UWF Grid Connection EIA Report (2019)

Volume C2: EIAR Main Report

Chapter 4: Alternatives Considered

ECOPOWER

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Glossary of Terms

Term	Definition
Consented Windfarm	Upperchurch Windfarm – 22 wind turbines, substation, windfarm roads and ancillary works, consented in August 2014 under Planning Reference: Tipperary County Council 13/51/0003, ABP PL 22.243040
Element	One of the 5 No. elements listed in 'Whole UWF Project' below.
Grid Connection Offer	Offer from the System Operator to connect a generator plant to the national electricity grid, by a specified method.
Sensitive Aspect	Any sensitive receptor in the local environment which could be impacted by the project.
Switchgear	The combination of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment.
System Operator SO	Operators of the national electricity grid – Eirgrid (TSO Transmission System Operator) or ESB Networks (DSO Distribution System Operator)
Whole UWF Project	Whole project made up of 5 No. elements – Element 1: UWF Grid Connection; Element 2: UWF Related Works, Element 3: UWF Replacement Forestry, Element 4: Upperchurch Windfarm and Element 5: UWF Other Activities.

List of Abbreviations

Abbreviation	Full Term
AIS	Air Insulated Switchgear
CER	Commission for Energy Regulation (now CRU – Commission for the Regulation of Utilities)
DSO	Distribution System Operator – ESB Networks, operator of distribution system to end customer
EDL	Ecopower Developments Limited
GIS	Gas Insulated Switchgear
Node	Electricity System grid connection point
OHL	Overhead Line
SAC	Special Area of Conservation
SO	System Operator, operator of the electricity system
SPA	Special Protection Area (for wild birds)
TSO	Transmission System Operator – Eirgrid, operator of the transmission system between generator plants
UWF	Upperchurch Windfarm
UGC	Underground Cables

Executive Summary

This Consideration of Alternatives chapter examines the alternatives for **Grid Connection Node Location; Grid Connection Technology (Overhead Line v Underground Cable); Alternative Public Road Routes for the Underground Cable; Alternative locations for Mountphilips Substation; Alternative Processes** and the **'Do-Nothing' Alternative**.

Grid Connection Locations

The sustainable and efficient use of the national grid infrastructure underpins the Eirgrid/ESBN Group Processing Approach which was implemented in the 'Gates' Grid Connection process. The assignment of connection points for new renewable electricity generation to the national grid requires in-depth planning and technical investigations to identify the optimum connection point for each Group where the reliability and safety of the grid would be maintained.

Limerick City is the nearest 'load centre' (electricity user) with the capability to use the large amount of electricity generation from Upperchurch Windfarm and it is technically practical, efficient and sustainable to connect a large generator to the national grid at a location on the network close to a suitably large load centre, without undermining the stability and safety of the grid. The Killonan Station is located 5km to the southeast of Limerick City centre, and is one of the main transmission system stations in the country. The Killonan Station forms the main bulk supply point for the Mid-West region – power is distributed through the Killonan Station using numerous regional networks at all voltages (110kV, 38kV and 20kV). One of these regional networks is the Killonan to Nenagh 110kV OHL, which is c.41km long, originating in the Killonan 220kV Station and ending in the Nenagh 110kV/38kV Substation. The Killonan – Nenagh 110kV OHL is one of the main electricity supplies into Nenagh town. Unlike the Killonan Station, the Killonan – Nenagh 110kV OHL has capacity to take the substantial amount of electricity which will be generated by Upperchurch Windfarm. This is why a connection at a new node on the Killonan to Nenagh 110kV line was allocated to Upperchurch Windfarm under Gate 3 in the first place.

There are strict criteria for applying for a modification to the allocated grid connection node. A Modification Request to change the connection node on the national grid, from the one allocated for Upperchurch Windfarm under it's Gate 3 Grid Connection Agreement, would not be considered acceptable by the System Operator because there is not enough available electrical capacity at other 110kV stations (i.e. Nenagh, Thurles, Tipperary and Cauteen Stations) in the region to accept the large amount of electricity that Upperchurch Windfarm will generate. The Killonan Station does not have the capacity to take this volume of electricity without requiring major station works, including extension works. The location of the grid connection point has been planned in the context of the available capacity on an overhead line (i.e. Killonan – Nenagh 110kV OHL) which connects to the main bulk supply point for the Mid-West Region – i.e. Killonan Station, which is located beside a suitably large load centre, (i.e Limerick City) to accept the large electricity generation capacity of Upperchurch Windfarm. The connection will be via a new looped in substation beside the overhead line at Mountphilips. This new substation will increase the Limerick/Tipperary transmission system security, increase the Killonan-Nenagh 110kV OHL stability and improve the system circuits Control and Protection.

Therefore, having examined alternative connection nodes (locations) for connecting Upperchurch Windfarm to the national grid, there was no other technically feasible alternative to the connection point prescribed in the ESBN Grid Connection Agreement (a new node to be built at Mountphilips along the Limerick to Nenagh 110kV line), and the prescribed connection node was considered to be the optimum location for connection to the national grid.

Grid Connection Technology (OHL v UGC)

Of the 2 no. alternative technologies – Overhead Line (OHL) and Underground Cable (UCG), neither technology was considered likely to cause significant effects. Overhead Line technology will have minimal effect on Public Roads or Road Users, but because of the technical requirements of Overhead Line technology, the OHL would need to be routed through the open countryside, which places construction works within natural habitats and close to watercourses. Moderate negative effects could occur to Biodiversity and Water receptors as a result. Because of its above ground characteristics, moderate negative effects to Landscape could also occur in this rural setting.

On the other hand, although Underground Cable technology will have negative Slight to Moderate effects on Road Users or to Public Roads; it is because of its location on public roads, that effects to natural habitats are avoided, and effects to animal species and watercourses are minimised.

When the emphasis is placed on the natural environment the use of underground technology (in public roads) is a better alternative than Overhead Line technology and therefore the underground cable alternative was chosen for the grid connection technology to the connection Node prescribed in the Upperchurch Windfarm Grid Connection Agreement.

Alternative locations and designs for the Mountphilips Substation

3 no. alternatives were considered for Mountphilips Substation – Gas Insulated Switchgear (GIS) substation on the western side of the OHL, GIS substation on the eastern side of the OHL or Air Insulated Switchgear (AIS) substation on the eastern side of the OHL. GIS on the western side of the OHL is likely to cause significant effects due to the requirement for outages of the Killonan to Nenagh 110kV OHL for a period of c.6months, while the OHL is not the only source of electricity into Nenagh town and surroundings, it is the main source, and an outage of this length presents a serious risk of electricity supply interruption in the Nenagh area, and is not considered to be acceptable.

While neither design at Site B is likely to cause significant effects, when the emphasis is placed on the natural environment it was considered that 'AIS at Site B' had least potential to cause significant effects to the natural environment due to the much smaller size of buildings within the substation and the shallow depth of excavations, and therefore 'AIS at Site B' was chosen for the location and design of the Mountphilips Substation.

Alternative Public Road Routes for the UGC

Three routes were considered; (1) Local Road through Toor, (2) R503 (through Newport), and (3) R503 (avoiding Newport).

In relation to effects to hen harrier, the 'Local Road through Toor' option is routed along very lightly trafficked local roads through a sparsely populated area, whereas the 'R503' routes are on busier roads through more densely populated areas. The baseline environment along the 'Local Road through Toor' route is considered to be a quiet rural area and it is considered that construction works will present a noticeable contrast to these quiet baseline conditions and therefore there is greater potential to disturb or displace hen harrier. On the R503 routes, by comparison, there are much higher volumes of traffic, much higher number of houses and development and a generally higher level of baseline activity and noise from the vicinity of the regional road and the local roads around Newport town.

In relation to the Lower River Shannon SAC, the Local Road through Toor is routed in close proximity to the SAC, which increases the potential for effects. The R503 routes on the other hand, are at least 1km from the SAC at the majority of works locations.

When the effects on Public Roads and Road Users is taken into account, 'Local Road through Toor' option will have low levels of effects mainly due to the very low number of road users and population in this area; when the two R503 options are considered, the 'R503 (avoiding Newport)'route is preferable to the 'R503 (through Newport)' route because of the ability to avoid traffic delays and road works in the town, and avoid affecting the Tipperary County Council planned pavement works in Newport Town which are scheduled for 2019.

Of the 3 no. alternative routes for the Underground Cable, none of the routes was considered likely to cause significant effects. When the emphasis is placed on biodiversity matters in this particular examination (the 3 No. alternative public road routes), either of the 'R503 routes' are preferable to the 'Local Road route through Toor' route, when the Hen Harrier species and the Lower River Shannon SAC is considered. When the effects on Material Assets are also taken into account, the R503 (avoiding Newport Town) is the best alternative. Therefore the **R503 (avoiding Newport Town) route alternative was chosen for the UGC route** to the connection Node prescribed in the Upperchurch Windfarm Grid Connection Agreement.

Alternative Processes

An examination of the processes associated with the project, by the Design and EIAR evaluation teams, resulted in alternative processes being devised to avoid, prevent or reduce environmental effects. These alternative processes are an intrinsic part of the design of the UWF Grid Connection project. These included the scheduling of construction works in Knocknabansha, Knockmaroe, Knockcurraghbola Crownlands and Knockcurraghbola Commons townlands; the sequencing of watercourse crossing works, earthworks, dewatering and excavation dewatering within 50m of a watercourse; the scheduling of construction works along the 110kV UGC to occur outside of the hen harrier breeding season; and the design of security lighting and restriction of construction works to daylight hours to minimise effects to bats.

The 'Do Nothing' Alternative

The very high impact of Climate Change to biodiversity and to our human wellbeing, is reflected in the Irish Oireachtas declaring a climate and biodiversity emergency on the 9th May 2019.

The most significant impact of UWF Grid Connection not being developed is the secondary impact of Upperchurch Windfarm not being developed; this would be a **significant lost opportunity to contribute to Ireland's action on Climate Change remediation.**

In the 'do-nothing' alternative, **not developing the Upperchurch Windfarm project means that** there will be a consequential loss of the carbon offset potential and **the emission of 106,216 tonnes of greenhouse gases every year from the generation of electricity by fossil fuel plant would not be avoided**.

4 Alternatives Considered

4.1 Introduction

The consideration of alternatives is a requirement of Annex IV (2) of the EIA Directive[1] where it states;

"A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of environmental effects the."

In this Chapter 4, a description of the reasonable alternative locations, technologies and processes which were considered, is presented.

4.1.1 Background to Upperchurch Windfarms grid connection Offer

Upperchurch Windfarm was granted a Grid Connection Offer from ESB Networks that allows the windfarm to connect and export electricity, to the National Grid. This Grid Connection Offer prescribed ESB Network's approved connection method to the national electricity grid for Upperchurch Windfarm per;

1. A new 110kV substation node at a point along the Killonan to Nenagh 110kV overhead line, in the Freagh[2] area, near Newport, County Tipperary.
2. An underground cable c.30km in length routed eastwards linking this new substation node back to the Windfarm Substation (already consented) at Upperchurch Windfarm.

4.1.2 Alternative to the First UWF Grid Connection Application

This is the second Application (2019 Application) to An Bord Pleanála for planning permission for the UWF Grid Connection works, designed in accordance with the grid connection requirements as prescribed by ESB Networks, in the Upperchurch Grid Connection Offer.

The Grid Connection Offer stipulated that Upperchurch Windfarm connects by 110kV underground cable (110kV UGC), to a new substation node to be built under the existing Killonan to Nenagh 110kV line. This new substation node will be constructed in Mountphilips townland. The route of the 110kV UGC is not specified. In the first 2018 UWF Grid Connection Application, Ecopower proposed a route for the 110kV UGC from the proposed new substation at Mountphilips to the windfarm substation that was a predominately cross country route along farm and forestry roads, and across farm and forestry lands. The 2018 Application was refused by An Bord Pleanála (the Board), in December 2018. In the Reasoned Conclusion of the Board Order it states;

[1] EIA Directive 2011/92/EU as amended by Directive 2014/52/EU

[2] The 110kV overhead line does not exist in Freagh townland, the closest townland to Freagh through which the 110kV overhead passes through is Mountphilips townland, which is to the west of Freagh townland. The location of the new node is described as Mountphilips in this EIAR.

The Board is not satisfied that sufficient consideration has been provided regarding the routing of the cable in the local road network or consideration of alternative grid connection technologies such as overhead line alternatives. Furthermore, no information has been provided in relation to alternative connection locations where the windfarm could potentially connect to the national electricity grid.

Therefore, this Consideration of Alternatives includes an examination of alternative grid connection locations, alternative grid connection technologies, and alternative routes to the national grid - Section 4.2, 4.3 & 4.5 respectively.

The examination takes into account comments and conclusions in the Board's Order and the Inspector's Report on the 2018 UWF Grid Connection Application (ABP-301959-18). The Inspectors Report is available at http://www.pleanala.ie/casenum/301959.htm

4.2 Alternative Grid Connection Location for Upperchurch Windfarm

This Section 4.2 sets out the all-island electricity system context and legislative context for any change that might be proposed to the grid connection location/node as set out in the Grid Connection Offer (a new node to be built at Mountphilips) that has been secured for Upperchurch Windfarm, from ESB Networks. Alternative grid connection nodes for Upperchurch Windfarm, in the general area, are also examined.

4.2.1 Gate 3 Grid Connection Offers

Prior to the Enduring Connection Policy (ECP) system, which allocates grid connection offers to prospective generators, being adopted by Eirgrid and ESB Networks in 2018, all renewable generator grid connections were processed in a 'Gate' system wherein all applications to connect to the electricity grid, that have met defined criteria, were processed in tranches (Gate 1, Gate 2 & Gate 3) by the relevant electricity network System Operator. Ecopower received a Gate 3 Grid Connection Offer from ESB Networks for Upperchurch Windfarm (Gate 3 Ref. DG96) and has accepted this Offer and secured a Grid Connection Agreement with ESB Networks.

The feasibility or viability of an alternative to the node identified in the Grid Connection Agreement would need to be verified in the context of Higher Level Plans produced in collaboration, by the national electricity System Operators, the Regulator of Utilities (all-island) and government legislation. These Higher Level Plans are explained in the following sections 4.2.2. & 4.2.3.

The following acronyms are used in this Section 4.2:

RES-E	Renewable Energy Sources - of Electricity
CER	Commission for Energy Regulation (now CRU – Commission for the Regulation of Utilities)
SO	System Operator, operator of the electricity system
TSO	Transmission System Operator – Eirgrid, operator of the transmission system between generator plants
DSO	Distribution System Operator – ESB Networks, operator of distribution system to end customer
Node	Grid Connection Point

4.2.2 General - RES-E on the Irish Electricity Grid

The EU 2001 RES-E Directive on the promotion of Electricity Generation from Renewable Energy Sources[3] in the internal EU electricity market states the following

Without prejudice to the maintenance of the reliability and safety of the grid, Member States will take the necessary measures to ensure that the transmission system operators and distribution system operators in their territory guarantee the transmission and distribution of electricity produced from renewable sources

This means that grid access must put in place measures to facilitate grid access for renewable sources of electricity while at the same time maintaining the reliability and safety of the grid.

The distribution and trading of electricity in Ireland is a 'Whole Island' system. In order to commence implementation of the RES-E Directive, the Utility Regulators - CER (Rep. of Ireland) and the Office for the

[3] RES-E Directive 2001/77/EC https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32001L0077

Regulation of Electricity and Gas (N. Ireland) commissioned a study to explore the effects of increasing levels of wind energy generation on the combined electricity systems of the whole island and this study was completed in 2003.[4] This was followed by further studies by the Utility Regulators and the electricity System Operators on the technical aspects of large amounts of wind generation on the grid; on granting grid connections for this generation and on the requirements for a new Wind Grid Code for these new grid generators accessing and operating on the grid.

In 2004, the TSO/Eirgrid and the DSO/ESBN published their proposal for a Group Processing Approach (GPA) for Renewable Energy Grid Connections – the Connection Offer Policy and Process Paper (COPP)[5]. This involved dividing renewable energy grid connection applications into Groups based on geographical areas. The TSO and DSO then carried out technical studies to identify the optimum connection point for each Group where the reliability and safety of the grid would be maintained. Both System Operators (Eirgrid and ESBN) then identified the connection method for each grid application within the Group/Sub-Group. The System Operators then issued grid connection offers in batches, for individual Nodes. Gate 1 offers to renewable projects commenced in December 2004. These were followed by Gate 2 and Gate 3 offers in the following years, all under the legal framework of various CER Directives.

In 2008, Eirgrid published it's long term grid development strategy, GRID25[6]. This strategy was based on a robust and stringent analysis of the long term needs of electricity users nationwide and includes solutions to deliver high quality, secure and economic power supplies in line with best international practice. The Gate 3 grid connection process (comprising wind energy generated electricity only) commenced in December 2008.

4.2.3 General - Modifications to a Gate 3 Grid Connection Agreement

It is anticipated in the Eirgrid/ESBN's Connection Offer Policy and Process Paper (COPP) that on occasion alternatives to the grid connection method, to that offered by the System Operator in the Grid Connection Offer, may be requested by the Gate 3 Connection Offer client.

It states in the COPP that the System Operator is open to accommodating Modifications to the Grid Connection Agreement, where feasible and within certain strict criteria. Any modification must meet the criteria set out in 'Clause 18.2: Ruleset of COPP' per;

- *It is technically feasible and there are no negative significant system, planning or environmental implications associated with the proposed connection method;*
- *It is in line with the general principles of the Group Processing Approach;*
- *Where the change impacts on shared assets any costs impact shall be to the account of the party requesting the change;*

[4] The Impacts of Increased Levels of Wind Penetration on the Irish Electricity Systems https://www.cru.ie/document_group/cer-ofreg-wind-study-report/

[5] Connection Offer Policy and Process Paper COPP (ESBN/Eirgrid May 2011) https://www.esbnetworks.ie/docs/default-source/publications/connection-offer-policy-and-process-paper.pdf?sfvrsn=a05c33f0_4

[6] Eirgrid GRID25 http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-GRID25.pdf

- *Where the change impacts on shared assets any impact other than cost – for example an impact on the timeline for delivery - must be agreed in writing by all projects affected;*
- *It is consistent with the long term development of the system including, but not limited to:*
- *Not adversely impacting upon the ability of the SOs to obtain necessary planning consents for other system developments in either the short or medium term.*
- *Not adversely affecting scarce station, or line routing capacity for potential future system development to the benefit of all customers.*
- *Not likely to lead to higher charges for existing or connecting customers which includes those within the Gate being processed at the time of the request.*
- *In the event that the change proposed might lead to a delay in connection of other projects, any projects affected must advise their agreement in writing*
- *Not likely to increase costs for the End User.*
- *Not resulting in a change of the designated connection point on the meshed transmission system originally chosen by the SO.*

A modification request to the System Operator to connect at an alternative grid connection Node than that set out in the Grid Connection Agreement will not be granted if it does not meet the strict criteria prescribed in Clause 18.2 (above) of the Eirgrid/ESBN's Connection Offer Policy and Process.

4.2.4 Upperchurch Windfarm in the Gate 3 Process

4.2.4.1 Allocated connection node for Upperchurch Windfarm

During the consideration of a Gate 3 Grid Connection allocation for Upperchurch Windfarm, Eirgrid and ESB Networks conducted detailed studies to determine a technically feasible connection method for the project whilst also considering wider network impacts, including the stability of the grid and the facilitation of other generators.

The grid connection capacity allocated under Gate 3 to Upperchurch Windfarm is an allocation of 94megawatts (MW) of wind generated electricity capacity assigned to Killonan Station. The Killonan Station does not have the existing capacity to take the substantial amount of electricity from Upperchurch Windfarm, without requiring major station works, including extension works. However, there is currently spare capacity on the Killonan to Nenagh 110kV Overhead Line. This capacity can be used for the electricity from Upperchurch Windfarm through the construction of a new looped in substation under the line.

The Killonan – Nenagh 110kV OHL is controlled and fed from the Killonan 220kV Station, which is located to the southeast of Limerick City. The Killonan Station is one of the main transmission system stations in the country with 3 No. 220kV lines feeding into the Station - from Tarbert, Knockraha and Shannonbridge power stations. This power is then distributed through the Killonan Station to the mid-west region using numerous regional networks at all voltages (110kV, 38kV and 20kV). One of these regional networks is the Killonan to Nenagh 110kV OHL, which is c.41km long, originating in the Killonan 220kV Station and ending in the Nenagh 110kV/38kV Substation. The Killonan – Nenagh 110kV OHL is one of the main electricity supplies into Nenagh town.

Killonan Station is located close to Limerick City, which is a major load centre (user of the electricity) on the network. Upperchurch Windfarm will produce a very substantial amount of electricity – c.220,000,000 Kwh/per annum and this electricity will be used to supply both Limerick City and County (and Nenagh Town and surrounding areas *(e.g.220,000,000 Kwh is enough electricity for 74% of the houses in Limerick City and County)*. From a technical, operational and sustainable use of the Transmission System perspective, the System Operator choose a grid connection point for a large high voltage generator near to a major load centre, this is the most sustainable solution.

As a result of in-depth system network investigations by Eirgrid and ESB Networks, the grid connection for Upperchurch Windfarm, is for the connection to be made at a new Node to be built under the Killonan to Nenagh 110kV overhead electricity line (OHL) by way of a new substation at Mountphilips. Also, from the System Operator's perspective, the addition of the new 110kV Mountphilips Looped station onto the National Grid will increase the Limerick/Tipperary transmission system security, increase the Killonan-Nenagh 110kV OHL stability and improve the system circuits Control and Protection.

4.2.4.2 Other Connection Nodes around Upperchurch Windfarm

In the Board Order refusing the 2018 UWF Grid Connection Application, the Board stated that no information had been provided in relation to alternative connection locations where the windfarm could potentially connect to the national electricity grid. Alternative connection locations (nodes) to the new node at Mountphilips, are examined in this section 4.2.4.2.

Because of the large size (capacity) of Upperchurch Windfarm, the electricity must be exported using the 110kV Transmission System. The applicant examined possible alternative connection nodes on the Eirgrid Transmission System, west, north, east and south of Upperchurch windfarm.

Killonan ESB Station ~32km west of Upperchurch Windfarm, Killonan Substation is one of the main transmission system stations in the country. The Killonan Station does not have the existing capacity to take the substantial amount of electricity from Upperchurch Windfarm, without requiring major station works, including extension works. In light of the above, a direct connection to the Killonan ESB Station was not a technically feasible viable alternative to the connection route and method proposed is this application.

Nenagh ESB Station ~30km north of Upperchurch Windfarm, Nenagh Station is connected to the Killonan Station Node by an 110kV overhead line. Nenagh is a 'tail fed' 110kV Station, not being connected to any other 110kV circuits. A Modification application, for Upperchurch Windfarm, to connect to the Nenagh Node would not be acceptable to the System Operators because Nenagh is a 'tail fed' Station and a connection of such capacity would trigger extensive 110kV network upgrade works, at Nenagh Station. There is an existing grid connection offer in place to connect Bunkimalta Windfarm at 38kV into the Nenagh node, which is possible because the electricity can be transported at the lower 38kV voltage for Bunkimalta Windfarm because the capacity of the project is substantially smaller (46MW) than Upperchurch Windfarm and there is adequate existing capacity at 38kV at Nenagh Station. There is limited capacity at 110kV at Nenagh Station, but not enough to cater for the substantial amount of electricity that will be generated at Upperchurch Windfarm. This is irrespective of whether Bunkimalta Windfarm is built, or not. In light of the above, a direct connection to the Nenagh ESB Station was not a technically feasible viable alternative to the connection route and method proposed is this application.

Thurles ESB Station ~20km to the east, does not have the technical capacity to accept the electricity from Upperchurch Windfarm. The capacity at Thurles Station has already been allocated to other (operating) windfarms i.e Lisheen Windfarm, Ballybay Windfarm, An Cnoc Windfarm and Foyle Windfarm. A Modification application, for Upperchurch Windfarm, to connect to Thurles Station would not be acceptable to the System Operators because there is no available capacity remaining at this station. In light of the above, a direct connection to the Thurles ESB Station was not a technically feasible viable alternative to the connection route and method proposed is this application.

Tipperary ESB Station ~34km to the south, does not have sufficient capacity to accept the electricity from Upperchurch Windfarm. The only wind generated capacity connected to Tipperary Station is 3MW from Slievereagh Windfarm (operating). A Modification application, for Upperchurch Windfarm, to connect to Tipperary Station would not be acceptable to the System Operators because of the limited capacity available at the Station. In light of the above, a direct connection to the Tipperary ESB Station was not a technically feasible viable alternative to the connection route and method proposed is this application.

Cauteen ESB Station ~25km to the south, does not have the sufficient remaining capacity to accept the electricity from Upperchurch Windfarm. The capacity at Cauteen Station has already been allocated to other large (operating) windfarms i.e Cappawhite Windfarm A & B, Garracummer Windfarm, Glenough Windfarm, Glencarbry Windfarm and Hollyford Windfarm. A Modification application, for Upperchurch Windfarm, to connect to Cauteen Station would not be acceptable to the System Operators, because there is not enough available capacity remaining. In light of the above, a direct connection to the Cauteen ESB Station was not a technically feasible viable alternative to the connection route and method proposed is this application.

4.2.5 Conclusion to Alternative Grid Connection Location for Upperchurch Windfarm

The sustainable and efficient use of the national grid infrastructure underpins the Eirgrid/ESBN Group Processing Approach which was implemented in the 'Gates' Grid Connection process. The assignment of connection points for new renewable electricity generation to the national grid requires in-depth planning and technical investigations to identify the optimum connection point for each Group where the reliability and safety of the grid would be maintained.

Limerick City is the nearest 'load centre' (electricity user) with the capability to use the large amount of electricity generation from Upperchurch Windfarm and it is technically practical, efficient and sustainable to connect a large generator to the national grid at a location on the network close to a suitably large load centre, without undermining the stability and safety of the grid. The Killonan Station is located 5km to the southeast of Limerick City centre, and is one of the main transmission system stations in the country. The Killonan Station forms the main bulk supply point for the Mid-West regional – power is distributed through the Killonan Station using numerous regional networks at all voltages (110kV, 38kV and 20kV). One of these regional networks is the Killonan to Nenagh 110kV OHL, which is c.41km long, originating in the Killonan 220kV Station and ending in the Nenagh 110kV/38kV Substation. The Killonan – Nenagh 110kV OHL is one of the main electricity supplies into Nenagh town. Unlike the Killonan Station, the Killonan – Nenagh 110kV OHL has capacity to take the substantial amount of electricity which will be generated by Upperchurch Windfarm. This is why a connection at a new node on the Killonan to Nenagh 110kV line was allocated to Upperchurch Windfarm under Gate 3 in the first place.

There are strict criteria for applying for a modification to the allocated grid connection node. A Modification Request to change the connection node on the national grid, from the one allocated for Upperchurch Windfarm under it's Gate 3 Grid Connection Agreement, would not be considered acceptable by the System Operator because there is not enough available electrical capacity at other 110kV stations (i.e. Nenagh, Thurles, Tipperary and Cauteen Stations) in the region to accept the large amount of electricity that Upperchurch Windfarm will generate. The Killonan Station does not have the capacity to take this volume of electricity without requiring major station works, including extension works. The location of the grid connection point has been planned in the context of the available capacity on an overhead line which connects to the main bulk supply point for the Mid-West Region – i.e. Killonan Station, which is located beside a suitably large load centre (i.e Limerick City) to accept the large electricity generation capacity of Upperchurch Windfarm. The connection will be via a new looped in substation beside the overhead line at Mountphilips. This new substation will increase the Limerick/Tipperary transmission system security, increase the Killonan-Nenagh 110kV OHL stability and improve the system circuits Control and Protection.

Therefore, having examined alternative connection nodes (locations) for connecting Upperchurch Windfarm to the national grid, there was no other technically feasible alternative to the connection point prescribed in the ESBN Grid Connection Agreement (a new node to be built at Mountphilips along the Limerick to Nenagh 110kV line), and the prescribed connection node was considered to be the optimum location for connection to the national grid.

4.3 Alternative Grid Connection Technologies Considered

4.3.1 Introduction to Alternative Technologies Considered

The ESB Networks Grid Connection Agreement for Upperchurch Windfarm specifies that the electricity output from the windfarm is supplied onto a new Node on the Killonan to Nenagh 110kV electricity line, via an 110kV underground cable from Upperchurch Windfarm substation.

The Board Order, issued for the Refusal of Permission for the 2018 UWF Grid Connection application, indicated that an alternative grid connection technology, such as an overhead connection line, should be considered as an alternative.

The use of overhead lines would require a modification to the Upperchurch Windfarm Grid Connection Agreement which specifies underground cable. Consideration of a modification to the Agreement by the System Operators, would be subject to the modification criteria set out in Eirgrid/ESBN's Connection Offer Policy and Process (COPP detailed in 4.2.3 above). A modification request to the System Operator to connect using an alternative grid connection technology i.e overhead line, is generally granted because such a modification can usually comply with the COPP Ruleset. Therefore alternative technologies to connect Upperchurch Windfarm substation to the national grid by underground cable (UGC) and by overhead line (OHL) were compared for environmental effects.

4.3.2 Description of the Alternative Technologies Considered – OHL and UGC

The 2018 Application which was refused by the Board, was for a cross-country, underground cable connection to the national grid. Therefore, when alternative technologies for the grid connection cable were being considered, two methods were possible;

1. Underground Cabling (UGC) in the public road network or
2. Overhead Line (OHL).

Description of Underground Cabling (UGC) in the public road network: 110kV UGC is typically installed in trenches c.1.25m deep and 0.6m wide, laid with 5 cable ducts through which the 3 electrical cables, communications cables, and copper cables (if required), are pulled. A length of c.29 - 33km of UGC (the approx. distance by road between Upperchurch Windfarm Substation and the new node selected by ESBN at Mountphilips) would require c. 36 - 40 No. joint bay, communication and link box chambers located at regular points along the route. The ducts are surrounded by concrete and the top of the trench is backfilled and reinstated. The only surface expression of underground cabling in public roads, is the man-hole type covers over the Joint Bays and the over-ground identification marker posts and marker plates, along the route. Spoil for the excavations would be classified as waste and would be disposed of in licenced waste facilities.

Overhead Line (OHL): Newly built Infrastructure would be required to carry the 110kV grid connection overhead line because the existing infrastructure throughout the area, of wooden poles carrying 20kV and 38kV electricity lines and telephone lines, would not have the required engineering or technical specifications to carry an 110kV line. Locating the new 110kV UGC along roadside verges/boundaries is also not technically possible to the number of bends on the public roads (110kV OHL must be constructed in straight lines, with steel pylons at all changes of direction) along with minimum separation distances from other electrical infrastructure and from ground level, therefore a grid connection using Overhead Line technology would be wholly off-road. The Overhead Line would involve c.26 - 30km of 110kV overhead line,

carried on c.150 to 165 structures comprising double wooden poles and steel pylons. The structures would be c.25m high, depending on the terrain.

4.3.3 Comparison of the Environmental Effects of the Alternative Technologies

The comparison of the environmental effects of the alternative technologies (UGC v OHL) uses the assessment methodology which was developed under the EU LIFE project IMPERIA[7].

4.3.3.1 Methodology used to Compare Environmental Effects – IMPERIA

The IMPERIA methodology is an assessment tool which was developed in the EC LIFE project – IMPERIA, for managing impact significance assessment in EIA projects. The IMPERIA methodology is described in full in Section 2.4 of Chapter 2: The EIAR Process including Scoping and is reproduced hereunder for ease of reference to this Chapter 4.

4.3.3.1.1 Overview of the IMPERIA Methodology

In the framework developed under the EC LIFE project - IMPERIA, the evaluation of impact significance uses a replicable, multi-criteria decision analysis, where the sensitivity of the receptor (i.e. the sensitivity of a Sensitive Aspect of the environment) and the magnitude of the change caused by a project are rated using sub-criteria or scales, and then the overall significance is evaluated using a matrix.

4.3.3.1.2 Criteria for Evaluating the Sensitivity of a Receptor

Sensitivity of the receptor is a description of the characteristics of the receptor or aspect of the environment which will be affected by the development. It is a measure of 1) existing regulations and guidance, 2) societal value and 3) vulnerability for the change. The sensitivity of a receptor is estimated in its current state prior to any change implied by the project.

	Criteria for Evaluating the Sensitivity of a Receptor		
Sensitivity	**Existing regulations:** *describes whether there are any such objects in the impact area, which have some level of protection by law or other regulations or whose conservation value is increased by programs or recommendations*	**Societal value:** *describes the value of the receptor to the society and depending on the type of impact may be related to economic values, social values or environmental values. Societal value measures general appreciation from the point of view of society. When relevant, the number of people impacted is taken into account.*	**Vulnerability to change:** *describes how liable the receptor is to be influenced or harmed by changes to its environment*
Low	Few or no recommendations which add to the conservation value of the impact area, and no regulations restricting use of the area (e.g. zoning plans).	The receptor is of small value or uniqueness. The number of people impacted is small.	Even a large external change would not have substantial impact on the status of the receptor. There are only few or none vulnerable receptors in the area.

[7] Improving Environmental Assessment by Adopting Good Practices and Tools of Multi-criteria Decision Analysis (IMPERIA 1.8.2012-31.12.2015) (LIFE 11 ENV/FI/905) https://www.jyu.fi/science/en/bioenv/research/natural-resources-and-environment/imperia-project

	Criteria for Evaluating the Sensitivity of a Receptor		
Sensitivity	**Existing regulations:** *describes whether there are any such objects in the impact area, which have some level of protection by law or other regulations or whose conservation value is increased by programs or recommendations*	**Societal value:** *describes the value of the receptor to the society and depending on the type of impact may be related to economic values, social values or environmental values. Societal value measures general appreciation from the point of view of society. When relevant, the number of people impacted is taken into account.*	**Vulnerability to change:** *describes how liable the receptor is to be influenced or harmed by changes to its environment*
Moderate	Regulation sets recommendations or reference values for an object in the impact area, or the project may impact an area conserved by a national or an international program.	The receptor is valuable and locally significant but not very unique. The number of people impacted is moderate.	At least moderate changes are needed to substantially change the status of the receptor. There are some vulnerable receptors in the area.
High	The impact area includes an object that is protected by national law or an EU directive (e.g. Natura 2000 areas) or international contracts which may have direct impact on the feasibility of the proposed development.	The receptor is unique and valuable to society. It may be deemed nationally significant and valuable. The number of people impacted is large.	Even a small external change could substantially change the status of the receptor. There are many vulnerable receptors in the area.
Very High	The impact area includes an object that is protected by national law or an EU directive (e.g. Natura 2000 areas) or international contracts which may prevent the proposed development.	The receptor is highly unique, very valuable to society and possibly irreplaceable. It may be deemed internationally significant and valuable. The number of people affected is very large.	Even a very small external change could substantially change the status of the receptor. There are very many vulnerable receptors in the area.

A general guide for deriving the **overall sensitivity of a receptor** is to pick the maximum of existing regulations and guidance and societal value and then adjust that value depending on the level of vulnerability.

Determining the Overall Sensitivity of a Receptor	
Low	The receptor has minor social value, low vulnerability for the change and no existing regulations and guidance. Even a receptor which has major or moderate social value may have low sensitivity if it's not liable to be influenced by the development.
Moderate	The receptor has moderate value to society, its vulnerability for the change is moderate, regulation may set reference values or recommendations, and it may be in a conservation program. Even a receptor which has major social value may have moderate sensitivity if it has low vulnerability, and vice versa.
High	Legislation strictly conserves the receptor, or it is very valuable to society, or very liable to be harmed by the development.
Very High	Legislation strictly conserves the receptor, or it is irreplaceable to society, or extremely liable to be harmed by the development. Even minor influence by the proposed development is likely to make the development unfeasible.

4.3.3.1.3 Criteria for Evaluating the Magnitude of an Impact

Magnitude of the impact describes the characteristics of changes the planned project is likely to cause. Magnitude is a combination of 1) intensity and direction, 2) spatial extent, and 3) duration. Assessment of magnitude evaluates the likely changes affecting the receptor *without* taking into account the receptors sensitivity to those changes.

Magnitude	**Criteria for Evaluating the Magnitude of an Impact – Intensity & Direction** *Intensity describes the physical dimension of a development. The direction of the impact/change is either positive (green) or negative (red).*
Very High	The proposal has an extremely beneficial effect on nature or environmental load. A social change benefits substantially people's daily lives
High	The proposal has a large beneficial effect on nature or environmental load. A social change clearly benefits people's daily lives.
Moderate	The proposal has a clearly observable positive effect on nature or environmental load. A social change has an observable effect on people's daily lives
Low	An effect is **positive** and observable, but the change to environmental conditions or on people is small
No impact	An effect so small that it has no practical implication. Any benefit or harm is negligible.
Low	An effect is **negative** and observable, but the change to environmental conditions or on people is small
Moderate	The proposal has a clearly observable negative effect on nature or environmental load. A social change has an observable effect on people's daily lives and may impact daily routines
High	The proposal has a large detrimental effect on nature or environmental load. A social change clearly hinders people's daily lives.
Very High	The proposal has an extremely harmful effect on nature or environmental load. A social change substantially hinders people's daily lives

	Criteria for Evaluating the Magnitude of an Impact – Spatial Extent & Duration	
Magnitude	**Spatial Extent** *describes the geographical reach of an impact area, or the range within which an effect is observable*	**Duration** *describes the length of time during which an impact is observable and it also takes other related issues such as timing and periodicity into account. These are relevant for impacts which aren't observable all the time such as periodic impacts*
Low	Impact extends only to the immediate vicinity of a source. Typical range is < 1 km.	An impact whose duration is at most one year, for instance during construction and not operation. A moderate-term impact may fall into this category if it's not constant and occurs only at periods causing the least possible disturbance
Moderate	Impact extends over one municipality. Typical range is 1-10 km	An impact lasts from one to a number of years. A long-term impact may fall into this category if it's not constant and occurs only at periods causing the least possible disturbance
High	Impact extends over one region. Typical range is 10-100 km	An impact lasts several years. The impact area will recover after the project is decommissioned.
Very High	Impact extends over several regions and may cross national borders. Typical range is >100 km	An impact is permanent. The impact area won't recover even after the project is decommissioned.

Determining the Overall Magnitude of the Change/Effect: Magnitude of the change is a comprehensive synthesis of its component factors. In a case, where intensity, spatial extent and duration all get the same value, the magnitude would also be given this value. In other cases, intensity is be taken as a starting point, and the assessment is then adjusted based on spatial extent and duration to obtain an overall level of magnitude. The aim is that the overall assessment captures the characteristics of an effect. The table below describes some example descriptions of different categories for the magnitude of the change.

Determining the Overall Magnitude of the Change/Effect	
Very High	The proposal has beneficial effects of very high intensity and the extent and the duration of the effects are at least high.
High	The proposal has beneficial effects of high intensity and the extent and the duration of the effects are high.
Moderate	The proposal has clearly observable positive effects on nature or people's daily lives, and the extent and the duration of the effects are moderate.
Low	An effect is positive and observable, but the change to environmental conditions or on people is small
No impact	No change is noticeable in practice. Any benefit or harm is negligible.
Low	An effect is negative and observable, but the change to environmental conditions or on people is small.
Moderate	The proposal has clearly observable negative effects on nature or people's daily lives, and the extent and the duration of the effects are moderate.
High	The proposal has harmful effects of high intensity and the extent and the duration of the effects are high
Very High	The proposal has harmful effects of very high intensity and the extent and the duration of the effects are at least high.

4.3.3.1.4 Assessing the overall significance of an impact

The **assessment of the overall significance uses the matrix below,** where positive impacts are in green and negative in red. The matrix is based on the **magnitude of the change** affecting a receptor and on the **sensitivity of the receptor** to those changes.

The values obtained from the table are indicative because the most relevant dimensions for characterising an impact are dependent on the type of impact. Thus, some discretion from the expert is required, in particular in cases, where the one component is low and the other one high or very high.

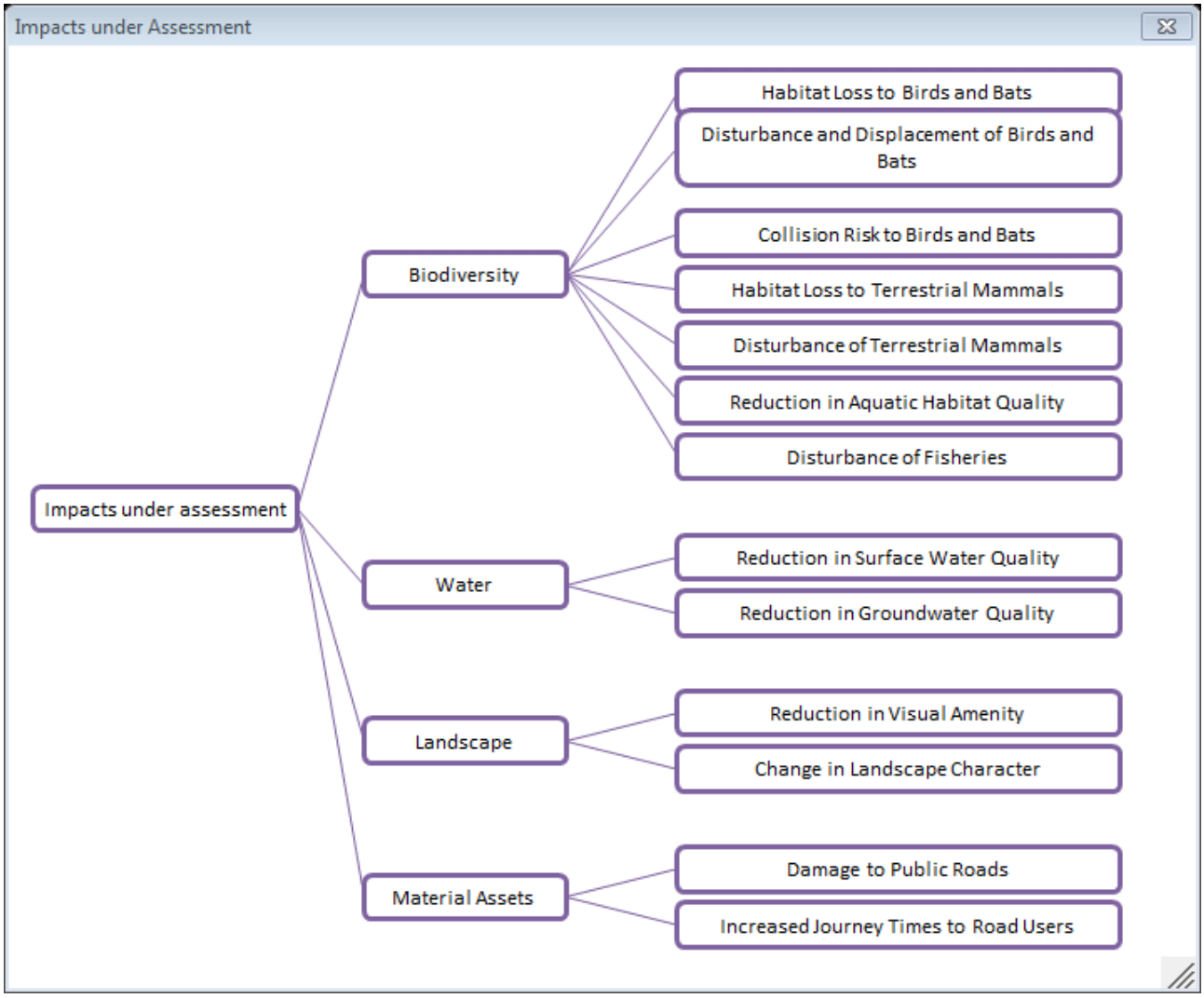
Determining the Overall Significance of an Impact

Impact Significance		**Magnitude of change**								
		Very High	**High**	**Moderate**	**Low**	**No Impact**	**Low**	**Moderate**	**High**	**Very High**
Receptor Sensitivity	**Low**	Significant*	Moderate*	Slight	Imperceptible	No Impact/ Neutral	Imperceptible	Slight	Moderate*	Significant*
	Moderate	Significant	Significant	Moderate	Slight	No Impact/ Neutral	Slight	Moderate	Significant	Significant
	High	Profound	Significant	Significant	Moderate*	No Impact/ Neutral	Moderate*	Significant	Significant	Profound
	Very High	Profound	Profound	Significant	Significant*	No Impact/ Neutral	Significant*	Significant	Profound	Profound

** Especially in these cases, significance might get a lower estimate, if sensitivity or magnitude is near the lower bound of the classification*

4.3.3.2 Potential Impacts of the Alternative Technologies OHL and UGC

The two technologies capable of transporting the electricity from Upperchurch Windfarm Substation to the new node at Mountphilips, are 110kV underground cable (UGC) or 110kV overhead line (OHL). The technologies are compared for environmental effect on the environmental topics, where there is potential for a significant impact. The environmental factor topics that were assessed and the impacts with potential for significant effect are set out in the Impact Tree below;



4.3.3.3 Comparison of the Environmental Effects on the Topics Chosen

A comparison of environmental impacts of the two alternative grid technologies i.e. UGC or OHL from Upperchurch Windfarm Substation to Mountphilips Substation, is presented in Table 4-1 below.

Table 4-1: Comparison of the Environmental Effects of Two Alternative Grid Technologies

Impact	Underground Cable in public roads	Overhead Line (cross country)
Biodiversity Habitat Loss, Disturbance and Displacement and Collision Risk to Birds and Bats.	**Context:** UGC construction and operation within the carriageway of public roads. **Low sensitivity of birds and bats to the UGC:** while birds and bats are protected by legislation and can be sensitive to habitat loss and disturbance, they are not considered to be vulnerable to works on the public road network due to location of UGC in built environments, and in the context of daily noise and human presence on public road. No vulnerability to the presence of operational underground cables. **Low Magnitude of change to birds and bats:** No habitat loss, and any disturbance would not be noticeable in practice in the context of works on public roads with daily noise and human presence. UGC has no operational collision or displacement impacts due to the underground nature of this type of grid connection technology.	**Context:** Overhead line across natural lands including agricultural and forestry lands. **Moderate sensitivity of Birds and Bats to the OHL** birds and bats are protected by legislation and are vulnerable to construction works on natural lands which can result in habitat loss and disturbance. Birds and bats can also be vulnerable to collision with overhead lines in natural landscapes. **Moderate Magnitude of change to birds and bats**: observable loss of habitat loss at structure locations and underneath the overhead lines (particularly felling of trees); which may be significant if habitat loss occurs in important foraging or breeding habitats. It is likely that observable disturbance and displacement of birds will occur, although this is generally mitigated by the short duration and linear nature of works. However effects could be significant should works occur in close proximity to sensitive species during key stages of their breeding cycle. Birds and bats could be significantly affected by the presence of overhead lines, particularly if these lines were routed across important feeding or migratory routes or core foraging areas.
	Result: **Imperceptible Negative**	Result: **Moderate Negative**
Biodiversity Habitat Loss, Disturbance to Terrestrial Mammals	**Context:** UGC construction and operation within the carriageway of public roads. **Moderate sensitivity of terrestrial mammals to the UGC:** while terrestrial mammals are protected by legislation and can be affected by habitat loss and disturbance, they are not considered to be vulnerable to works on the public road network due to location of UGC in built environments, and in the context of daily noise and human presence on road.	**Context:** Overhead line across natural lands including agricultural and forestry lands. **High sensitivity of terrestrial mammals to the OHL:** terrestrial mammals are protected by national and international legislation and considered vulnerable to habitat loss and disturbance in natural environments.

Impact	Underground Cable in public roads	Overhead Line (cross country)
	Low Magnitude of change to Terrestrial Mammals: No habitat loss, and any disturbance would not be noticeable in practice in the context of works on public roads with daily noise and human presence. While internationally protected species such as Otter may occur near bridge crossing locations, any disturbance would be in the context of works on the public road network, which is already a source of noise and human presence.	**Low Magnitude of change to Terrestrial Mammals**: observable loss of habitat loss at structure locations and underneath the overhead lines (particularly felling of trees); which may be significant if habitat loss occurs in important foraging or breeding habitats, or if habitat fragmentation occurs as a result of forestry felling. It is likely that observable disturbance and displacement of mammals will occur during the construction stage, although this is generally mitigated by the short duration and linear nature of works. However effects could be significant should works occur in close proximity to highly sensitive species such as otter or badger during sensitive part of their breeding cycle.
	Result**: Imperceptible Negative**	Result**: Moderate Negative**
Biodiversity Reduction in Aquatic Habitat Quality, Disturbance of Fisheries	**Context:** UGC construction within the carriageway of public roads with existing watercourse crossing structures in place. No storage of excavations from road excavations with all excavations removed to waste facilities. **Moderate Sensitivity of Aquatic Habitat and Fisheries to the UGC** aquatic habitats and fisheries are protected by legislation, however it is considered that these receptors are less vulnerable to road works for UGC than for OHL, because works will take place from paved surfaces, with the capability to use existing watercourse crossing structures to cross watercourses. **Low Magnitude of change to Aquatic Habitats & Fisheries** - works will occur on public roads, the potential for sedimentation is reduced due to the location of the excavations – i.e. within road pavements, the movement of vehicles on road pavements rather than natural lands, and the removal of all excavated materials from the works locations. The requirement for instream works for UGC along a public road would also be minimal with sufficient coverage and structure integrity likely to be encountered at most locations. There is less potential to disturb fish species due to the availability of existing crossing structures.	**Context:** OHL construction on natural lands and likely to require new crossings of watercourses to provide access to at least some of the OHL support structures. Small excavations at the structure locations would be stored adjacent to works at least for a temporary duration. **High Sensitivity of Aquatic Habitat and Fisheries to the OHL**: aquatic habitats and fisheries are protected by legislation, and it is considered that these receptors are vulnerable to water quality impacts due to excavation works, storage of excavated materials and the presence of machinery in proximity to watercourses. Fish species are also vulnerable to disturbance where watercourse crossing works require instream works. **Moderate Magnitude of change to Aquatic Habitats & Fisheries** while aquatic habitats are likely to be avoided where possible, it is likely that due to the fact that the OHL will be constructed over c.30km of natural lands including c.70- 100 watercourses, that there will be works in close proximity to watercourses with new temporary/permanent watercourse crossings likely to be required to access at least some of the c.165 OHL support structures. There will also be small excavation volumes at structure locations, some of which are likely to be in close proximity to watercourses. There is a risk of sediment laden run off into adjacent watercourses as a result of construction works. Heavy machinery and vehicles will also be tracking over natural lands with a risk of soil erosion and subsequent sediment runoff. Sedimentation related impacts may persist until excavated/disturbed ground has vegetated. Fish

Impact	Underground Cable in public roads	Overhead Line (cross country)
		species may also be disturbed should instream crossing works occur during sensitive periods of their life cycle.
	Result: **Imperceptible Negative**	Result: **Moderate Negative**
Water Reduction in Surface water and Groundwater Quality	**Context:** UGC construction within the carriageway of public roads with existing watercourse crossing structures in place. No storage of excavations from road excavations with all excavations removed to waste facilities. **Moderate Sensitivity of Water to the UGC:** although water bodies are protected by legislation, it is considered that surface waters are less vulnerable to works on public roads for UGC because of the location of excavations within paved surfaces, and the capacity to use existing watercourse crossing structures, with minimum instream works required to install a UGC along public road. Groundwater, similarly, is not as vulnerable to excavations within road pavements, due to the smaller proportion of natural soils under roadways. **Low Magnitude of change to Water**: works will occur on public roads, the potential for sedimentation is reduced due to the location of the excavations – i.e. within road pavements, the movement of vehicles on road pavements rather than natural lands avoids the risk of addition soil erosion due to vehicular movements, and the removal of all excavated materials from the works locations also removes a main source of sediment from works locations. The requirement for instream works for UGC along a public road would also be minimal with sufficient coverage and structure integrity likely to be encountered at most locations. Effects to groundwater are minimised due to the location of excavations within paved road structures.	**Context:** OHL construction on natural lands and likely to require new crossings of watercourses to provide access to at least some of the OHL support structures. Small excavations at the structure locations would be stored adjacent to works at least for a temporary duration. **High Sensitivity of Water to the OHL**: waterbodies are protected by legislation, and it is considered that both surface waters and groundwater are vulnerable to excavation works, storage of excavated materials and the presence of machinery in natural lands and in proximity to watercourses. **Low Magnitude of change to Water**: due to the fact that the OHL will be constructed over c.30km of natural lands including c.70- 100 watercourses, that there will be works in close proximity to watercourses with new temporary/permanent watercourse crossings likely to be required to access at least some of the c.165 OHL support structures. There will also be small excavation volumes at structure locations, some of which are likely to be in close proximity to watercourse. There is a higher risk of sediment laden run off into adjacent watercourses as a result of construction works. Heavy machinery and vehicles will also be tracking over natural lands with a risk of soil erosion and subsequent sediment runoff. Sedimentation related impacts may persist until excavated/disturbed ground has vegetated. Groundwater may be affected by excavation works in natural lands. The magnitude of impact is reduced by the location of works across several catchments.
	Result: **Imperceptible Negative**	Result: **Moderate Negative**

Impact	Underground Cable in public roads	Overhead Line (cross country)
Landscape Reduction in Visual Amenity, Change in Landscape Character	**Context:** Underground cable constructed within the carriageway of public roads. **Low Sensitivity of the Landscape to the UGC**: although roads in the area are designated scenic routes, these routes are not considered vulnerable to UGC due to the underground nature of this grid connection technology. **No Magnitude of change to Landscape:** albeit that construction works will take place on scenic routes, these works will be similar to road works which are commonly encountered and will be temporary in duration, the long term operational impact will be negligible due to the underground nature of the UGC with manholes and marker plates as the only visible evidence of its presence. Result**: Neutral**	**Context:** Overhead line across natural lands including agricultural and forestry lands. **Moderate Sensitivity of Landscape to the OHL**: more vulnerable to OHL than UGC due to the tranquil nature with low intensity land uses of the upland landscape between the Upperchurch Windfarm and Mountphilips Substation, with views of the OHL likely from scenic routes along roads around the upland area. **Moderate Magnitude of change to Landscape**: While overhead electricity and telecom lines are generally commonplace in the countryside, the addition of new OHL infrastructure across this upland landscape would have an observable negative effect from scenic routes in the form of increased visual clutter. Result**: Moderate Negative**
Material Assets Damage to Public Roads, Increased Journey Times to Road Users	**Context:** UGC construction and operation within the carriageway of public roads. **Moderate Sensitivity of Material Assets (public road) to the UGC**: due to the value of public roads as transport routes for local and regional populations. **Moderate Magnitude of change to Material Assets (public road):** UGC will be wholly constructed within public pavements, which will extend for c.30km. Delays to Road Users due to road works, and road closures will have an observable temporary effect on people's daily lives and may impact daily routines during the construction phase, however the roads in the area are not congested. The magnitude of impact is mitigated through the temporary duration of works, and the reinstatement of public roads following the completion of works. **Result: Moderate Negative**	**Context:** Overhead line across natural lands including agricultural and forestry lands. **Low Sensitivity of Material Assets (public road and built services) to the OHL:** neither public roads nor road users are usually vulnerability to OHL works which take place at off-road locations, although some stringing of OHL will be required across public roads. **No Magnitude of change to Material Assets (public road):** no works on the road, stringing activities will not affect public road structures and any delays to road users during stringing activities will be negligible. **Result: Neutral**

4.3.4 Conclusion to Comparison of Alternative Grid Connection Technologies – OHL and UGC

Table 4-2 Summary Classification of Impacts – Alternative Grid Connection Technologies

Significance		Underground Cable in the Public Road Network	Overhead Line (Cross Country)
No impact/ Neutral Impact		- **Landscape:** Reduction in Visual Amenity, Change in Landscape Character.	- **Material Assets:** Damage to Public Roads, Increased Journey Times to Road Users.
Negative	**Imperceptible**	- **Biodiversity:** Habitat Loss, Disturbance and Displacement and Collision Risk to Birds and Bats. - **Biodiversity:** Habitat Loss, Disturbance to Terrestrial Mammals. - **Biodiversity:** Reduction in Aquatic Habitat Quality, Disturbance of Fisheries. - **Water:** Reduction in Surface Water and Groundwater Quality.	
	Slight	n/a	n/a
	Moderate	- **Material Assets:** Damage to Public Roads, Increased Journey Times to Road Users**.**	- **Biodiversity:** Habitat Loss, Disturbance and Displacement and Collision Risk to Birds and Bats. - **Biodiversity:** Habitat Loss, Disturbance to Terrestrial Mammals. - **Biodiversity:** Reduction in Aquatic Habitat Quality, Disturbance of Fisheries. - **Water:** Reduction in Surface Water and Groundwater Quality. - **Landscape:** Reduction in Visual Amenity, Change in Landscape Character.
	Significant	n/a	n/a
	Profound	n/a	n/a

Underground Cable: The results of the analysis of the environmental effects of an **Underground Cable (UGC)** ranged from **No Impact (for impacts to Landscape)** to **Imperceptible Negative (for impacts on Biodiversity and Water)** due to the location of the construction works being carried out within public roads with crossings structures in place, which avoids or minimises impacts such as habitat loss, disturbance, instream works and water quality impacts, and the location of the UGC technology underground which negates operational stage impacts such as collision risk and reductions in visual amenity and landscape character. More negative effects **(Moderate Negative)** are likely to **Material Assets** – *public roads and road users*, due to the location of the UGC construction works on public roads which would require the cutting and excavation of road pavements and would also cause some travel delays to road users, however any impacts would be temporary and reversible with reinstatement of roads following the completion of construction works.

Overhead Line: The results of the analysis of the environmental effects of an **Overhead Line (OHL)** ranges from **No Impact/Neutral Impact (for impacts to Material Assets** – *public roads and road users***)** due to absence of works on the public road; to more negative effects to **Biodiversity and Water (Moderate Negative**), due to the location of the OHL construction works on natural lands, with some habitat loss and disturbance expected, and due to the carrying out of works in close proximity to watercourses with some instream works likely to be required, the magnitude of impact is reduced by the location of works across several water catchments. Impacts to **Landscape** are also likely to be **Moderate Negative** due to the addition of new above ground structures across a rural and low intensity landscape, with structures visible from scenic routes.

Conclusion: Overhead Line technology will have minimal effect on Material Assets (public roads and road users), but because of the technical requirements of Overhead Line technology, the OHL would need to be routed through the open countryside, which places construction works within natural habitats including watercourses. Moderate negative effects could occur to Biodiversity and Water receptors as a result. Because of its above ground characteristics, moderate negative effects to Landscape could also occur in this rural setting.

On the other hand, although Underground Cable technology will have negative Moderate effects on Material Assets (public roads and road users); it is because of its location on public roads, that direct effects to natural habitats are avoided, and effects to animal species and watercourses are minimised.

Of the 2 no. alternative technologies, while neither technology was considered likely to cause significant effects, it was considered that OHL had more potential to cause significant effects to the natural environment. **When the emphasis is placed on the natural environment the use of underground technology (in public roads) is a better alternative than Overhead Line technology and therefore the underground cable alternative was chosen for the grid connection technology** to the connection Node prescribed in the Upperchurch Windfarm Grid Connection Agreement.

4.4 Alternatives Considered for the Mountphilips Substation

The Grid Connection Agreement for Upperchurch Windfarm requires that a new node is created by building a new 110kV substation at Mountphilips, under the existing Killonan - Nenagh 110kV overhead line.

The alternative locations and designs which were considered for the Mountphilips Substation are described in this section, together with a comparison of the environmental effects of these alternatives considered.

4.4.1 Alternative Locations for the new 110kV Substation

4.4.1.1 Description of Alternative Locations for the 110kV substation

Two alternative locations in the Mountphilips area were investigated, both locations were proximate to the existing Killonan - Nenagh 110kV line; were located outside of any Natura 2000 Sites; had suitable ground conditions (i.e. not peatland); had availability of lands; had sufficient distance from neighbouring dwellings to avoid any operational effects (such as noise); and had adequate screening to reduce visual impacts.

Two designs were considered - Gas Insulated Switchgear (GIS) and Air Insulated Switchgear (AIS); GIS substations have a smaller footprint but involve the location of the switchgear in a large deep underground room, whereas AIS substations involve larger compound areas but no requirement for underground switchgear rooms and therefore any excavations are shallow in nature.

The two locations, Site A and Site B, are both in agricultural grassland fields, with Site A on the western side of the OHL, and Site B on the eastern side of the OHL. Due to the size of the site at Site A, the design of the substation at Site A was based on a GIS substation. At Site B, because the site area was larger, the design of the substation compound could be either GIS or AIS.

Relevant Volume C3 EIAR Figures:

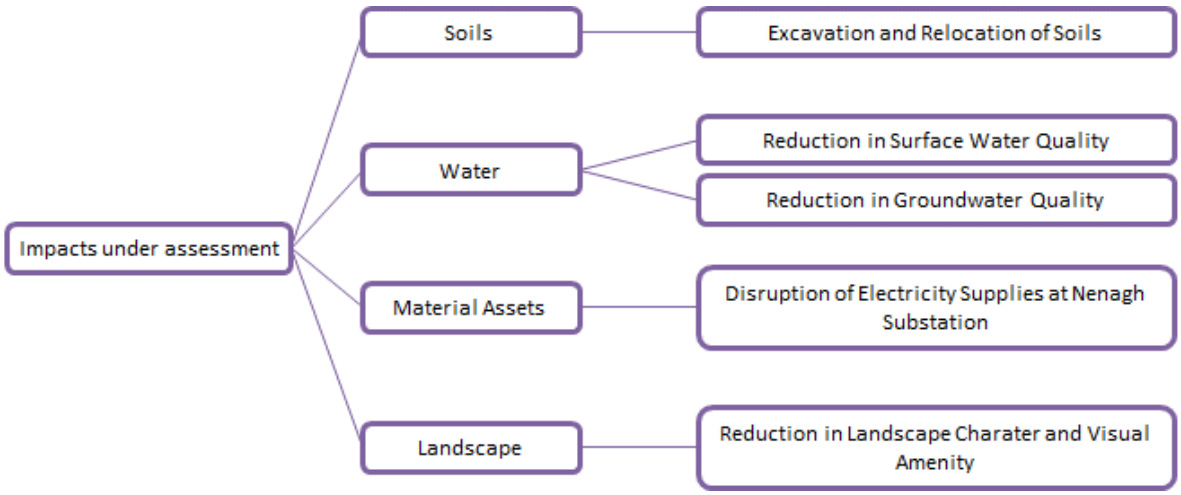
The location and layout of the three options is illustrated on Figure GC 4-1: Alternative Locations/Designs considered for the Mountphilips Substation

4.4.1.2 Comparison of the Environmental Effects of the Alternative Substation Locations

The comparison of the environmental effects of these 3 alternatives – GIS at Site A, GIS at Site B, AIS at Site B - uses the assessment methodology which was developed under the EU LIFE project IMPERIA. The IMPERIA methodology is described above in Section 4.3.3.1.

4.4.1.3 Potential Impacts of the Alternative Substation Locations

The 3 No. substation location/design options were investigated for potential for environmental effects. The environmental factor topics assessed and the impacts with potential for significant effect are set out in the Impact Tree below;



4.4.1.4 Comparison of the Environmental Effects on the Topics Chosen

A comparison of relevant environmental impacts of the three alternative substation location/design options, is presented in Table 4-3 below.

Table 4-3: Comparison of the Environmental Effects of 3 No. Alternative Substation Locations

IMPACT	GIS AT SITE A – WESTERN SIDE OF OHL, GIS DESIGN	GIS AT SITE B – EASTERN SIDE OF OHL, WITH GIS DESIGN	AIS SITE B – EASTERN SIDE OF OHL, WITH AIS DESIGN
Soils Excavation and Relocation of Soils	**Context:** Site investigations found firm ground and gentle evenly sloped topography. Longer access road to Site A from site entrance than Site B **Moderate Sensitivity** of Soils due to the moderate fertility of the soils, local value of the soils, but absence of peat, the soil is not unique and occurs abundantly in the area. **Moderate Magnitude** of change to Soils due to the moderate volumes of productive mineral soils and rock which would require to be permanently removed to construct the GIS substation and access road. Deeper excavations increase risk of contamination of soils. Result: **Moderate Negative**	**Context:** Site investigations found firm ground and flat topography. Shorter access road from site entrance to Site B. **Moderate Sensitivity** of Soils due to the moderate fertility of the soils, local value of the soils, but absence of peat, the soil is not unique and occurs abundantly in the area. **Moderate Magnitude** of change to Soils due to the moderate volumes of productive mineral soils and rock which would require to be permanently removed to construct the GIS substation and access road. Deeper excavations increase risk of contamination of soils. Result: **Moderate Negative**	**Context:** Site investigations found firm ground and flat topography. Shorter access road from site entrance to Site B. **Moderate Sensitivity** of Soils due to the moderate fertility of the soils, local value of the soils, but absence of peat, the soil is not unique and occurs abundantly in the area. **Low Magnitude** of change to Soils due to the moderate volumes of productive mineral soils and rock which would require to be permanently removed to construct the AIS substation and access road. However, all excavations will be shallow. Result: **Slight Negative**
Water Reduction in Surface Water and Groundwater	**Context:** A stream flows to the east of the OHL, gently sloping surface water and groundwater flowpaths into this stream from the substation compound area,	**Context:** A stream flows to the west of the substation compound, between the substation compound and the OHL, surface water and groundwater flowpaths over	**Context:** A stream flows to the west of the substation compound, between the substation compound and the OHL, surface water and groundwater flowpaths over

IMPACT	GIS AT SITE A – WESTERN SIDE OF OHL, GIS DESIGN	GIS AT SITE B – EASTERN SIDE OF OHL, WITH GIS DESIGN	AIS SITE B – EASTERN SIDE OF OHL, WITH AIS DESIGN
Quality	deeper excavations with greater potential for groundwater impacts, larger volumes of excavated material for GIS; requirement for new permanent watercourse crossing structure over this stream to provide construction and operational access to the substation.	flat topography into this stream from the substation compound area, deeper excavations with greater potential for groundwater impacts, larger volumes of excavated material for GIS; requirement for temporary watercourse crossing structure over the stream to provide construction access to the new end masts to be constructed under the OHL.	flat topography into this stream from the substation compound area, shallow excavations and slightly smaller volumes (overall) of excavated material for AIS; requirement for temporary watercourse crossing structure over the stream to provide construction access to the new end masts to be constructed under the OHL.
	Moderate Sensitivity of Water due to the Good WFD Status of the local stream, and the high local value, in the context of the occurrence of streams such as this in the surrounding area.	**Moderate Sensitivity** of Water due to the Good WFD Status of the local stream, and the high local value, in the context of the occurrence of streams such as this in the surrounding area.	**Moderate Sensitivity** of Water due to the Good WFD Status of the local stream, and the high local value, in the context of the occurrence of streams such as this in the surrounding area.
	Moderate Magnitude of change to Water: while standard construction methods and environmental protection measures will mitigate the magnitude of the effects to water quality, there is most potential risk associated with Site A than with Site B due to the large volumes of excavated material and the sloping flowpaths from Site A into the local stream. The presence of deep excavations, greater potential for dewatering, increases risks to groundwater. This option also requires a permanent crossing/road over the local stream.	**Moderate to Low Magnitude** of change to Water: while standard construction methods and environmental protection measures will mitigate the magnitude of the effects to water quality, there is more potential risk associated with this GIS option at Site B than the AIS option at Site B due to the presence of large volumes of excavated material, which is mitigated by the flat topography at Site B. The presence of deep excavations, greater potential for dewatering, increases risks to groundwater. This option only requires a temporary crossing of the local stream.	**Low Magnitude** of change to Water: slightly smaller volumes of excavated materials, flat topography and shallow excavations, along the standard construction methods and environmental protection measures will mitigate the magnitude of the effects to water quality. This option only requires a temporary crossing of the local stream.
	Result: **Moderate Negative**	Result: **Moderate Negative**	Result: **Slight Negative**

IMPACT	GIS AT SITE A – WESTERN SIDE OF OHL, GIS DESIGN	GIS AT SITE B – EASTERN SIDE OF OHL, WITH GIS DESIGN	AIS SITE B – EASTERN SIDE OF OHL, WITH AIS DESIGN
Material Assets Disruption of Electricity Supplies at Nenagh Substation	**Context:** Construction works on the substation cannot be carried out safely due to the proximity of the operating Killonan – Nenagh OHL and therefore switch out during construction would be required. **High sensitivity** of the Material Asset: due to the regional importance of the OHL between Killonan and Nenagh, being a main supply of electricity into Nenagh town and surrounding area. **High Magnitude** of change to Material Asset: due to the close proximity of the substation compound to the OHL, the line between Killonan and Nenagh will be de-energised and switched out for c.6months. While electricity can be backfed to Nenagh from other parts of the network, the length of the outage presents a major risk of shortages in electricity supply at Nenagh and a substation at this location would trigger realignments of the overhead line to avoid such a long outage of the 110kV overhead line supply into Nenagh. Result: **Significant Negative**	**Context:** Construction works on the substation can be carried out at a sufficiently safe working distance from the operating Killonan – Nenagh OHL which means that the OHL does not need to be switched out during the construction work. **High sensitivity** of the Material Asset: due to the regional importance of the OHL between Killonan and Nenagh, being a main supply of electricity into Nenagh town and surrounding area. **No Magnitude** of change to Material Asset**:** construction of the substation will not require electricity outages of c.6months. Commissioning of the substation and final connection to the line will require an outage of c.4 days. During the commissioning of the new Mountphilips Substation, the line between Killonan and Nenagh will be de-energised and switched out. This is unlikely to have any effect on supply into Nenagh. Result**:** **Neutral Impact**	**Context:** Construction works on the substation can be carried out at a sufficiently safe working distance from the operating Killonan – Nenagh OHL which means that the OHL does not need to be switched out during the construction work. **High sensitivity** of the Material Asset: due to the regional importance of the OHL between Killonan and Nenagh, being a main supply of electricity into Nenagh town and surrounding area. **No Magnitude** of change to Material Asset**:** construction of the substation will not require electricity outages of c.6months. Commissioning of the substation and final connection to the line will require an outage of c.4 days. During the commissioning of the new Mountphilips Substation, the line between Killonan and Nenagh will be de-energised and switched out. This is unlikely to have any effect on supply into Nenagh. Result**:** **Neutral Impact**
Landscape Reduction in Landscape Character and Visual Amenity	**Context:** Site A is slightly more elevated location than Site B, although still considered low lying, five fields in from the public road, Site A is surrounded by high tree-lined hedgerows, substation comprises bulky GIS building	**Context:** Site B is a low-lying location, four fields in from the local road, Site B is surrounded by high tree-lined hedgerows, substation comprises bulky GIS building	**Context:** Site B is a low-lying location, four fields in from the local road, Site B is surrounded by high tree-lined hedgerows, substation comprises small control building and discrete AIS structures

Impact	GIS at Site A – Western side of OHL, GIS design	GIS at Site B – Eastern side of OHL, with GIS design	AIS Site B – Eastern side of OHL, with AIS design
	Moderate to High Sensitivity of Landscape: Site A is located in the lowland area contained within 'LCA12 River Shannon – Newport', with a Moderate-High Sensitivity. **Moderate Magnitude** of change to the Landscape: The substation will result in an increase in the amount of above-ground built development, which will be slightly more noticeable in than Site B, however screening will limit its visibility.	**Moderate to High Sensitivity** of Landscape: Site B is located in the lowland area contained within 'LCA12 River Shannon – Newport', with a Moderate-High Sensitivity. **Low Magnitude** of change to the Landscape: The substation will result in an increase in the amount of above-ground built development, which will be noticeable in this rural setting, but screening will minimise its visibility.	**Moderate to High Sensitivity** of Landscape: Site B is located in the lowland area contained within 'LCA12 River Shannon – Newport', with a Moderate-High Sensitivity. **No Magnitude** of change to the Landscape: Due to the screening, low lying location and discrete character of AIS substation structures, the addition of the new AIS substation will be barely noticeable at this location.
	Result: **Slight Negative**	Result: **Slight Negative**	Result: **Neutral Impact Negative**

4.4.2 Conclusion to Comparison of Alternatives for the Mountphilips Substation

Table 4-4 Summary Classification of Impacts – Alternatives considered for the Mountphilips Substation

Significance		GIS AT SITE A – WESTERN SIDE OF OHL, GIS DESIGN	GIS AT SITE B – EASTERN SIDE OF OHL, WITH GIS DESIGN	AIS SITE B – EASTERN SIDE OF OHL, WITH AIS DESIGN
No impact/ Neutral Impact			- **Material Assets:** Disruption of Electricity Supplies at Nenagh Substation	- **Material Assets:** Disruption of Electricity Supplies at Nenagh Substation - **Landscape:** Reduction in Landscape Character and Visual Amenity
Negative	**Imperceptible**			
	Slight	- **Landscape:** Reduction in Landscape Character and Visual Amenity	- **Landscape:** Reduction in Landscape Character and Visual Amenity	- **Soils:** Excavation and Relocation of Soils - **Water:** Reduction in Surface Water and Groundwater Quality
	Moderate	- **Soils:** Excavation and Relocation of Soils - **Water:** Reduction in Surface Water and Groundwater Quality	- **Soils:** Excavation and Relocation of Soils - **Water:** Reduction in Surface Water and Groundwater Quality	
	Significant	- **Material Assets:** Disruption of Electricity Supplies at Nenagh Substation		
	Profound			

GIS at Site A *(western side of the OHL)* The results of the analysis of the environmental effects of the location of the **new GIS substation at Site A,** ranges from **Slight Negative (Landscape)** due to its relatively low lying location and screening from surrounding hedgerows; to **Moderate Negative (Soils and Water)** due to the requirement for deep excavations, resultant moderate volumes of excavated material and short sloping flowpaths to the local stream, in addition to the requirement for a new permanent crossing of this stream. **Significant Negative (Material Assets)** due to the requirement for outages of the Killonan to Nenagh 110kV OHL for a period of c.6months, while the OHL is not the only source of electricity into Nenagh town and surroundings, it is the main source, and an outage of this length presents a serious risk of electricity supply interruption in the Nenagh area.

GIS at Site B *(eastern side of the OHL)* The results of the analysis of the environmental effects of the location of the **new GIS substation at Site B,** ranges from **Neutral (Material Assets)** the very short duration of outages of the OHL – c.4 days with no impact likely on electricity supply into Nenagh; to **Slight Negative (Landscape)** due to the addition of new bulky building which would be mitigated by the low lying location and screening from surrounding hedgerows; to **Moderate Negative (Soils and Water)** due to the requirement for deep excavations, resultant moderate volumes of excavated material and flatter topography for flowpaths to the local stream.

AIS at Site B *(eastern side of the OHL)* The results of the analysis of the environmental effects of the location of the **new GIS substation at Site B,** ranges from **Neutral (Material Assets and Landscape)** due to the very short duration of outages of the OHL – c.4 days with no impact likely on electricity supply into Nenagh; and the discrete nature of the AIS structures which would be barely noticeable in the surrounding area; to **Slight Negative (Soils and Water)** due to no requirement for deep excavations – all excavations will be shallow, and flatter topography for flowpaths to the local stream.

Of the 3 no. alternatives for Mountphilips Substation – GIS on the western side of the OHL, GIS on the eastern side of the OHL or AIS on the eastern side of the OHL; GIS on the western side of the OHL is likely to cause significant effects due to the requirement for outages of the Killonan to Nenagh 110kV OHL for a period of c.6months, while the OHL is not the only source of electricity into Nenagh town and surroundings, it is the main source, and an outage of this length presents a serious risk of electricity supply interruption in the Nenagh area, and is not considered to be acceptable. While neither design at Site B is likely to cause significant effects, **when the emphasis is placed on the natural environment** it was considered that 'AIS at Site B' had least potential to cause significant effects to the natural environment due to the much smaller size of buildings within the substation compound and the shallow depth of excavations, **and therefore 'AIS at Site B' was chosen for the location and design of the Mountphilips Substation**.

4.5 Alternative Grid Connection UGC Routes along the Public Road

4.5.1 Description of the Alternative UGC Routes

According to the Grid Connection Agreement secured for Upperchurch Windfarm, the connection point for Upperchurch Windfarm is at a new node to be built on the existing Killonan to Nenagh 110kV overhead line, c.24km west of the windfarm substation and the connection method is by underground cable (UGC).

In consideration of the comparison of the alternative grid connection technologies (i.e. UGC in the public road v OHL cross country) as set out in the previous section, an underground cable along the public road (which is the method stipulated in the Grid Connection Agreement) is the preferred grid connection technology.

Three possible alternative UGC public road routes were considered.

All three routes run (east to west) from the Consented Upperchurch Windfarm Substation in Knockcurraghbola Commons along a private paved road for 700m; then for 300m on the L6188-0; and then for 1.9km on the L2264-50, as far as the junction with the Thurles to Limerick Regional Road (R503) at Knockmaroe townland. The UGC for all 3. No. routes then follows the R503 for 12.7km as far as Rear Cross, approximately half way along the route.

There are 3 No. alternative public road routes for the 2nd half of the route i.e. from Rear Cross on the R503, to Coole Crossroads on the L2166-10, 730m south of the proposed Mountphilips Substation Entrance. The 3 No. alternative routes from Rear Cross to Coole Crossroads are;

1. **Local Roads (through Toor):** From Rear Cross, turning north onto the Local Road Network (L2114-0) and then in a westerly direction through Toor, avoiding Newport Town using the Local Road Network of the L2157-5, L2157-0, L5183-0 and L6013-0 to Coole Crossroads.
2. **R503 (through Newport Town):** Continuing west from Rear Cross on the R503, through Newport Town and then north on the L2166-0 to Coole Crossroads.
3. **R503 (avoiding Newport Town):** Continuing west from Rear Cross on the R503 and turning north onto the L6009-0 at the GAA grounds outside Newport Town and using the Local Road Network (L6009-0), thus avoiding Newport by using the Local Road Network of the L2157-0, L2156-0and L6013-0 to Coole Crossroads.

The following similarities apply to all 3 No. routes:

- The UGC on all 3 No. routes on the public road, can be laid entirely under the road pavement. All routes will require a single lane and/or full road closures during the works.
- An UGC comprises a trench c.1.25m deep and 0.6m wide, laid with 5 cable ducts and with joint bay and communications chamber points located at regularly intervals along the route. Following reinstatement of the road, the only surface expression of an UGC is the manhole type covers over the Joint Bay locations and the over-ground identification marker posts and plates along the route.
- All three routes pass through the boundaries of the Slievefelim to Silvermines Mountains SPA and the Lower River Shannon SAC. All routes are mainly located in the regional Lower River Shannon & Mulkear catchment area.
- Habitats on either side of the roads on all routes are broadly similar and comprise a mix of forestry of varying age classes, improved agricultural grassland and rough grazing.

Relevant Volume C3 EIAR Figures:

Figure GC 4-2: Alternative Routes considered for the 110kV UGC from Rear Cross to Coole Crossroads

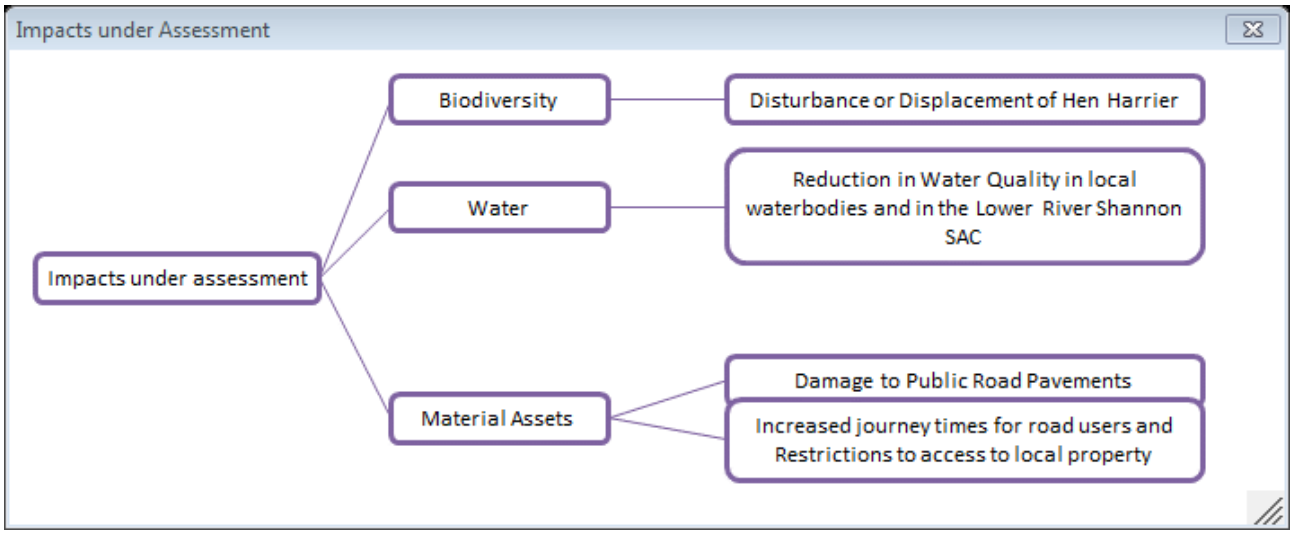
4.5.1 Comparison of the Environmental Effects of the Alternative UGC Routes

The comparison of the environmental effects of the alternative UGC routes uses the assessment methodology which was developed under the EU LIFE project IMPERIA. The IMPERIA methodology is described above in Section 4.3.3.1.

4.5.1.1 Potential Impacts of the Alternative UGC Routes along the Public Road

The 3 No. public road routes were investigated for potential for environmental effects, particularly on biodiversity. Investigations included site visits by Inis Consultants (Biodiversity), Hydro Environmental Services (Water) and TLI Group (Material Assets).

The environmental factor topics assessed and the impacts with potential for significant effect are set out in the Impact Tree below;



4.5.1.2 Comparison of the Environmental Effects on the Topics Chosen

A comparison of relevant environmental impacts of the three alternative UGC routes along the public road network from Rear Cross on the Regional Thurles to Limerick Road (R503) to Coole Crossroads c.18km to the west, is presented in Table 4-5 below.

Table 4-5: Comparison of the Environmental Effects of 3 No. Alternative UGC Routes

IMPACT	LOCAL ROADS (THROUGH TOOR)	R503 (THROUGH NEWPORT TOWN)	R503 (AVOIDING NEWPORT TOWN)
Biodiversity Disturbance and/or Displace-ment of Hen Harrier	**Context:** UGC construction and operation within the pavement of the local public road. c.6.2km of the UGC route from Rear Cross to Coole traverses the Slieve Felim to Silvermines SPA. The UGC is along a Local Road where it overlaps the SPA boundary. These roads are very lightly trafficked and the area is sparsely populated. Quiet anthropological setting. **High Sensitivity** of the species to the UGC: Protection of the species is highly regulated particularly within the SPA. **Low to Moderate Magnitude of change to Hen Harrier:** the route is through a sparsely populated area and the local road network is very lightly trafficked *(Annual Average Daily Traffic (AADT) on the Local Roads (through Toor) route is c.160 vehicles)*, overall this route is through a quieter area than the R503 options. There is potential for disturbance/displacement to hen harrier in the SPA due to the presence of works and personnel on the roads, and it is considered that construction activity levels will contrast with existing baseline conditions. There is no potential for direct habitat loss due to the location of works entirely on the public road network. Result**: Moderate Negative**	**Context:** UGC construction and operation within the pavement of the public road. c.4.9km of the UGC route from Rear Cross to Coole traverses the Slieve Felim to Silvermines SPA. The UGC is along a Regional Road where it overlaps the SPA boundary. Higher traffic volumes, higher number of houses and development along the route, busier anthropological setting **High Sensitivity** of the species to the UGC: Protection of the species is highly regulated particularly within the SPA **Low Magnitude of change to Hen Harrier:** the route is along a regional road connecting Thurles to Limerick and Newport to Cappamore, traffic and activity levels are much higher than through Toor due to the location on a regional road (*AADT on the R503 Regional Road between Rearcross and Derryleigh is 18 times higher than the Toor route at c.2860 vehicles*). There are more houses and development along the R503, than elsewhere in the SPA. Therefore in relation to disturbance/ displacement effects, it is considered that construction activity levels would not significantly contrast with existing baseline conditions with regional traffic volumes and many houses adjoining the road. Similar to the Toor route, there is no potential for direct habitat loss due to the location of the works entirely on the public road network. Result**: Imperceptible Negative**	**Context:** UGC construction and operation within the pavement of the public road. c.4.9km of the UGC route from Rear Cross to Coole traverses the Slieve Felim to Silvermines SPA. The UGC is along a Regional Road where it overlaps the SPA boundary. Higher traffic volumes, higher number of houses and development along the route, busier anthropological setting. **High Sensitivity** of the species to the UGC: Protection of the species is highly regulated particularly within the SPA **Low Magnitude of change to Hen Harrier:** the route is along a regional road connecting Thurles to Limerick and Newport to Cappamore, traffic and activity levels are much higher than through Toor due to the location on a regional road (*18 times higher traffic volumes than the Toor route*). There are more houses and development along the R503, than elsewhere in the SPA. Therefore in relation to disturbance/ displacement effects, it is considered that construction activity levels would not significantly contrast with existing baseline conditions with regional traffic volumes and many houses adjoining. Similar to the Toor route, there is no potential for direct habitat loss due to the location of the works entirely on the public road network. Result: **Imperceptible Negative**

IMPACT	LOCAL ROADS (THROUGH TOOR)	R503 (THROUGH NEWPORT TOWN)	R503 (AVOIDING NEWPORT TOWN)
Water Reduction in Water Quality in local waterbodies and in the Lower River Shannon SAC	**Context:** Located in the regional Mulkear River catchment. Passes through the following Local Surface Water Bodies (LSWBs); Clodiagh River, Bilboa River, Clare River, Small River and Newport (Mulkear) River catchments. The surface water quality in the LSWBs is typically at least "Good Status". A large proportion of the route (12-13km) runs close to the SAC (within 300 - 400m) with effectively zero downstream distance. **High Sensitivity** of the SAC to the UGC: Due to highly regulated receptor nearby (SAC) and proximity of the works and direct water pathways to the receptor. However works will be temporary; carried out over several LSWBs; and standard works methodologies and appropriate environmental protection measures will mitigate potential for effects of surface water run-off and pumped water. **Low Magnitude of change to the SAC:** Although a large proportion of the route drains directly into the SAC allowing effectively no potential for dilution of potential contaminants, standard construction methods and environmental protection measures will mitigate the magnitude of the effects of water run-off. Result: **Moderate Negative**	**Context:** Located in the regional Mulkear River catchment. Passes through the following Local Surface Water Bodies (LSWBs; Clodiagh River, Bilboa River, Clare River, Small River and Newport (Mulkear) River catchments. The surface water quality in the LSWBs is typically at least "Good Status". The majority of the Lower River Shannon SAC is more than 1km downstream of works on the R503. **Low Sensitivity of the SAC to the UGC:** Due to highly regulated receptor nearby (SAC) but reduced vulnerability due to a separation distance to the SAC of at least 1km from the majority of the works, in addition to the temporary duration of works and the location of works within public roads, spread over several local surface waterbodies. **Low Magnitude of change to the SAC:** Standard construction methods and environmental protection measures will mitigate potential for effects of surface water run-off and pumped water.; increased separation distance from the SAC will dilute/mitigate the magnitude of the effects further Result: **Imperceptible Negative**	**Context:** Located in the regional Mulkear River catchment. Passes through the following Local Surface Water Bodies (LSWBs; Clodiagh River, Bilboa River, Clare River, Small River and Newport (Mulkear) River catchments. The surface water quality in the LSWBs is typically at least "Good Status". The majority of the Lower River Shannon SAC is more than 1km downstream of works on the R503. **Low Sensitivity of the SAC to the UGC:** Due to highly regulated receptor nearby (SAC) but reduced vulnerability due to a separation distance to the SAC of at least 1km from the majority of the works, in addition to the temporary duration of works and the location of works within public roads, spread over several local surface waterbodies. **Low Magnitude of change to the SAC:** Standard construction methods and environmental protection measures will mitigate potential for effects of surface water run-off and pumped water.; increased separation distance from the SAC will dilute/mitigate the magnitude of the effects further Result: **Imperceptible Negative**

IMPACT	LOCAL ROADS (THROUGH TOOR)	R503 (THROUGH NEWPORT TOWN)	R503 (AVOIDING NEWPORT TOWN)
Material Assets Damage to Public Road Pavements	**Context:** Trench in Local Roads from Rear Cross to Coole Crossroads. Existing pavement condition indicating poor load spreading ability and moderate to weak subgrade. Unmarked carriageway up to 3.5m in width. Water services in the road network.	**Context:** Trench in Regional Road R503 from Rear Cross; through Newport Town and then in the Local Road to Coole Crossroads. Pavement condition of R503 is good. Road width up to 6m. Only water services in the R503 – no gas pipes, occasional underground electrical cables connecting into roadside homes. Underground services in the public road through Newport Town include gas, telecoms, electricity, sewage and storm water drains.	**Context:** Trench in Regional Road R503 from Rear Cross and avoiding Newport Town by using Local Roads to the north and north west of the town. Pavement condition is good on the R503 and poor on the Local Roads. Only water services in the R503 and on the local roads – no gas pipes, occasional underground electrical cables connecting into roadside homes.
	Moderate Sensitivity of the Road Pavement to the UGC: while the local roads through Toor would not carry as high a societal value, due to their poor condition they are likely to be more vulnerable to damage during construction works.	**High Sensitivity** of the Road Pavement to the UGC: the R503 and particularly through Newport Town has high economic value. Tipperary County Council have pavement refurbishment works planned for 2019 for Newport Town.	**Moderate Sensitivity** of the Road Pavement to the UGC: due to the high societal value of the R503.
	Low Magnitude of change to the road pavement: because the impact will be confined to the road pavement, road opening will be temporary and carried out in a linear fashion with each section temporarily reinstated before the following section is commenced. The full road will be fully reinstated to former or better condition.	**Low Magnitude** of change to the road pavement: because the impact will be confined to the road pavement, road opening would be temporary and carried out in a linear fashion with each section temporarily reinstated before the following section is commenced. The road would be reinstated to former or better condition. However the works may happen after Tipperary County Council's planned pavement refurbishment works in Newport Town in 2019.	**Low Magnitude of change to the road pavement:** because the impact would be confined to the road pavement, road opening would be temporary and carried out in a linear fashion with each section temporarily reinstated before the following section is commenced. The road would be reinstated to former or better condition
	Result: **Slight Negative**	Result: **Moderate Negative**	Result: **Imperceptible Negative**

IMPACT	LOCAL ROADS (THROUGH TOOR)	R503 (THROUGH NEWPORT TOWN)	R503 (AVOIDING NEWPORT TOWN)
	Context: Because of the width of the Local Roads, cabling works would require the most road closures of the three options. Alternative routes are available, albeit longer, and local access would be accommodated.	**Context:** On the R503, single lane closures only would be required and traffic can be managed to maintain good traffic flow. Alternative routes around Newport available. Otherwise, route includes lightly traffic sections of the R503 with adequate available capacity. Traffic through Newport Town would be disrupted for c.1 month during the cabling works.	**Context:** On the Local Road section, cabling works would require some road closures and these are lightly trafficked with available capacity on all roads. Alternative routes available and local access can be accommodated. On the R503, single lane closures only will be required and traffic can be managed to maintain good traffic flow. Otherwise, route includes lightly traffic sections of the R503 with adequate available capacity.
Material Assets: Increased journey times for road users and restrictions to access to local property	**Low Sensitivity** of Road Users to the UGC: because although road closures would be required the number of people affected would be very Low.	**Moderate Sensitivity** of Road Users to the UGC: high number of road users in Newport town in particular, and also along the R503, in the context of lower vulnerability to change due to wider nature of the roads with single lane closures rather than road closures being required.	**Low Sensitivity of Road Users to the UGC:** The R503 and the wider local roads will only require one-lane closures to accommodate the works. On the narrower Local Roads, although road closures will be required, local access will be maintained.
	Moderate Magnitude of change to Road Users: Road closures would be in place for a number of months, however the numbers of people affected would be low and the impact would be reversible on completion of the works. Alternative routes available, albeit these routes are significantly longer.	**Moderate Magnitude** of change to Road Users: Although the impact will be temporary, traffic disruption would affect people and businesses in Newport Town, during the cabling works.	**Low Magnitude of change to Road Users:** On Local Roads, road closures would be short (c.1 to 2 weeks on any road) and would not impact on many people, with acceptable alternative routes available. Effects to Road Users on the R503 would be observable but the change in journey times would be negligible.
	Result: **Imperceptible Negative**	Result: **Moderate Negative**	Result: **Imperceptible Negative**

4.5.2 Conclusion to Comparison of Alternative UGC Routes in the Public Road

Table 4-6 Summary Classification of Impacts – Alternative UGC Routes

Significance		LOCAL ROADS (THROUGH TOOR)	R503 (THROUGH NEWPORT TOWN)	R503 (AVOIDING NEWPORT TOWN)
	No impact/ Neutral Impact			
Negative	**Imperceptible**	- **Material Assets:** Increase journey times for road users and restrictions to access to local property	- **Biodiversity:** Disturbance and/or Displacement of Hen Harrier - **Water:** Reduction in Water Quality in local waterbodies and in the Lower River Shannon SAC	- **Biodiversity:** Disturbance and/or Displacement of Hen Harrier - **Water:** Reduction in Water Quality in local waterbodies and in the Lower River Shannon SAC - **Material Assets:** Damage to Public Road Pavements - **Material Assets:** Increase journey times for road users and restrictions to access to local property
	Slight	- **Material Assets:** Damage to Public Road Pavements		
	Moderate	- **Biodiversity:** Disturbance and/or Displacement of Hen Harrier - **Water:** Reduction in Water Quality in local waterbodies and in the Lower River Shannon SAC	- **Material Assets:** Damage to Public Road Pavements - **Material Assets:** Increase journey times for road users and restrictions to access to local property	
	Significant			
	Profound			

Local Roads (through Toor)

The results of the analysis of the environmental effects of the Local Roads (through Toor) route ranges from **Imperceptible Negative** to **Moderate Negative.** Impacts to **Public Roads and Road Users** are likely to be **Imperceptible Negative** and **Slight Negative**, respectively, due to the lightly trafficked nature of the road and the capacity to repair any damage to the local roads with reinstatement following construction works. Impacts to **Biodiversity and Water** are likely to be **Moderate Negative** due to higher potential for disturbance/displacement of hen harrier from increased activity from the construction works which will contrast with existing quiet baseline condition on the 6.1km of a quiet Local Road traversing through a sparsely populated part of the SPA. Potential for moderate impacts to water quality in the SAC due to the near proximity of the works and direct water pathways to the Lower River Shannon SAC, although standard water protection measures as part of construction works will reduce the potential for effects.

R503 (through Newport Town)

The results of the analysis of the environmental effects of the R503 (through Newport Town) route ranges from **Imperceptible Negative to Moderate Negative.** Impacts to **Biodiversity and Water** are likely to be **Imperceptible Negative** due to lower potential for disturbance/displacement of hen harrier from increased activity from the construction works which will not contrast significantly with existing baseline condition on a busier regional road through a populated part of the SPA. Potential for impacts to water quality in the SAC is reduced due to distance of 1km of the SAC from the majority of the works. Impacts to **Public Roads and Road Users** is likely to be **Moderate Negative** due to the high value of the regional road, the larger number of Road Users which could be affected, and the potential effects on the planned pavement works by Tipperary County Council, particularly in Newport Town.

R503 (avoiding Newport Town)

The results of the analysis of the environmental effects of the R503 (avoiding Newport Town) route is likely to be **Imperceptible Negative** for **Biodiversity, Water, Public Roads and Road Users**. Impacts to Biodiversity (hen Harrier) is likely to be **Imperceptible Negative** due to lower potential for disturbance/displacement of hen harrier from increased activity from the construction works which will not contrast significantly with existing baseline condition on a busier regional road through a populated part of the SPA. Impacts to Water and water quality in the SAC is likely to be **Imperceptible Negative** due to distance of at least 1km of the SAC from the majority of the works, due to the poor quality of the existing road pavement and lightly trafficked nature of the Local Road; and the adequate carrying capacity of the R503. Impacts to **Public Roads and Road Users** are likely to be **Imperceptible Negative** due to the capacity to keep one lane of the R503 and the wider local roads open during works, the short duration of any road closures (1 to 2 weeks) on the narrower local roads and the reversibility of any impacts to road pavements with reinstatement following construction works.

Although **none of the Public Road route options are likely to have a significant effect on Biodiversity or Water**, when the emphasis is placed on biodiversity matters in this particular examination (the 3 No. alternative public road routes), either of the 'R503 routes' are preferable to the 'Local Road route through Toor' route, when the Hen Harrier species and the SAC is considered. When the effects on Material Assets are also taken into account, the R503 (avoiding Newport Town) is the best alternative. **Therefore the R503 (avoiding Newport Town) route alternative was chosen for the UGC route to the new station node at Mountphilips.**

Relevant Volume C3 EIAR Figures:

Figure GC 4-2: Alternative Routes considered for the 110kV UGC from Rear Cross to Coole Crossroads

4.6 Alternative Process

Within each design solution there can be a number of alternatives as to how the processes or activities of the development can be carried out e.g. the management of processes that affect the volumes and characteristics of emissions or traffic. Consideration of alternative process at the earlier stages in the evolution of a project is an effective way of avoiding adverse effects on the environment.

An examination of the processes associated with the project, by the Design and EIAR evaluation teams, resulted in alternative processes being devised to avoid, prevent or reduce environmental effects. These alternative processes are an intrinsic part of the design of the UWF Grid Connection project.

These alternative processes are listed and compared in Table 4.7 below.

Table 4-7: Alternative Processes introduced as part of the project design

Environmental Factor	Potential Significant Negative Effect	Alternative Process and Comparison of Environmental Effect
Air & Human Health (Local Residents)	Dust and noise from construction works and machinery	The Process: Construction works for various elements of the Whole UWF Project taking place at the same time. Alternative Process: Construction works in Knocknabansha, Knockmaroe, Knockcurraghbola Crownlands and Knockcurraghbola Commons townlands, which are within 350m of local residences, will not take place at the same time as either the UWF Related Works or Upperchurch Windfarm where those works also occur within 350m. *(This process forms Project Design Measures PD11, See Chapter 5, Section 5.2.3)* 110kV UGC construction works along the local roads L2264-50 and L6188-0, will not take place at the same time as the UWF Related Works Haul Route Works on these roads. The 110kV UGC construction works will also be scheduled so that the works do not occur on the same days as concrete deliveries for Consented UWF Turbines along these local roads. *(This process forms Project Design Measures PD07, See Chapter 5, Section 5.2.3)* Comparison: This timing of works will prevent significant cumulative effects to Air (Local Residents & Community), due to noise and dust from more than one source of construction works, that may have arisen should the works take place at the same time.
Water *(In this EIA Report Class 1 and Class 2 watercourses are watercourses which contain habitats suitable for fish and*	In-combination sedimentation effects to Water	The Process: Watercourse crossing works, earthworks, dewatering and excavation dewatering taking place, potentially at the same time, within 50m of a watercourse. Alternative Process: A phased approach will be undertaken in relation to excavations, excavation dewatering and any culvert replacement works, where these works occur within 50m of a watercourse. The phased approach will only permit one of main potential sediment producing activities (i.e. excavations,

Environmental Factor	Potential Significant Negative Effect	Alternative Process and Comparison of Environmental Effect
aquatic species, such as streams and rivers. Drains, on the other hand are generally classified as Class 3 and Class 4 watercourses, which means that they no fisheries value).		excavation dewatering or culvert replacement works), to be carried out within 50m a watercourse, at any one time. *(This process forms Project Design Measures PD26, See Chapter 5, Section 5.2.3)* Comparison: This management of works will avoid the potential for localised in-combination effects on surface water quality which could occur should all of the main potential sediment sources occur in close proximity of a watercourse at the same time. Carrying out these sources (activities) separately both reduces the risk of impacts occurring, and also makes management of each of the activities easier in order to ensure no significant effects occur.
Biodiversity (Hen Harrier)	Disturbance	The Process: Application of standard mitigation measures as per Scottish Natural Heritage Guidance 2017 – i.e. 'No construction works to be carried out within 500m of a hen harrier nest during the breeding season (March to August inclusive)'. Alternative Process: - UWF Grid Connection construction works during the Hen Harrier breeding season (March to August inclusive) will only take place at the Mountphilips Substation Site; construction of the 110kV UGC between the Mountphilips Substation site and the Consented UWF Substation compound will be carried out during the months of September to February inclusive. *(This process forms Project Design Measures PD01, See Chapter 5, Section 5.2.3)* - If works at Mountphilips Substation site are programmed to begin in the Hen Harrier breeding season (March to August) confirmatory Hen Harrier breeding surveys will be completed, before such works initiate, such that all pre breeding nuptial activity, nesting activity and active nests are recorded within 2km of the entire construction works area boundary. These surveys will be completed prior to the start-up of all construction activities. No works will take place within 2 km of any identified active Hen Harrier nest during the hen harrier breeding season. *(This process forms Project Design Measures PD02, See Chapter 5, Section 5.2.3)* Comparison: While the SNH guidance of 500m will make an disturbance to breeding hen harrier unlikely, the application of the alternative process for UWF Grid Connection (via PD01 and PD02) removes any potential for disturbance or displacement impacts and effectively puts constructions during the breeding season beyond 4km of known hen harrier nests.
Biodiversity (Bats)	Disturbance effects	The Process: Security lighting at the construction works area at Mountphilips Substation Compound and the Temporary Compound overnight for security, with motion sensor lights at the substation compound during operation. Construction working

Environmental Factor	Potential Significant Negative Effect	Alternative Process and Comparison of Environmental Effect
		hours during the standard 7am to 7pm regardless of the time of year, therefore requirement for lighting at works areas during the period October to March. Alternative Process: Security lighting will still be used, however: - All construction works will be carried out during daylight hours. All lighting will be cowled in order to prevent light spill and no lighting will be left turned on overnight. Lighting will be controlled by motion and time sensors to minimise the amount of time the lights are operational. *(This process forms Project Design Measures PD63, See Chapter 5, Section 5.2.3)* Comparison: Cowling and controlling the direction and the duration of lighting better mitigates the disturbance effect to Bats during the controlled lighting times. The restriction of working hours to daytime hours means that there will be no requirement for lighting at works areas, and thereby will avoid disturbance effects to foraging bats.

4.7 'Do-Nothing' Alternative

The 'do-nothing' alternative examines trends currently occurring in the environment and the effects caused by not proceeding with the development.

The subject application comprises the grid connection for Upperchurch Windfarm, therefore the 'do nothing' scenario of UWF Grid Connection not being developed is the secondary impact of Upperchurch Windfarm not being developed.

From an economical point of view (with increases in wealth a determinant of better health), the 'do nothing' scenarios also represents a 'lost opportunity cost' to the economy, both at local and county level. Should the Upperchurch Windfarm project not be developed, the following positive long term economic gain locally during the operation phase of Upperchurch Windfarm would not be realised; Annual commercial rates payments to Tipperary County Council of est. €1.2 million per annum for the lifetime of the windfarm; Annual community benefit payments to local organisations of est. €88,000; and in relation to the local economy - Annual rental payments to 36 local landowners of €700,000 annually for the lifetime of the windfarm.

From a national security of supply point of view, should the Upperchurch Windfarm not be developed, there would be no positive contribution to the balance of payments through the substitution of an indigenous energy source (wind) for an imported energy source (fossil fuels).

However, the most significant impact of a 'do-nothing' scenario is the consequence of inaction in relation to climate change remediation. According to the Environmental Protection Agency:

> *Climate change impacts are projected to increase in the coming decades and during the rest of this century. Uncertainties remain in relation to the scale and extent of these impacts, particularly during the second half of the century. The greatest uncertainly lies in how effective global actions will be in reducing greenhouse gas emissions. Predicted adverse impacts include:*
>
> - *sea level rise,*
> - *more intense storms and rainfall events,*
> - *increased likelihood and magnitude of river and coastal flooding and*
> - *water shortages in summer in the east*
> - *adverse impacts on water quality*
> - *changes in distribution of plant and animal species*
> - *effects on fisheries sensitive to changes in temperature*

Climate change represents a serious threat to the environment. In response to the serious consequences of climate change, Ireland has signed up to the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement (which came into force in November 2016), and will contribute to climate change remediation via the Nationally Determined Commitment tabled by the EU in March 2015 on behalf of Member States, which commits to at least a 40% reduction in EU-wide emissions by 2030 (compared to 1990 levels). Nationally, the White Paper 'Ireland's Transition to a Low Carbon Energy Future 2015 – 2030' aims to transform Ireland to a low carbon economy, with a target of 70% electricity generation to come from renewable sources by 2030. The Government of Ireland's Climate Action Plan 2019 iterates the 70% target of electricity from renewable sources by 2030, with on-shore wind envisaged as a key component of this effort.

In the 'do-nothing' alternative, **not developing the Upperchurch Windfarm project means that** there will be a **consequential loss of the carbon offset potential** and **the emission of 106,216 tonnes of greenhouse gases every year from the generation of electricity by fossil fuel plant would not be avoided**. If the UWF

Grid Connection does not proceed, the renewable generation for Upperchurch Windfarm will not be transported to the National Grid and the subsequent benefits of GHG offsets will not occur.

To conclude, the very high impact of Climate Change to biodiversity and to our human wellbeing, is reflected in the Irish Oireachtas declaring a climate and biodiversity emergency on the 9th May 2019.

The most significant impact of UWF Grid Connection not being developed is the secondary impact of Upperchurch Windfarm not being developed, this would be a **significant lost opportunity** to contribute to Ireland's action on **Climate Change remediation**.