
Chapter 25

Interactions

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25. INTERACTIONS

25.1 Introduction

The potential for interaction of environmental effects of the DART+ Coastal North project (“Proposed Development”) has been assessed throughout this EIAR, as part of the impact assessment process of the individual environmental factors in Chapters 6 to 24. These previous chapters have identified, described and assessed the relevant interactions arising between one or more of the individual environmental factors. This chapter of the EIAR presents a summary of those potential interactions. Close co-ordination and discussion between the wider EIA team has informed the assessment of interactions and the preparation of this chapter to ensure that interactions identified have been adequately assessed and where necessary mitigation proposed.

The chapter presents the legislation, policy and guidance used to inform the preparation of the interactions assessment (Section 25.2) and a summary table is presented identifying the interacting environmental factors for both the potential construction and operational impacts of the Proposed Development. The main chapters (Chapters 6 to 24 in Volume 2 of this EIAR) consider these interactions and detail the associated mitigation measures to address the potential effects.

25.2 Legislation, Policy and Guidance

25.2.1 Legislation

The Transport (Railway Infrastructure) Act 2001 (as amended) (“the 2001 Act”) provides for the making of a Railway Order application by Córas Iompair Éireann (“CIÉ”) to An Bord Pleanála (“the Board”). The European Union (Railway Orders) (Environmental Impact Assessment) (Amendment) Regulations 2021 (S.I. No. 743 of 2021) gives further effect to the transposition of the Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU (“the EIA Directive”) by amending the Transport (Railway Infrastructure) Act 2001 (“the 2001 Act”). The 2001 Act as amended (including by Statutory Instrument No. 743/2021) at section 37 requires, *inter alia*, that the application be made in writing and be accompanied by:

- A draft of the proposed Railway Order;
- A plan of the proposed railway works;
- A book of reference to a plan describing the works which indicates the identity of the owners and of the occupiers of the lands described in the Plan; and
- A report on the likely effects on the environment of the proposed railway works.

A report of the likely effects on the environment of the proposed railway works is addressed by the preparation of this Environmental Impact Assessment Report (EIAR) (previously referred to as an Environmental Impact Statement in Section 39 of the 2001 Act prior to the amendments effected by S.I. No. 743/2021). As mentioned, this EIAR is based on a coordinated approach in order to facilitate An Bord Pleanála carrying out a coordinated assessment with any assessment under Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (“the Habitats Directive”) (Council Directive 92/43/EEC of 21 May 1992) or Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (“the Birds Directive”).

By virtue of Section 38 of the 2001 Act the development which is the subject matter of a Railway Order is deemed to be exempted development and the provisions of Part IV of the Planning and Development Act 2000, which relates to architectural heritage and contains provisions in respect of “protected structures”, are disapplied where the works involved are authorised by a Railway Order.

An examination, analysis and evaluation is carried out by the Board in order to identify, describe and assess, in the light of each individual case, the direct and indirect significant effects of the proposed railway works, including significant effects derived from the vulnerability of the activity to risks of major accidents and disasters relevant to it, on: population and human health; biodiversity, with particular attention to species and habitats protected under the Habitats and Birds Directives; land, soil, water, air and climate; material assets, cultural heritage and the landscape, and the interaction between the above factors. The draft Railway Order makes specific provision for interference with apparatus which includes *inter alia* any substation, inspection chamber, junction box, booster station, pipe, sewer, drain, duct, tunnel, conduit, wire, cable, fibre, insulator, masts, support structures and such other thing as may be used by an undertaker for or in connection with the provision of a service to the public and an “undertaker” means any person or body with power and authority in relation to apparatus to install or relocate such apparatus or cause it to be installed or relocated.

In accordance *inter alia* with Section 39 of the 2001 Act and the provisions of the EIA Directive, CIÉ, as the applicant for this Railway Order, has ensured that the EIAR is prepared by competent experts; contains a description of the proposed railway works comprising information on the site, design, size and other relevant features of the proposed works; contains a description of the likely significant effects of the proposed railway works on the environment; contains the data required to identify and assess the main effects which the proposed railway works are likely to have on the environment; contains a description of any features of the proposed railway works, and of any measures envisaged, to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment; contains a description of the reasonable alternatives studied by the applicant – here CIÉ – which are relevant to the proposed railway works and their specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the railway works on the environment; contains a summary in non-technical language of the above information; takes into account the available results of other relevant assessments under European Union or national legislation with a view to avoiding duplication of assessments; in addition to and by way of explanation or amplification of the specified information referred above, the EIAR contains such additional information specified in Annex IV to the EIA Directive relevant to the specific characteristics of the particular railway works, or type of railway works, proposed and to the environmental features likely to be affected and in this regard Annex IV sets out the information which is referred to in Article 5(1) of the EIA Directive. Further the EIAR includes the information that may reasonably be required for reaching a reasoned conclusion in accordance with section 42B of the 2001 Act on the significant effects of the proposed railway works on the environment, taking into account current knowledge and methods of assessment. This assessment has been undertaken in accordance with the above legislative and regulatory regime.

The key legislation and guidance is also referenced in the preparation of the EIAR and is outlined in Chapter 1 (Introduction) (Sections 1.5, 1.6 and 1.7).

25.2.2 Guidance

This Chapter has been prepared with reference to the following guidance documents:

- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022);
- European Commission Guidance on the Preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU), (EC 2017); and
- Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions, European Commission (EC, 1999).

25.3 Methodology

The assessment of interactive effects has considered likely significant effects arising from impact interactions that may occur during the Construction Phase, Operational Phase and decommissioning of the Proposed Development. The approach has aligned with the above guidance and that described in Chapter 1 (Introduction). The study area is defined by the study areas of each of the individual environmental topic assessments, which are discussed in the relevant topic EIAR Chapters 6 – 24. The approach taken has been to:

- Identify the potential for interactions between different environmental topics over the life cycle of the project in matrix format, including consideration in terms of cumulative effects. The determination of interactions was facilitated through an iterative design process that included consultation between designers, environmental specialists and technical specialists. It also considers the potential for mitigation measures prescribed in respect of one particular environmental factor to give rise to unintended negative impacts in respect of one or more other factor, as appropriate; and
- Prepare a summary of the interactions between different environmental topics which have been identified and addressed in this EIAR.

25.3.1 Consultation

The EIAR coordination team consulted with the relevant specialists to inform the assessment of interactive effects. This included the facilitation of data exchange and coordination of relevant specialist's input into the assessment of potential interactions between environmental factors (addressed in more detail within the applicable chapters of the EIAR and mitigation measures identified to address such interactions). This was undertaken throughout the specialist impact assessment process.

25.3.2 Difficulties Encountered / Limitations

This chapter of the EIAR has been prepared with reference to current best practice and relevant guidelines. There were no difficulties encountered in preparing the assessment of interactions and inter-relationships of impacts.

25.4 Description of Potential Impacts

25.4.1 Interaction Matrix

The potential significant interactions between factors are identified in Table 25-1. The effects matrix identifies the factors in the left-hand column, which have the potential to impact on other factors listed in the top row of the matrix. Where a tick '✓' exists, this indicates that the Proposed Development has potential to result in an interaction between the two factors. Where there is no potential for an interaction between factors, this is indicated by a hyphen 'X' in the matrix.

The purpose of the matrix is to identify the likely interactive effects of significance. A description of the interactive effect is provided in Section 25.4 along with a reference to where the assessment has been completed in Chapters 6 – 24.

Table 25-1 Interactive Effects Summary Matrix Identifying Interactions Between Factors

	Traffic & Transport		Population		Biodiversity		Land & Soils		Water		Hydrogeology		Air Quality & Climate		Noise & Vibration		Landscape & Visual		Ag & Non-Ag		Utilities, Resource & Waste Mngt		Built Heritage		EMF		Human Health	
	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O
Traffic and Transport																												
Population	✓	✓																										
Biodiversity	✓	✓	X	X																								
Land & Soils	X	X	X	X	X	X																						
Water	✓	✓	X	X	✓	✓	✓	✓																				
Hydrogeology	X	X	X	X	✓	✓	✓	✓	✓	✓																		
AQ & Climate	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X																
Noise & Vibration	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X														
Landscape & Visual	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X												
Ag & Non-Ag	X	X	X	X	✓	✓	X	X	X	X	X	X	X	X	X	X	✓	✓										
Utilities, Resource & Waste Mngt	✓	✓	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	✓	X	X	X								
Built Heritage	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	✓	✓	X	X	X	X						
EMF (Electro-magnetic Fields)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	X	X					
Human Health	✓	✓	✓	✓	X	X	X	X	X	X	X	X	✓	✓	✓	✓	X	X	X	X	X	X	X	X	✓	✓		

Note: 'C' denotes Construction Phase, 'O' denotes Operational Phase

25.4.2 Traffic & Transportation

As identified in Table 25-1 interactions between Traffic and Transportation and the following factors have been identified and assessed:

- Population;
- Biodiversity;
- Water (including Hydrology & Flood Risk);
- Air Quality and Climate;
- Noise and Vibration;
- Landscape and Visual;
- Material Assets – Utilities;
- Material Assets – Resource and Waste Management; and
- Human Health.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.2.1 Population

The construction of the Proposed Development will result in increased construction traffic (including but not limited to HGV) using the national road network, particularly in the vicinity of Construction Compounds and along the Proposed Development. This will likely impact on the journey characteristics and journey amenities of road users (motorised vehicles, cyclists, and pedestrians). While construction traffic will initially use national/ regional routes for access to the local area, construction traffic may be routed through existing urban and/ or rural areas to gain local access and this will include residential, community, educational, medical, and commercial areas. Access to community infrastructure and amenities will be maintained as far as practicable during the Construction Phase however, there is a potential for impacts to occur due to an increase in traffic during both daytime and night-time construction works.

Delays and longer commute times for some road traffic may occur in some locations due to increased traffic levels. A number of road closures and traffic diversions will be required over the course of the Construction Phase. Although temporary in nature these closures will impact on resident communities and also on commuters (other public transport, car, pedestrian and cyclist) that need to access the construction impact zone to commute to work and services. Impacts will include delays, congestion, increased traffic volumes on diversion routes as well as limitations on space for vulnerable road users. Increased noise and reduced air quality may potentially occur. Additionally, there will be disruption of the rail services associated with construction works where track possession is required during railway operational hours. This will include weekend possessions which will interrupt commuter services.

During the Operational Phase, traffic and transport factors will interact to give rise to positive effects also, notably enhanced multimodal connectivity through interchanges with other public transport networks and increased services to existing DART users and new DART services to settlements within the vicinity of the railway corridor between Malahide and Drogheda MacBride Stations.

Chapter 7 (Population) assesses impacts on Population from traffic and transport proposals. Mitigation measures are proposed to minimise effects of traffic and transport on Population as relevant.

25.4.2.2 Biodiversity

The Construction Phase of the Proposed Development will result in increased traffic and transportation within the study area. These increases have the potential to negatively impact on Biodiversity through temporary habitat fragmentation, increased noise and light disturbance, pollution, and mortality. Construction traffic and other related construction activities such as watercourse crossings can present as a temporary barrier and/ or hazard to mobile species such as otter, bats, badger, and fish. Construction vehicles can produce sediment runoff through potential spillage of hydrocarbons and other materials with potential to impact on water quality, which may subsequently have negative impacts for aquatic species. Furthermore, the transport of machinery, equipment and material during the Construction Phase can facilitate the introduction and/ or spread of invasive species.

During the Operational Phase, there is potential for collision of birds and bats with electrification infrastructure. There is also the potential for long-term habitat fragmentation where linear features are not reinstated. This is particularly the case in the urban environment where alternatives are limited.

Chapter 8 (Biodiversity) assesses impacts from traffic and transport proposals on the Biodiversity along the route. Mitigation measures are proposed to minimise the effects of Traffic and Transport on sensitive ecological features.

25.4.2.3 Water (including Hydrology and Flood Risk)

There is a potential for contaminated run off from the machinery on site during the Construction Phase. The increased traffic and transportation levels associated with the proposed works increase the risk of hydrological contamination via diffuse and point sources such as road runoff or oil/ fuel spills. Any such spills have the potential to negatively impact water quality in the surrounding hydrological regimes. This potential interaction is more likely during the Construction Phase. Mitigation measures are proposed within Chapter 10 (Water) and Appendix A5.1 (CEMP) in Volume 2 of this EIA to minimise the potential impacts during the Construction Phase. No significant adverse impacts are likely to arise during the Construction Phase following the implementation of mitigation measures.

During the Operational Phase, water quality can be impacted with any accidental release of oils, fuels, and chemicals, hydraulic fluids etc. from road service vehicles, trains etc. Measures to control the risk of flooding and contamination to local waterbodies and the hydrological environment have been included within the design of the Proposed Development. Maintenance of the railway and substations will be on-going to ensure the risks are minimised during the Operational Phase. Maintenance activities will be in accordance with Iarnród Éireann best practice procedures to ensure that no additional risks to waterbodies are encountered. Following implementation of the mitigation measures outlined Chapter 10 (Water), no significant impacts are anticipated on any of the receptors and no significant residual risks are envisaged during the Operational Phase.

Chapter 10 (Water) assesses impacts from traffic and transport proposals. Mitigation measures are proposed to minimise effects of traffic and transport on the receiving water environment.

25.4.2.4 Air Quality and Climate

The generation of road traffic due to the Construction Phase delivery of materials, removal of waste and redistribution of other road users has the potential to impact air quality including an increase in emissions of particulate matter, nitrogen dioxides and greenhouse gases (GHS). This will be particularly the case where road closures and diversions lead to localised congestion during the Construction Phase and a resultant increase in pollution and emissions for the duration of the closure/ diversion. HGV traffic leaving construction sites also has the potential to generate dust emissions due to track-out of dust from the vehicle wheels to public roads. No significant adverse impacts are likely to arise during the Construction Phase following the implementation of mitigation measures.

During the Operational Phase, the impact on Air Quality and Climate will be broadly neutral as the electrification of the lines will facilitate a shift toward an electrified fleet (EMU) and away from a reliance on a diesel fleet in terms of rail transport as well as a modal shift away from motor vehicles for road transport with long term positive effects for air quality and climate.

Chapter 12 (Air Quality) assesses impacts from traffic and transport proposals. Mitigation measures are proposed to minimise effects of Traffic and Transport on sensitive receptors as relevant.

Chapter 13 (Climate) assesses impacts from traffic and transport emissions. Mitigation measures are proposed to minimise effects of traffic and transport on achievement of climate related targets.

25.4.2.5 Noise and Vibration

The construction of the Proposed Development will result in an increase in the traffic volumes on local roads due to road closures and diversions and an increase in HGV movements around Construction Compounds and along haul routes. The movements will contribute to increased noise levels. Works are likely to take place during day and night time and will have an impact on the baseline noise levels. However, these impacts are short-term and mitigation measures will include best practice noise control measures, appropriate hours of operation and scheduling of works. This will ensure noise impacts are controlled as far as practicable during the Construction Phase. Vibration impacts relating to construction traffic will be limited given the low generation of vibration from vehicles along well-maintained roads.

During the Operational Phase, no significant noise impacts associated with the operation of the railway have been identified. There is a potential for a reduction in road traffic noise over the long-term where a modal shift away from motor cars can be achieved.

Chapter 14 (Noise and Vibration) assesses impacts from traffic and transport proposals. Mitigation measures are proposed to minimise effects of traffic and transport on sensitive noise receptors as relevant.

25.4.2.6 Landscape and Visual

During the Construction Phase, Construction Compounds and associated HGV movements along haulage routes to and from construction sites are likely to have temporary visual impacts on visual receptors.

During the Operational Phase, there will be permanent change to visual amenity due to the introduction of modified bridges, new OHLE infrastructure and new substations, etc along with increased frequency of passing rail traffic.

Chapter 15 (Landscape and Visual) assesses impacts from traffic and transport proposals. Mitigation measures are proposed to minimise effects of traffic and transport on sensitive receptors as relevant.

25.4.2.7 Material Assets – Utilities

There will be temporary diversions or repositioning and specification for permanent reinstatement of utility services during the Construction Phase.

During the Operational Phase, there will be permanent alterations to utility services.

Chapter 18 (Material Assets – Utilities) assesses impacts from traffic and transport proposals on utilities including built services. Mitigation measures are proposed to minimise effects of traffic and transport on these receptors as relevant.

25.4.2.8 Material Assets – Resource and Waste Management

During the Construction Phase there is potential for direct and indirect interaction between Resource Management and construction of the Proposed Development. Resources are required to deliver the project including electrification infrastructure, track infrastructure, concrete, rebar for bridge replacements etc. This material will have to be transported by road to site. Similarly, materials arising from construction of the Proposed Development, e.g. excavated spoils, concrete, glass, bricks, wood etc from demolitions, which cannot be reused on site will require transport off site to suitable recovery, recycling, treatment and disposal facilities. This will require truck and HGV movements, resulting in construction traffic on the local road network.

During the Operational Phase, there will be generation of waste from the passenger trains and track maintenance. This is anticipated to be limited in nature and will be included in existing transport arrangements for disposal of materials arising at all Iarnród Éireann services.

Chapter 19 (Material Assets – Resource and Waste Management) assesses impacts from traffic and transport proposals on materials and waste. Mitigation measures are proposed to minimise effects of traffic and transport on these receptors as relevant.

25.4.2.9 Human Health

The increased traffic during the Construction Phase may result in indirect impacts related to Air Quality and Noise levels on human health. The changes in traffic flow rate and risks of accidents/injuries can also have a negative impact on health across the community. However, the opportunities for income and employment generation have the potential to affect Human Health positively through the delivery of the Proposed Development.

There is a potential for benefits during the Operational Phase including improved air quality due to electrification of the rail fleet and overall increased capacity of the rail services. Opportunities for a modal shift to public transport and active travel options will also benefit human health.

Chapter 23 (Human Health) assesses impacts from traffic and transport proposals. Mitigation measures are proposed to minimise effects of traffic and transport on sensitive receptors as relevant.

25.4.3 Population

As identified in Table 25-1 interactions between Population and the following factors have been identified and assessed:

- Traffic and Transportation;
- Air Quality and Climate;
- Noise and Vibration;
- Human Health; and
- Landscape and Visual.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.3.1 Traffic and Transportation

See Section 25.4.2 above.

25.4.3.2 Air Quality and Climate

Related to Traffic and Transportation emissions. See Section 25.4.2.4 above.

25.4.3.3 Noise and Vibration

The increased noise and vibration levels during the Construction Phase will emanate from traffic and transport sources (See Section 25.4.2.1 above) and from construction activities such as demolitions, excavations and piling. These activities can cause disturbance to local populations in the surrounding areas of the Proposed Development, negatively impacting on enjoyment of indoor and outdoor spaces including residential, recreational areas and public spaces in the surrounding areas due to exposure to increased noise levels and/or vibration.

During the Operational Phase, the population along the Proposed Development will experience changes in noise and vibration character as a result of the higher frequency of trains, modifications to track alignments and substation noise.

Chapter 14 (Noise and Vibration) assesses impacts on noise sensitive receptors in the receiving environment. Mitigation measures are proposed to minimise effects on these noise sensitive receptors as relevant.

25.4.3.4 Human Health

Interactions between Population and Human Health are via the impact pathways of emissions to air and noise arising from traffic and transport and construction activities as discussed above in this section and in Section 25.4.2.1 above.

25.4.3.5 Landscape and Visual

There is potential for the landscape to interact with the surrounding population as a result of the design of the Proposed Development. Chapter 15 (Landscape and Visual) assesses impacts on nearby sensitive receptors in the receiving environment. Mitigation measures are proposed to minimise effects on these sensitive receptors as relevant. These interactions are considered in Chapter 7 (Population) and Chapter 15 (Landscape and Visual) in Volume 2 of this EIA.

25.4.4 Biodiversity

As identified in Table 25-1 interactions between Biodiversity and the following factors have been identified and assessed:

- Traffic and Transportation;
- Water (including Hydrology & Flood Risk);
- Hydrogeology;
- Air Quality and Climate;
- Noise and Vibration;
- Landscape and Visual;
- Material Assets – Agriculture/Non-agriculture;
- Built Heritage (including Archaeology, Architecture and Cultural Heritage).

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIA.

25.4.4.1 Traffic and Transportation

See Section 25.4.2 above.

25.4.4.2 Water (including Hydrology & Flood Risk) and Hydrogeology

There is a potential for interaction between Water and Biodiversity during the Construction Phase and the Operational Phase of the Proposed Development. During the Construction Phase, there is a potential for release of suspended solids and other polluting substances from construction traffic and other construction activities such as earthworks, to waterbodies resulting in negative effects for water quality. Pollution control measures have been included in the CEMP to address this.

During the Operational Phase of the Proposed Development, there is potential for pollution impacts on water quality from ongoing operational activities, which may in turn impact upon biodiversity. Inspection and maintenance will occur to ensure that drainage features such as attenuation tanks operate as intended for the design life of the railway to prevent pollution of watercourses.

Chapter 10 (Water) assessed impacts on the receiving water environment including drainage and flooding. Mitigation measures are proposed in Chapter 8 (Biodiversity) and in Chapter 10 (Water) to minimise effects on biodiversity as a result of interactions with this factor as relevant.

Chapter 11 (Hydrogeology) assessed impacts on the receiving hydrogeological environment. Mitigation measures are proposed in Chapter 8 (Biodiversity) and in Chapter 11 (Hydrogeology) to minimise effects on biodiversity as a result of interactions with this factor as relevant.

25.4.4.3 Air Quality and Climate

There is potential for interactions between Air Quality, Climate and Biodiversity during both the Construction Phase and Operational Phase. These relate to emissions of nitrogen oxides and dust settling on vegetation which can hamper growth. Mitigation measures are proposed in Chapter 12 (Air Quality) and in Chapter 13 (Climate) to minimise effects on Air Quality and Climate as a result of interactions with this factor as relevant.

25.4.4.4 Noise and Vibration

There is potential for interactions between Noise and Vibration and Biodiversity at the construction and operational phase, related to disturbance from construction traffic, demolitions, earthworks, piling, and soil nailing and ongoing disturbance during operation from road, rail and passenger traffic associated with the Proposed Development. Construction works in particular will result in disturbance to fauna in the areas within and in proximity to the Proposed Development boundary, including birds and bats. This ongoing noise and vibration disturbance may result in reduction or limitations to available feeding, resting, nesting, and breeding areas. During the operational phase, noise emissions will be of a different nature, typically associated with road traffic, passing EMU and diesel trains and people accessing stations.

Chapter 14 (Noise and Vibration) assesses impacts on the receiving environment. Mitigation measures are proposed in Chapter 8 (Biodiversity) to minimise effects on biodiversity as a result of interactions with noise and vibration.

25.4.4.5 Landscape and Visual

There is potential for interactions between Landscape and Visual and Biodiversity during the Construction Phase and Operational Phase. Construction works including site clearances and earthworks will involve permanent severance of some hedgerows and removal of trees. This has the potential to subsequently lead to permanent changes to the existing habitats and thereby landscape and amenity of the area of the Proposed Development. There is also a potential that development of new lighting and infrastructure which will cause disturbance to bird or bat species present in the vicinity of the Proposed Development.

During the Operational Phase interactions relate to the landscape design elements used in the project. The proposed mitigation to address landscape and visual impacts arising from the Proposed Development have the potential for interaction with biodiversity by way of the nature and extent of planting proposed. To support biodiversity and contribute to maintenance of the ecological network, appropriate planning will be required in the landscape design.

The choice of species and the extent of planting will have operational interactions with potential for positive effects. Mitigation measures are proposed in Chapter 15 (Landscape and Visual) to minimise effects on Biodiversity as a result of interactions with this factor as relevant.

Chapter 15 (Landscape and Visual) assesses impacts on the receiving landscape environment including biodiversity.

25.4.4.6 Material Assets – Agriculture/Non-agriculture

There is potential for interactions between Agricultural, Non-agricultural Material Assets and Biodiversity during both the Construction Phase and Operational Phase, related to land use change. During site clearance, lands required to construct and operate the Proposed Development will be cleared. This includes (as necessary) topsoil stripping, vegetation clearance, demolition/modification of bridges. These features all have potential to support biodiversity directly and indirectly. Bats have not been identified among trees and other structures which will be removed to facilitate the Proposed Development however additional surveys will be required pre-construction to ensure this is still the case before works start. Other mobile species use existing features as linear cover to move along and between territories. Other non-mobile plant and animal species rely on the walls and land as substrate to grow. This has the potential to result in disturbance and mortality to habitats and species encountered prior to ecological resolution on site, e.g. relocation of badger setts, fencing of invasive species, etc. It is essential that the sequence of enabling works permits the advanced survey work necessary to secure all biodiversity receptors in advance topsoil stripping. Similarly, prior to interference with any features identified as ecological receptors, notably bridges, resolution of bat issues must precede any works on these features. A Project Ecologist (ecological clerk of works) will be essential to inform the sequencing.

No interactions are anticipated during the Operational Phase subject to resolution of issues at pre-construction stage. While the main interaction will be during the Construction Phase when these features are removed, there will be a permanent long-term loss of habitat and a long term land use change as a result.

Chapter 16 (Material Assets: Agricultural) and Chapter 17 (Material Assets: Non-agricultural), assess potential impacts on land from the Proposed Development. Mitigation measures are proposed in Chapter 8 (Biodiversity) to minimise effects on Biodiversity as a result of interactions with this factor as relevant.

25.4.4.7 Built Heritage (including Archaeology, Architectural and Cultural Heritage)

During pre-construction enabling works, further archaeological testing may be undertaken along the Proposed Development in sensitive areas if required. This has the potential to result in disturbance and mortality to habitats and species encountered prior to ecological resolution on site, e.g. relocation of badger setts, fencing of invasive species etc. It is essential that the sequence of enabling works permits the advanced survey work necessary to secure all biodiversity receptors in advance topsoil stripping. Similarly, prior to interference with any features identified as ecological receptors, notably bridges resolution of bat issues must precede any works on these features. A Project Ecologist (ecological clerk of works) will be essential to inform the sequencing.

No interactions are anticipated during the Operational Phase subject to resolution of issues at pre-construction stage.

Chapter 20 (Archaeology and Cultural Heritage) and Chapter 21 (Architectural Heritage), assess impacts on built heritage. Mitigation measures are proposed in Chapter 8 (Biodiversity) to minimise effects on Biodiversity as a result of interactions with this factor as relevant.

25.4.5 Land & Soils

As identified in Table 25-1 interactions between Land and Soils and the following factors have been identified and assessed:

- Water (including Hydrology & Flood Risk)
- Hydrogeology; and
- Material Assets – Utilities, Resource and Waste Management.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.5.1 Water (including Hydrology & Flood Risk) and Hydrogeology

There is potential for interactions between Land and Soils and Water during the Construction Phase and Operational Phase of the Proposed Development. This arises from the potential for accidental emissions and release of potentially hazardous substances to surface and groundwater leading to a deterioration in water quality. The source of pollution during the Construction Phase may include contaminated soils, fuels, concrete and other construction materials. Accidental spillages of fuels, chemicals or other contaminants during construction works may also result in localised contamination of soils/ subsoils underlying the site which may act as a conduit for groundwater contamination.

Large-scale and widespread excavation and removal of topsoil, subsoil and bedrock during construction may also result in loss of suspended solids to surface water leading to localised deterioration in water quality with potential for ongoing erosion of soils along the length of the Proposed Development.

During the Operational Phase this is related to accidental spillages of fuels, chemicals or other contaminants during operation and maintenance activities which may result in localised contamination of soils.

Chapter 9 (Land and Soils) assesses the impacts to the receiving geological environment. This impact has also been considered in Chapter 10 (Water (including Hydrology and Flood Risk)) and Chapter 11 (Hydrogeology). Mitigation measures are proposed in these chapters to minimise effects on water as a result of interactions with these factors, as relevant.

25.4.5.2 Material Assets –Utilities, Resource and Waste Management

There is potential for interactions between Land and Soils and Materials Assets, notably waste management as a result of the excavated materials which will be generated during construction and the potential for excavation of contaminated soils during the Construction Phase and generation of contaminated material, e.g. ballast during operation and maintenance.

Chapter 19 (Resource and Waste Management) assesses the impact on Resource and Waste Management and considers the nature and quantity of materials arising from the Construction and Operational Phases of the Proposed Development. Mitigation measures are proposed to minimise effects on Resource and Waste Management as a result of interactions with this factor, as relevant.

25.4.6 Water (including Hydrology & Flood Risk)

As identified in Table 25-1 interactions between Water (including Hydrology & Flood Risk) and the following factors have been identified and assessed:

- Traffic and Transportation;
- Biodiversity;
- Land and Soils; and
- Hydrogeology.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.6.1 Traffic and Transportation

See Section 25.4.2 above.

25.4.6.2 Biodiversity

See Section 25.4.4 above.

25.4.6.3 Land and Soils

See Section 25.4.5 above.

25.4.6.4 Hydrogeology

There is potential for interactions between Water and Hydrogeology during the Construction Phase and Operational Phase of the Proposed Development. This arises from the potential for accidental emissions and release of potentially hazardous substances to groundwater leading to a deterioration in groundwater quality. The source of pollution during the Construction Phase may include contaminated soils, fuels, concrete and other construction materials. Accidental spillages of fuels, chemicals or other contaminants during construction works may also result in localised contamination of soils/ subsoils underlying the site which may act as a conduit for groundwater contamination.

During the Operational Phase this is related to accidental spillages of fuels, chemicals or other contaminants during operation and maintenance activities which may result in localised groundwater contamination.

Chapter 10 (Water) assesses the impacts to the receiving water environment. This has been considered in Chapter 11 (Hydrogeology) and mitigation measures are proposed to minimise effects on Water as a result of interactions with this factor, as relevant.

25.4.7 Hydrogeology

As identified in Table 25-1 interactions between Hydrogeology and the following factors have been identified and assessed:

- Biodiversity;
- Land and Soils; and
- Water (including Hydrology & Flood Risk).

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.7.1 Biodiversity

See Section 25.4.4 above.

25.4.7.2 Land and Soils

See Section 25.4.5 above.

25.4.7.3 Water (including Hydrology & Flood Risk)

See Section 25.4.6 above.

25.4.8 Air Quality and Climate

As identified in Table 25-1 interactions between Air Quality and Climate and the following factors have been identified and assessed:

- Traffic and transportation;
- Population;
- Biodiversity; and
- Human Health.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.8.1 Traffic and transportation

See Section 25.4.2 above.

25.4.8.2 Population

See Section 25.4.3 above.

25.4.8.3 Biodiversity

See Section 25.4.4 above.

25.4.8.4 Human Health

There is a potential for interaction between Air Quality and Human Health during both the Construction Phase and Operational Phase of the Proposed Development. The generation of road traffic during the Construction Phase has the potential to impact air quality including an increase in the emissions of particulate matter and nitrogen oxides and GHG giving rise to the potential for local air quality impacts for residents located along the roads proposed as diversionary routes and haul routes. Where traffic levels are in excess of 10% of the baseline, there is a potential for significant effect on air quality for these residents. The routes where the greatest changes to road traffic as a result of the diversions and/ or construction traffic have been assessed for local impact. Levels are compared against statutory limits and WHO guidelines for exposure. The greatest potential impact on Air Quality during the Construction Phase is from construction dust emissions and the potential for nuisance dust. Potential impacts typically occur to humans within 350m of the route used by construction vehicles on the public road, up to 500m from the site entrance.

The impact on Air Quality and Climate during the Operational Phase will be broadly neutral as the electrification of the lines will facilitate a shift toward EMU and away from a reliance on a diesel fleet in terms of rail transport as well as a modal shift away from motor vehicles for road transport with long term positive effects for Air Quality and Climate and indirectly for Human Health.

Chapter 12 (Air Quality) assesses the impacts of the Proposed Development on Air Quality having regard to statutory emission limits set for the protection of human health and climate.

25.4.9 Noise & Vibration

As identified in Table 25-1 interactions between Noise and Vibration and the following factors have been identified and assessed:

- Traffic and transportation;
- Population;
- Biodiversity; and
- Human Health.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.9.1 Traffic and transportation

See Section 25.4.2 above.

25.4.9.2 Population

See Section 25.4.3 above.

25.4.9.3 Biodiversity

See Section 25.4.4 above.

25.4.9.4 Human Health

There is potential for interactions between Noise and Vibration and Human Health particularly during the Construction Phase of the Proposed Development. A key feature of the construction works relevant to the Proposed Development is the proximity of works to noise sensitive receptors, as well as the duration, and extent of noise generating activities proposed. These include noise emissions from construction traffic along haul routes, enhanced road traffic movements associated with road closures, diversions, machinery used for demolition and excavations, machinery used for construction and significant noise generation activities such as piling. Some of these activities will be carried out in close proximity to residences, schools, medical facilities, commercial and recreational facilities. These activities will also take place during both daytime and nighttime hours and on weekends. Sensitive noise receptors may experience temporary significant noise and vibration impacts over the Construction Phase with potential for negative effects on Human Health on the short term.

Chapter 22 (Human Health) assesses the impacts of the Proposed Development on people having regard to emission limits set for the protection of human health.

25.4.10 Landscape & Visual Amenity

As identified in Table 25-1 interactions between Landscape and Visual the following factors have been identified and assessed:

- Traffic and transportation;
- Biodiversity;
- Material Assets: Agricultural/Non-Agricultural Properties;
- Material Assets: Utilities, Waste and Resource Management;
- Built Heritage (including Archaeology, Architecture and Cultural Heritage); and
- Population.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIA.

25.4.10.1 Traffic and transportation

See Section 25.4.2 above.

25.4.10.2 Biodiversity

See Section 25.4.4 above.

25.4.10.3 Material Assets: Agricultural/Non-Agricultural Properties

Potential for interactions between Landscape and Visual and Material Assets: Agricultural and Non-agricultural properties has been noted for both the Construction Phase and Operational Phase. Land use change required to deliver the Proposed Development will result in a change to the landscape character along the route, albeit recognising that several areas are identified for development in relevant land use plans.

Notwithstanding this, CIÉ lands and 3rd party lands will be required for works associated with construction which will necessitate demolition/modification of bridges and the use of small to medium sized open space and industrial areas for Construction Compounds. Construction Compounds will be reinstated following construction if they are not required for the permanent works (such as new substations). The long term will see altered land use patterns associated with substations and track widening to facilitate the works.

Chapter 16 (Material Assets: Agricultural Properties) and Chapter 17 (Material Assets: Non-Agricultural Properties) assess the impacts of the Proposed Development on agricultural and non-agricultural material assets having regard to lands within CIÉ ownership, private lands and also the requirements of the compulsory purchase order (CPO) for the Proposed Development.

25.4.10.4 Material Assets: Utilities, Waste and Resource Management

Potential for interactions between Landscape and Visual and Material Assets Utilities, Resource and Waste Management have been noted during the Construction Phase. This relates to the potential for re-use of materials arising on site for landscaping to achieve a better materials balance.

Chapter 18 (Material Assets: Utilities) and Chapter 19 (Material Assets: Resource and Waste Management) assess the impacts of the Proposed Development on Utilities and Resource and Waste Management having regard to options for reuse of materials.

25.4.10.5 Built Heritage (including Archaeology, Architecture and Cultural Heritage)

Interaction with the built heritage is anticipated during both Construction Phase and the Operational Phase. The Proposed Development will be delivered while coming into contact with many heritage features with the potential to change the nature and setting of associated features notably stations and bridges along the length of the Proposed Development. Several heritage bridges will be directly impacted by the Proposed Development, permanently altering the historic landscape.

Potential visual impacts on archaeological, architectural and cultural heritage features during the Operational Phase will be incurred as a result of changes in the character of the receiving historic environment.

Chapter 20 (Archaeology and Cultural Heritage) and Chapter 21 (Architectural Heritage) assess the impacts of the Proposed Development on Built Heritage having regard to statutory heritage designations and associated legal protections.

25.4.10.6 Population

See Section 25.4.3 above.

25.4.11 Material Assets: Agricultural and Non-agricultural Properties

As identified in Table 25-1 interactions between Material Assets: Agricultural and Non-Agricultural properties the following factors have been identified and assessed:

- Biodiversity; and
- Landscape and Visual.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.11.1 Biodiversity

See Section 25.4.4 above.

25.4.11.2 Landscape and Visual

See Section 25.4.10 above.

25.4.12 Material Assets: Utilities, Resource & Waste Management

As identified in Table 25-1 interactions between Material Assets: Agricultural, Non-Agricultural properties and Waste management and the following factors have been identified and assessed:

- Traffic and Transportation;
- Land and Soils;
- Landscape and Visual; and
- Electromagnetic Effects and Stray Current.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.12.1 Traffic and Transportation

See Section 25.4.2 above.

25.4.12.2 Land and Soils

See Section 25.4.5 above.

25.4.12.3 Landscape and Visual

See Section 25.4.10 above.

25.4.12.4 Electromagnetic Effects and Stray Current

Interaction with Electromagnetic Effects and Stray Current is possible primarily in relation to utilities during the Operational Phase of the project. Stray current has the potential to cause accelerated decay of certain types of material used in built services such as water mains, gas pipelines etc. unless protection distances are maintained. Similarly, interference can occur with other services where stray current may cause impact such as railway signalling.

Chapter 23 (Electromagnetic Effects and Stray Current) assesses the impacts of the Proposed Development in terms of Electromagnetic Effects and Stray Current having regard both to impacts on the rail system and impacts from the rail system. Mitigation and embedded design measures are proposed to ensure separation/ protection distances are maintained.

25.4.13 Built Heritage (including Archaeology, Architectural and Cultural Heritage)

As identified in Table 25-1 interactions between Built Heritage (including Archaeology, Architectural and Cultural Heritage) and the following factors have been identified and assessed:

- Biodiversity; and
- Landscape and Visual.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.13.1 Biodiversity

See Section 25.4.4 above.

25.4.13.2 Landscape and Visual

See Section 25.4.10 above.

25.4.14 Electromagnetic Effects & Stray Current

As identified in Table 25-1 interactions between Electromagnetic Effects and Stray Current and the following factors have been identified and assessed:

- Landscape and Visual;
- Material Assets: Utilities, Waste and Resource Management; and
- Human Health.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.14.1 Material Assets: Utilities, Waste and Resource Management

See Section 25.4.12 above.

25.4.14.2 Human Health

There is potential for interaction between Electromagnetic Effects and Stray Current and Human Health during the Operational Phase of the Proposed Development. International guidelines for limits on the levels of EMF required to protect the public and workers from established acute adverse health effects are published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The guidelines establish basic restrictions on exposure based on a systematic review of all available scientific evidence regarding health effects due to EMFs. The guidelines also provide reference levels on easily measured or estimated characteristics of EMFs that guarantee that the basic restrictions are satisfied if the reference levels are not exceeded. The ICNIRP limits have been adopted by the European Commission for the public and occupational exposure within EU Recommendation 1999/519/EC and the EMF Directive respectively. Exposure assessments have been made against the reference levels.

Chapter 23 (Human Health) assesses the impacts of the Proposed Development in terms of Human Health. Mitigation and embedded design measures are proposed to ensure protection of human health.

25.4.15 Human Health

As identified in Table 25-1 interactions between Human Health and the following factors have been identified and assessed:

- Traffic and Transportation;
- Population;
- Air Quality;
- Noise and Vibration; and
- Electromagnetic Effects and Stray Current.

There is also potential for these interactions to go beyond the Proposed Development in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.4.15.1 Traffic and Transportation

See Section 25.4.2 above.

25.4.15.2 Population

See Section 25.4.3 above.

25.4.15.3 Air Quality

See Section 25.4.8 above.

25.4.15.4 Noise and Vibration

See Section 25.4.9 above.

25.4.15.5 Electromagnetic Effects and Stray Current

See Section 25.4.14 above.

25.5 Mitigation Measures

As described in the previous sections, interactions occur between many of the environmental factors. The assessments for each of these environmental factors undertaken in this EIAR have considered, and taken cognisance of these direct, indirect, cumulative, and synergistic interactions during both the Construction Phase and the Operational Phase of the Proposed Development. The individual environmental assessments have identified appropriate mitigation measures to address these interactions to avoid, reduce or mitigate likely significant environmental effects which are described, and residual effects identified in the respective specialist chapters of this EIAR. Therefore, no additional mitigation is proposed in this chapter.

25.6 Cumulative Effects

The cumulative impacts assessment is presented in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

25.7 References

Environmental Protection Agency (EPA) (2022). Guidelines on the information to be Contained in Environmental Impact Assessment Reports.

European Commission (EC) (1999). Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions European Commission.