireland (GSI) online map viewer	www.gsi.ie/Mapping.htm
Mapping & Aerial Imagery	Ordnance Survey Ireland (OSI) Geohive online mapping portal (also delivers numerous environmental datasets as presented above)	www.geohive.ie/
	Myplan.ie (Initiative of Department of Housing, Planning, Community and Local Government/Local Authorities).	http://myplan.ie/index.html
Red Lists	IUCN Red Lists prioritise species for conservation purposes at a global scale. NPWS and NIEA produce irregular regional Red Lists for the island of Ireland.	www.npws.ie/publications/red-lists
Birds of Conservation Concern (BoCCI)	BirdWatch Ireland and the RSPB NI have produced a list of Birds of Conservation Concern (BoCCI) in Ireland. Birds on the Red List birds are those of highest conservation concern, Amber List birds are of medium conservation concern.	www.birdwatchireland.ie/Ourwork/SurveysProjects/BirdsofConservationConcern/tabid/178/Default.aspx

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