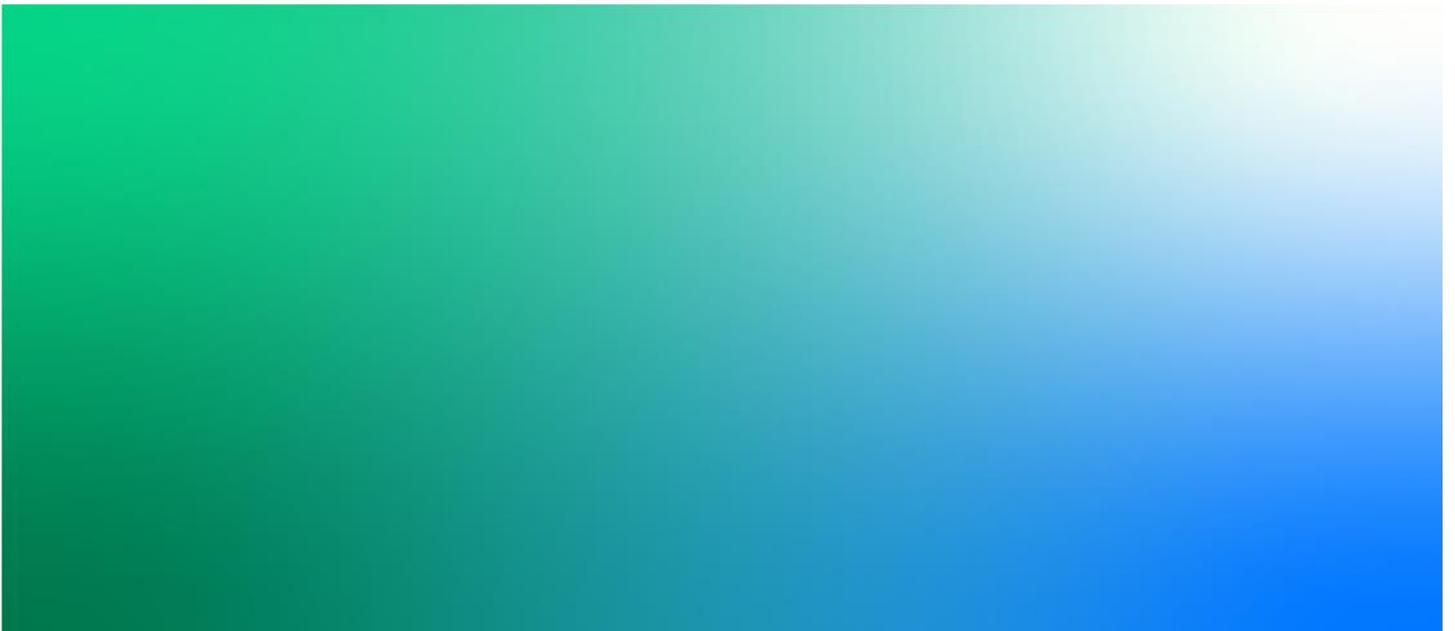


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Cork Line Level Crossings
Volume 3, Chapter 16 Cross Cutting Themes
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Table of Acronyms

Acronym	Meaning
AADT	Annual Average Daily Traffic Flow
CEMP	Construction Environmental Management Plan
CO	Carbon monoxide
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent
DMP	Dust Management Plan
DMRB	Design Manual for Roads and Bridges
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIRP	Environmental Incident Response Plan
ERP	Emergency Response Plan
EPA	Environmental Protection Agency
EU	European Union
FRA	Flood Risk Assessment
HDV	Heavy Duty Vehicle
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
LC	Level Crossing
LDVs	Light Duty Vehicles
MANDs	Major Accidents and/or Natural Disasters
NIS	Natura Impact Statement
NO ₂	Nitrogen Dioxide
PICP	Pollution Incident Control Plan
PM ₁₀	Particulate Matter 10 micrometres or less in diameter
PM _{2.5}	Particulate Matter 2.5 micrometres or less in diameter
SO ₂	Sulphur Dioxide
TII	Transport Infrastructure Ireland
µg/m ³	micrograms (one-millionth of a gram) per cubic meter

16. Cross Cutting Themes

16.1 Introduction

This chapter describes the likely significant effects on the environment arising from a number of environmental aspects considered to be 'cross-cutting' and complex. These were identified in both the EIA Screening and Scoping Report of November 2019 and the January 2020 update, this included:

- Risk of major accidents and disasters;
- Material Assets;
- Resource Use and Waste; and
- Climatic factors.

This chapter of the EIAR does not include an assessment for Resource Use and Waste as this is now addressed in Volume 3, Chapter: 14 Resource Use and Waste Management.

This chapter sets out the methodology used to predict the likely impacts of the proposed Project on three aspects of the environment and whether these would be significant; describes the baseline conditions for each aspects; identifies the likelihood and significance of impacts on the baseline during the construction and operational phases of the proposed Project; and proposes mitigation measures where necessary to avoid or reduce significant impacts.

16.2 Risk of Major Accidents & Disasters

16.2.1 Introduction

This section determines the vulnerability of the proposed Project to and from Major Accidents and Disasters (MANDS). It also considers whether any impacts on the proposed Project to or from MANDS are significant and if they could be, proposes mitigation or risk management measures to avoid or minimise the impacts.

16.2.2 Study Area

The study area for the purposes of identifying risk of major accidents and disasters is the proposed Project extent as described in Volume 2, Chapter 3: Project Description; haul routes to and from the proposed Project during the construction phase, and locally designated high-risk areas such as flood risk zones.

16.2.3 Consultation

The key issues raised during consultation with prescribed bodies and other consultees in relation to Risk and Safety are broadly summarised below in Table 16.1.

Table 16.1 Consultation Responses

Consultee Comments	Response
<p>Cork County Council</p> <p>Noted that the proposals will improve road safety and provide accessibility for motorists on a permanent basis on those gates which were closed at night.</p>	<p>Details relating to the improved safety on the network as a result of the proposed Project are provided in Volume 2, Chapter 1: Introduction.</p>
<p>Limerick County Council</p> <p>General queries regarding road design, width, gradient and extinguishment of roads. Requested widening of the bridge at XC201 Thomastown to '<i>future proof</i>' the design.</p> <p>Noted the importance of public consultation, the need to stress the increased safety of the rail network following the works and citing accident figures</p>	<p>Dialogue has continued through the design process with Limerick County Council and queries and concerns related to design and safety standards have been addressed.</p> <p>Details relating to the improved safety on the network as a result of the proposed Project are provided in Volume 2, Chapter 1: Introduction.</p>

Consultee Comments	Response
<p>Transport Infrastructure Ireland</p> <p>The EIAR should identify the methods/techniques proposed for any works traversing/in proximity to the national road network in order to demonstrate that the development can proceed complementary to safeguarding the capacity, safety and operational efficiency of that network.</p> <p>TII Standards should be consulted to determine the requirement for Road Safety Audit (RSA) and Road Safety Impact Assessment (RSIA).</p>	<p>See Volume 3, Chapter 11: Traffic and Transport. This chapter considers the traffic and access implications of the proposed Project with reference to the impacts of construction and operational traffic. The chapter has also considered the comments made by TII in regard to safeguarding the capacity, safety and operational efficiency of the network and concludes that when considering actual volumes of traffic, the predicted flows are well within the practical operating capacity of these roads. Notwithstanding this, appropriate mitigation measures have been identified, including the provision of a Construction Traffic Management Plan (CTMP) which will ensure that any potential significant effects are mitigated.</p> <p>A Stage 1 Road Safety Audit (RSA) and Road Safety Impact Assessment (RSIA) have been prepared and are included in Volume 5, Appendix 1J. All problems highlighted by the Road Safety Auditor have been resolved or eliminated;</p>
<p>Gas Networks Ireland (9th August 2019)</p> <p>This included details of the Gas Transmission Pipeline in the area of the proposed Project. It provided contact details and also states that <i>"I can't see your proposals as having any impact on the GNI Infrastructure, but it is as well you know where same is as not."</i></p>	<p>This has been noted in the design and PSDP.</p>
<p>Health Service Executive (19th November 2019)</p> <p>Acknowledged receipt and considered the consultation wasn't an issue for HSE. Stated it might be relevant for the Health and Safety Authority.</p>	<p>Noted.</p>

16.2.4 Baseline Environment

For the purposes of this assessment the baseline environment will be largely informed by the other chapters, in particular Volume 3, Chapter 6: Population and Human Health, Chapter 7: Biodiversity, Chapter 9: Water, Chapter 8: Soils, Geology and Hydrogeology, Chapter 11: Traffic and Transport: and the Flood Risk Assessment (Volume 5, Appendix 9A). Consideration will also be given to 'climatic' factors which is outlined in Section 0 of this Chapter.

16.2.5 Desktop Study

The assessment of major accidents and disasters is entirely desk-based, with field surveys and findings from other topics, as set out above, also used to inform the assessment of risk and impacts as a result of MANDs.

16.2.6 Methodology

The assessment of vulnerability of the proposed Project to and from major accidents and natural disasters has been carried out in accordance with the EIA Directive 2014/52/EU of 16 April 2014 (See Volume 2, Chapter 4: EIA Process and Methodology) which states the need to *"assess the expected effects deriving from the vulnerability of the project to risks of major accidents and/or disasters that are relevant to the project concerned"*.

For the purpose of this assessment, the following definitions have been adopted:

- **Major Accident** – incidents or events that threaten immediate or chronic serious damage to human health, welfare and/or the environment;
- **Natural Disaster** – naturally occurring extreme weather events (e.g. storm, flood, temperature) with the potential to cause an event or incident;

- **Risk** – defined as the likelihood of an incident occurring, combined with magnitude effect or consequence(s) of the impact on a receptor or surrounding area; and
- **Significance** – Significant impact resulting from major accidents and/or natural disasters are adverse impacts if they meet the criteria for 'Significant', 'Very Significant' or 'Profound' under the Draft EPA Guidelines on the information to be Contained in Environmental Impact Assessment Reports (EPA 2017).

16.2.7 Relevant Guidelines, Policy and Legislation

The development of the risk assessment methodology has been informed by the following guidelines:

- Advice Notes for Preparing Environmental Impact Statements (EPA 2015b);
- EIA Directive (2014/52/EU) (See Volume 2, Chapter 4: EIA Process and Methodology);
- Revised Guidelines on the Information to be Contained in Environmental Impact Statements (EPA 2015a);
- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA 2017);
- National Risk Assessment 2018 Overview of Strategic Risks (Department of the Taoiseach 2018);
- Guidance on Assessing and Costing Environmental Liabilities (EPA 2014);
- A Guide to Risk Assessment in Major Emergency Management (Department of Environment, Heritage and Local Government (DoEHLG) 2010);
- A National Risk Assessment for Ireland 2017 (Department of Defence 2017); and
- Risk Assessment Methodology.

The three stages of this risk assessment are outlined below:

- Identification and Screening;
- Risk Classification; and
- Risk Evaluation.

Following identification, classification and evaluation of each identified risk; mitigation has been proposed for any occurrences which are categorised as medium or high risk. New scoring for the likelihood and consequence post-mitigation will be assessed in order to give a post-mitigation score.

16.2.8 Identification and Screening

The first stage of the assessment is to identify potential unplanned risks that the proposed Project may be vulnerable to. An initial list of MANDs was sourced through consultation with relevant environmental specialists, project engineers and using the guidelines and reference documentation.

The list of potential MANDs was subjected to an initial screening assessment to identify the potential risks that meet the scoping criteria. The risks were screened out of the assessment according to the following criteria:

- MANDs addressed in the Design Risk Assessment for the design and planning phase of the proposed Project;
- MANDs that have already been assessed in other areas of this EIA, for example flood risk. These are summarised and referenced in this Section;
- MANDs associated with construction phase and operational phase activities that fall within the scope of health and safety legislation and associated obligations, for example risks associated with working at height;
- MANDs where no 'Source-Pathway-Receptor' linkage exists. Examples include incidents that cannot be plausibly associated with the proposed Project, such as volcanic activity, earthquakes and risk of nuclear accidents; and

- MANDs that possess low likelihood/low consequence, for example the risk traffic accidents on the road network causing delays construction or operational phase vehicles.
- Risk Classification

A summary of those risks that were 'Screened Out' of the assessment can be found in Section 16.2.10 and Table 16.7.

Following the initial identification and screening process, remaining MANDs were evaluated with regard to the likelihood of occurrence and the potential impact. The rating criteria adopted for the assessment follows that used in A Guide to Risk Assessment in Major Emergency Management (DoEHLG, 2010). The Draft EPA Guidelines (EPA 2017) state that the risk assessment must be based on a 'worst case' approach. Therefore, the consequent rating assumes that all proposed mitigation measures and safety procedures have failed to prevent the MAND.

The classification and rating of likelihood and consequence are provided in Table 16.2 and Table 16.3.

Table 16.2: Classification of Likelihood

Rating	Classification	Impact Description
1	Extremely Unlikely	May occur only in exceptional circumstances; once every 500 or more years.
2	Very Unlikely	Is not expected to occur; no recorded incidents or anecdotal evidence; and/or very few incidents in associated organisations, facilities or communicates; and/or little opportunity, reason or means to occur. May occur once every 100 to 500 years.
3	Unlikely	May occur at some time; and/or few, infrequent, random recorded incidents or little anecdotal evidence; some incidents in associated or comparable organisations worldwide; some opportunity, reason or means to occur. May occur once every 10 to 100 years.
4	Likely	Likely to or may occur; regular recorded incidents and strong anecdotal evidence Will probably occur once every 1 to 10 years.
5	Very Likely	Very likely to occur; high level of recorded incidents and/or strong anecdotal evidence. Will probably occur more than once a year.

Table 16.3 Classification of Consequence

Rating	Classification	Impact	Description
1	Minor	Life, Health, Welfare, Environment, Infrastructure, Social	<ul style="list-style-type: none"> ▪ Small number of people affected; no fatalities and small number of minor injuries with first aid treatment. ▪ No contamination, localised effects. ▪ <0.5M Euro. ▪ Minor localised disruption to community services or infrastructure (<6 hours).
2	Limited	Life, Health, Welfare, Environment, Infrastructure, Social	<ul style="list-style-type: none"> ▪ Single fatality; limited number of people affected; a few serious injuries with hospitalisation and medical treatment required. Localised displacement of a small number of people for 6-24 hours. Personal support satisfied through local arrangements. ▪ Simple contamination, localised effects of short duration. ▪ 0.5M-3M Euro. ▪ Normal community functioning with some inconvenience.

Rating	Classification	Impact	Description
3	Serious	Life, Health, Welfare, Environment, Infrastructure, Social	<ul style="list-style-type: none"> ▪ Significant number of people in affected area impacted with multiple fatalities (<5), multiple serious or extensive injuries (20), significant hospitalisation. Large number of people displaced for 6-24 hours or possibly beyond; up to 500 evacuated. External resources required for personal support. ▪ Simple contamination, widespread effects or extended duration. ▪ 3M-10M Euro. ▪ Community only partially functioning, some services available.
4	Very Serious	Life, Health, Welfare, Environment, Infrastructure, Social	<ul style="list-style-type: none"> ▪ 5 to 50 fatalities, up to 100 serious injuries, up to 2,000 evacuated. ▪ Heavy contamination, localised effects or extended duration. ▪ 10M-25M Euro. ▪ Community functioning poorly, minimal services available.
5	Catastrophic	Life, Health, Welfare, Environment, Infrastructure, Social	<ul style="list-style-type: none"> ▪ Large numbers of people impacted with a significant number of fatalities (>50), injuries in the hundreds, more than 2000 evacuated. ▪ Very heavy contamination, widespread effects of extended duration. ▪ >25M Euros. ▪ Serious damage to infrastructure causing significant disruption to, or loss of, key services for prolonged period. Community unable to function without significant support.

16.2.9 Risk Evaluation

In accordance with the DoEHLG’s (2010) guidelines, the evaluated MANDs will be subject to a risk matrix to determine the level of significance of each risk for each scenario. These have been grouped according to three categories described below and presented visually in Table 16.4.

- **High Risk** - Scenarios that have an evaluation score of 15 to 25, as indicated by the Red Zone
- **Medium Risk** - Scenarios that have an evaluation score of 8 to 12, as indicated by the Amber Zone
- **Low Risk** - Scenarios that have an evaluation score 1 to 6, of as indicated by the Green Zone

Table 16.4 Levels of Significance

Likelihood	5 – V. Likely					
	4 – Likely					
	3 – Unlikely					
	2 – V. Unlikely					
	1 – Ext. Unlikely					
		1 – Minor	2 – Limited	3 – Serious	4 – V. Serious	5 – Catastrophic
		Consequence of Impact				

Significant impacts resulting from MANDs are adverse impacts that are described as ‘Significant’, ‘Very Significant’ or ‘Profound’ under the Draft EPA Guidelines (EPA 2017). Consequently, MANDs that fall within the Amber or Red Zones (‘Medium’ or ‘High’ risk scenarios) are brought forward for further consideration and assessment for further mitigation.

16.2.10 Predicted Impacts

As has been described, the predicted impacts assume a worst-case scenario, which does not consider the implementation of mitigation measures or Emergency Plans that are implemented to reduce the impact of any MANDs.

Table 16.5 presents the potential risks that could occur during the construction phase and operational phase of the proposed Project. The identified risks may not be applicable to a number of sites throughout the proposed Project. The risks are evaluated, and this is provided in Table 16.6.

A number of other risks were considered but considered to be extremely unlikely to occur; these were screened out of the assessment and are presented in Table 16.7.

Table 16.5 Rating of Major Accidents and Disasters in the Absence of Mitigation for the proposed Project

Risk ID	Event	Proposed Project Element	Phase Impacted	Likelihood	Rating	Consequence	Rating	Resulting Risk Category
Major Accident								
A	Power Failure – operational phase Risk of outage of power supply impacting the operation of the proposed Project.	CCTV	Operation	Very Unlikely	2	Limited	2	Low
B	Damage to Power Infrastructure for all sites Damage to high voltage overhead lines that cross the proposed Project.	Throughout	Construction	Unlikely	3	Serious	3	Medium
C	Damage to Gas Infrastructure XC201 Thomastown, XC211 Newton and XC212 Ballycoskery, XC215 Shinanagh and XC219 Buttevant Striking of underground gas pipeline.	Throughout	Construction	Unlikely	3	Serious	3	Medium
D	Accidental Release to Surface Water for XC201 Thomastown, XC209 Ballyhay, XC211 Newton and XC212 Ballycoskery, XC215 Shinanagh and XC219 Buttevant Pollution event leading to environmental damage.	Throughout	Construction	Likely	4	Limited	2	Medium
E	Biosecurity Breach – construction phase Spread of livestock diseases (i.e. TB).	Throughout	Construction	Unlikely	3	Catastrophic	5	High
F	Contaminated Land for XC201 Thomastown, XC209 Ballyhay, XC211 Newton and XC212 Ballycoskery, XC215 Shinanagh and XC219 Buttevant Encountering unknown contaminated ground and mobilisation during construction.	Throughout	Construction	Unlikely	3	Limited	2	Low
G	Invasive Species – Construction Phase for XC215 Shinanagh Risk of spread of invasive species. Invasive species have been noted within Volume3, Chapter 7:Biodiversity.	Throughout	Construction	Likely	4	Serious	3	Medium
H	Road Traffic Accident – construction phase for all sites Road traffic accidents on-site or resulting from Construction Phase traffic.	Throughout	Construction	Unlikely	3	Serious	3	Medium
I	Fire for all sites In any works during construction.	Throughout	Construction	Very Unlikely	2	Limited	2	Low
J	Fire for all sites Within the trains.	Throughout	Operation	Very Unlikely	2	Limited	2	Low
K	Fall due to Working from Heights Due to lifting operations.	Throughout	Construction	Unlikely	3	Very Serious	4	Medium

Risk ID	Event	Proposed Project Element	Phase Impacted	Likelihood	Rating	Consequence	Rating	Resulting Risk Category
Natural Disasters for All Sites								
L	Prolonged Drought Risk of extended drought	Throughout	Construction	Unlikely	3	Minor	1	Low
M	Prolonged Flooding – Sediment Release Extreme weather (rainfall) event resulting in sediment load runoff during construction.	Throughout	Construction	Unlikely	3	Limited	2	Low
N	Prolonged Flooding – Embankment Failure Extreme weather events leading to a breach in the embankments at XC201 Thomastown, XC211, XC212 Newtown and Ballycoskery, XC215 Shinanagh and XC219 Buttevant	Throughout	Operational	Unlikely	3	Very Serious	4	Medium

The results from the evaluation have been applied to Table 16.6 to determine the Levels of Significance.

Table 16.6 Evaluation of Levels of Significance in the Absence of Mitigation

Likelihood	5 – V. Likely					
	4 – Likely		D	G, K		
	3 – Unlikely	L	F, M	B, C, H	N	E
	2 – V. Unlikely		A, I, J			
	1 – Ext. Unlikely					
		1 – Minor	2 – Limited	3 – Serious	4 – V. Serious	5- Catastrophic
Consequence of Impact						

Risk IDs B, C, D, G, H, K and N fall within Amber Zone ('Medium' risk scenario) and are therefore brought forward for further consideration and assessment of mitigation measures. Risk ID E falls within the Red Zone ('High' risk scenario) and is therefore brought forward for further consideration and assessment of mitigation measures, see Table 16.8.

Risks O to W, identified in Table 16.7 have been screened out of the assessment as they are considered to possess low likelihood/low consequence of occurring.

Table 16.7 Major Accidents and Disasters Screened out from Assessment

Risk ID	Event	Proposed Project Element	Phase Impacted	Likelihood
O	Subsidence / land collapse for XC201 Thomastown, XC211 Newton and XC212 Ballycoskery, XC215 Shinanagh and XC219 Buttevant Deep Piling during construction for bridge bearing/foundation supports leading to subsidence of land, with the potential to lead to an accident.	Deep Piling	Construction	Extremely Unlikely
P	Subsidence / land collapse XC201 Thomastown, XC211 Newton and XC212 Ballycoskery, XC215 Shinanagh and XC219 Buttevant Subsidence of land from new bridge, with the potential to lead to an accident.	Deep Piling	Operation	Extremely Unlikely
Q	Road Traffic Accident – operational phase for all sites Road traffic accidents on-site or resulting from Operational Phase traffic	Throughout	Operation	Extremely Unlikely
R	Rail Accident for all sites Train collision or derailling.	Throughout	Operation	Extremely Unlikely
S	Prolonged Rainfall Inflow of water to the during construction leading to floatation of partly completed substructures	Throughout	Construction	Extremely Unlikely
T	Power Failure – construction phase for all sites Risk of outage of power supply impacting on winter working/ night time working.	Throughout	Construction	Extremely Unlikely
U	Damage to Power Infrastructure for all sites Damage to power to the rolling stock causing operation to halt	Throughout	Construction	Extremely Unlikely

Risk ID	Event	Proposed Project Element	Phase Impacted	Likelihood
V	Lightning Strike Major lightning strike on leading to signal failure to railway/CCTV operations	Railway/CCTV	Operational	Extremely Unlikely
W	Biosecurity Breach – operational phase Spread of livestock diseases (i.e. TB)	Throughout	Operational	Extremely Unlikely

16.2.11 Mitigation Measures

The proposed Project has been designed in accordance with TII's Standards March 2020 which include designs to improve pedestrian and road safety and reduce risks.

The proposed Project has also been designed in accordance with the Health and Safety Authority Project Supervisor Design Process (PSDP) to identify and minimise risks during construction.

In addition, further measures identified in the EIAR Technical Chapters have been embedded into the design of the proposed Project to minimise risks associated with those topics. Those identified in the EIAR are identified as being of 'Medium' risk (Amber Zone) and 'High' risk (Red Zone) were subject to further assessment and determination of risk, post-implementation of mitigation measures. The results are presented in Table 16.8.

Table 16.8 Major Accidents and/or Disasters – Assessment of Mitigation Measures

Risk ID	Event	Proposed Project Element	Phase Impacted	Pre-Mitigation Risk Score	Mitigation Measures	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category
Major Accidents								
B	<p>Damage to Power Infrastructure for all sites</p> <p>Damage to high voltage overhead lines that cross the proposed Project.</p>	Throughout	Construction	Medium	<p>High voltage lines in proximity to the proposed Project have been identified. Any crossings of High Voltage lines have been identified and assigned a unique ID. Adequate provision has been made within the Planning Application Boundary to ensure there is sufficient space to accommodate works. Overhead services will be stated and included in any method / lifting plans so they can be avoided.</p> <p>In particular where noted on the preliminary drawings, such as for XC219, existing ESB O/H service to be decommissioned. The status of these will be checked and verified from the utility owner and a certificate issued to confirm. If the infrastructure / cables of these services remain on site, appropriate safety notices and warnings will be displayed throughout the construction works. Where necessary a demarcation zone may be implemented to prevent operatives or plant coming into contact. Sufficient time should be allowed in the programme in advance of site works to allow such statutory authority searches / utility decommissioning or required diversions.</p>	2 Very Unlikely	3 Serious	Low
C	<p>Damage to Gas Infrastructure XC201 Thomastown, XC211 Newton and XC212 Ballycoskery, XC215 Shinanagh and XC219 Buttevant</p> <p>Striking of underground gas pipeline.</p>	Throughout	Construction	Medium	<p>Underground utilities and services have been mapped as part of the outline design process. The appointed Contractor will confirm the location of known services and will undertake ground scans in advance of excavations and construction work.</p>	2 Very Unlikely	3 Serious	Low

Risk ID	Event	Proposed Project Element	Phase Impacted	Pre-Mitigation Risk Score	Mitigation Measures	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category
D	Accidental Release to Surface Water for XC201 Thomastown, XC211 Newton and XC212 Ballycoskery, XC215 Shinanagh and XC219 Buttevant Pollution event leading to environmental damage.	Throughout	Construction	Medium	The risk of accidental release to surface water will be reduced by the development and implementation of mitigation measures outlined in Volume 3, Chapter 9: Water and within the CEMP (Volume 5, Appendix 11). The appointed Contractor will develop and implement a detailed Pollution Control Plan (PICP), Emergency Response Plan (ERP) and Method Statements for working near waterbodies, drafted in agreement with Inland Fisheries Ireland and other relevant authorities, and having regard to relevant pollution prevention guidelines.	2 Very Unlikely	3 Serious	Low
E	Biosecurity Breach – construction phase Spread of livestock diseases (i.e. TB)	Throughout	Construction	High	The appointed Contractor will develop and follow strict biosecurity measures to prevent the spread of infectious diseases. This will form part of the detailed CEMP.	2 Very Unlikely	5 Catastrophic	Medium
G	Invasive Species – construction phase for XC215 Shinanagh Risk of spread of invasive species. Invasive species have been noted within Volume 3, Chapter 7: Biodiversity	Throughout	Construction	Medium	Refer to Volume 3, Chapter 7: Biodiversity for mitigation measures on Invasive Species.	2. Very unlikely	3. Serious	Low
H	Road Traffic Accident – Construction Phase for all sites Road traffic accidents on-site or resulting from Construction Phase traffic	Throughout	Construction	Medium	The appointed Contractors will adhere to the Traffic Management Plan (TMP) developed as part of the detailed design phase of the proposed Project. Further mitigation measures are identified within Volume 3, Chapter 11: Traffic and Transport.	2 Very Unlikely	3 Serious	Low
K	Fall due to Working from Heights Due to lifting operations	Throughout	Construction	Medium	The appointed contractors will adhere to the strict safety protocols set out in the Project Health & Safety Plan.	2 Very Unlikely	4 Very Serious	Medium
Natural Disasters								
N	Prolonged Flooding – Embankment Failure Extreme weather events leading to a breach in ditch embankments at XC212 Ballycoskery, and a ditch and riverbank at XC219 Buttevant	Throughout	Operational	Medium	See Volume 3, Chapter 3 Project Description and Volume 5, Appendix 9A Flood Risk Assessment. The proposed Project is designed to withstand flood events to the appropriate standard.	2. Very unlikely	4. Very Serious	Low

The results from the evaluation of risk, once mitigation measures have been applied as per Table 16.9.

Table 16.9 Evaluation of Levels of Significance Post-Mitigation

Likelihood	5 – V. Likely					
	4 – Likely					
	3 – Unlikely					
	2 – V. Unlikely			C, D, H, G	K, N	E
	1 – Ext. Unlikely					
		1 – Minor	2 – Limited	3 – Serious	4 – V. Serious	5 – Catastrophic
		Consequence of Impact				

Further Mitigation Measures

Mitigation Measures Embedded into the Design of the proposed Project

Regulation 15 of the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013) places a duty on designers carrying out work related to the design of a project to take account of the General Principles of Prevention as listed in Schedule 3 of the Safety, Health and Welfare at Work Act 2005.

In addition to the duties imposed by Regulation 15 of the Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013), designers must comply with Section 17(2) of the Safety, Health and Welfare at Work Act 2005 which requires persons who design a project for construction work to ensure, so far as is reasonably practicable, that a project is designed and is capable of being constructed to be safe and without risk to health, can be maintained safely and without risk to health during use, and complies in all respects, as appropriate, with other relevant legislation. This includes the Building Regulations 2012 (S.I. No. 138 of 2012) and, if the works being designed are intended for use as a workplace, the relevant parts of the Safety, Health and Welfare at Work (General Application) Regulations 2007 (S.I. No. 299 of 2007).

In accordance with these requirements, the proposed Project design team established a consistent and appropriate means of assessing the risks that may arise from design decisions and of applying the General Principles of Prevention, mitigation measures that are to be embedded into the design and operational activities through Design Risk Assessments.

Construction Environmental Management Plan

An outline CEMP has been prepared as part of this EIAR (Volume 5, Appendix 11). Prior to the commencement of works, the appointed Contractor to construct the proposed Project will prepare a detailed CEMP. The CEMP will be a live document which will be updated post-consent as it will include method statements and work programmes that provide more detailed phasing of work based on the methodologies and the mitigation measures contained in this EIAR, in addition to any relevant conditions contained in the planning consent. The appointed Contractor will develop a series of detailed plans for the construction of the proposed Project. This will include (but will not be limited to) a Construction Traffic Management Plan (CTMP) and Travel Plan, Environmental Incident Response Plan (EIRP), Pollution Incident Control Plan (PICP) and Dust Management Plan (DMP), each of which is outlined below.

Construction Traffic Management Plan and Travel Plan

Prior to commencement of construction, the appointed contractor shall prepare a CTMP for the proposed Project. The purpose of the CTMP is to set out management and mitigation measures to prevent or minimise the transport impacts during the Construction Phase of the proposed Project. A Travel Plan will also be available to provide the mechanism to support and promote sustainable travel for staff, contractors and visitors travelling to the proposed Project sites to minimise potential pollution generation. Further information on the CTMP and Travel Plan are contained within the CEMP (Volume 5, Appendix 11).

Environmental Incident Response Plan

The EIRP will contain Incident Response Procedures which will outline the detailed procedures for dealing with any potential emergency and shall include the following:

- Initial response procedures;
- List of emergency contact details;
- Records and sharing of records with prescribed bodies;
- Training; and
- Details (location, number and type) of emergency response equipment maintained on site.

Pollution Incident Control Plan

Contractors will develop and implement a PICP which will detail their response in the event of any incident on site. Further information on the PICP is contained within the CEMP (Volume 5, Appendix 11).

Dust Management Plan

A Dust Management Plan (DMP) will be produced by the principle contractor post consent but pre construction for the proposed Project. The DMP is a plan for the management of dust which is likely to arise during the construction phase of the proposed Project, relevant to each site, where applicable. The DMP will provide measures to control other emissions, approved by the local authority. The level of detail will depend on the risk, and should include, as a minimum, the highly recommended measures in this assessment. The desirable measures should be included as appropriate for the site (desirable rather than highly recommended for low risk sites). This will help control potential pollution from the proposed Project. The DMP is highlighted as a mitigation measure in Volume 3, Chapter 15: Air Quality and Volume 5 Appendix 11 (CEMP).

16.2.12 Residual Impacts

Following the implementation of biosecurity mitigation measures there remains a risk of significant impacts associated with the proposed Project being impacted by a biological contagion. The classification of consequence has been set as 'Catastrophic' in acknowledgement of the significant impacts an outbreak of diseases like Foot and Mouth can have. The 2001 Foot and Mouth outbreak resulted impacts including (but not limited to):

- The implementation of restriction zones;
- A ban on movements of cattle, sheep, pigs, goats, deer and a range of animal products;
- Restrictions on the movement of animals between farms;
- Cancellation of a number of social and cultural events;
- Reduction in tourism and visitors to Ireland; and
- Introduction of a slaughter policy within an exclusion zone in County Cork and County Limerick.

In the event of a biosecurity incident like the 2001 Foot and Mouth outbreak during the construction phase, all construction activities will be suspended. During the operational phase all non-essential maintenance work and walkovers/inspections will be postponed. All guidance and direction provided by the Department of Agriculture will be followed and any required additional biosecurity measures or restrictions will be implemented.

The EIRP is a live document that undergoes monitoring, review and update throughout the lifetime of the proposed Project. The risk management assessment of MANDs will be continued on an ongoing basis throughout the planning, detailed design, construction phase and operational phase of the Proposed Project. Activities on-site will be monitored to ensure that risk does not increase over time on the site.

16.2.13 Interactions

There are interactions between this topic and a number of others within the EIAR: Volume 3, Chapter 7: Biodiversity (biosecurity); Volume 3, Chapter 8: Soils, Geology and Hydrogeology (Contaminate Land); Volume 3, Chapter 9: Water (pollution incident), Volume 3, Chapter 11: Traffic & Transport (Construction Traffic risks); and Chapter 15: Air Quality (Dust Management). The mitigation plans for these chapters provide the basis of mitigation for major accidents and disasters. Volume 5, Appendix 11, CEMP also outlines the requirement for the Contractor to adhere to health and safety regulations and prepare an emergency and incident response plan.

16.2.14 Cumulative Impacts

Of the 33 projects identified in the screening of developments within a 5km radius of the proposed Project, only one is significant enough to have the potential for cumulative impacts: the M20 road project. There will be no cumulative impacts during the construction stage as the construction programmes for the two projects do not overlap. The proposed Project has been designed in accordance with road safety standards and to ensure it does not contribute to nor is affected by flooding. As a result, no cumulative impacts with the M20 are predicted during operation.

16.2.15 Difficulties Encountered in Compiling Information

In terms of identifying potential risks from and to the proposed Project, detailed mapping of underground and above ground services was required, in addition to Ground Investigations at each site. The mapped services, where they are below ground, will only be confirmed during a Third-party utilities survey, prior to construction. In the meantime, it is assumed the information is up to date and complete. It is acknowledged that it might not be either.

16.3 Material Assets

16.3.1 Introduction

The EIA Regulations (S.I. No. 296, 2018) require the inclusion of an assessment of the effects of a project on 'Material Assets'. There is no definition of this term in the legislation, either at a national or EU level. However, Material Assets are considered to be resources and amenities that are valued and that are intrinsic to specific places. These may be of human or natural origin.

Material Assets of a human origin include:

- Existing Properties;
- Road Network;
- Rail Network;
- Canal Network;
- Recreational facilities and amenities;
- Cultural heritage;
- Public Utilities; and
- Pedestrian Ways including footways.

Material assets of a natural origin include:

- Land resources;
- Geological Resource;
- Natural Amenities;
- Watercourses (rivers & streams); and
- Raw Materials.

For the most part, these aspects of the environment are assessed as part of the topic-specific assessments, in particular:

- Utilities: Volume 2, Chapter 3: Project Description.
- Land use, property, amenity: Volume 3, Chapter 6: Population & Health.
- Soils and minerals, private and public water supplies, public and private wastewater treatment systems: Volume 3, Chapter 8: Soils & Geology.
- Water resources, flood defences: Volume 3, Chapter 9: Water.
- Road and rail infrastructure: Volume 3, Chapter 11: Traffic & Transport.
- Cultural and archaeological assets: Volume 3, Chapter 12: Cultural heritage.
- Above ground structures, e.g. electricity and telecommunications lines, being moved or altered: Volume 3, Chapter 13: Landscape & Visual.
- Materials use: Volume 3, Chapter 14: Resource Use & Waste Management.

16.3.2 Study Area

The study area for the purposes of identifying effects on Material Assets is the proposed Project extent as described in Volume 3, Chapter 3: Project Description.

16.3.3 Consultation

Statutory consultees, other stakeholders and the public have been consulted which have informed the development of the Environmental Impact Assessment Report (EIAR). The consultation responses can be found in Volume 2, Chapter 1: Introduction and Volume 5, Appendices 1A to 1J.

The key issues raised during consultation with prescribed bodies and other consultees in relation to material assets are broadly summarised below in Table 16.10

Table 16.10 Consultation Submissions and Responses.

Consultee Comments	Response
Gas Networks Ireland (9th August 2019) This included details of the Gas Transmission Pipeline in the area of the proposed Project. It provided contact details and also states that <i>"I can't see your proposals as having any impact on the GNI Infrastructure, but it is as well you know where same is as not."</i>	This has been noted in the design and PSDP.

16.3.4 Baseline Environment

Baseline Environment – Material Assets of Human Origin

Material assets of human origin (e.g. existing properties, recreational facilities, public utilities and road/rail/canal infrastructure) have been taken into consideration and identified by desktop assessment and engineering site visits and walkovers where applicable.

Existing Properties

The proposal for the elimination/de-manning of the level crossings is through a combined scheme that delivers the temporary and permanent closure of roads used by residents of existing properties. Volume 3, Chapter 6: Population and Health outlines the effect on residential land and residents and the impact on existing properties due to the closure of roads during construction and operation.

Road Network

There are direct and indirect impacts by the proposed Project on the road network. Direct impacts incorporate permanent infrastructure associated with the proposed Project, such as the construction of bridges, and indirect impacts include the movement of plant, labour and materials to access and egress the various locations of the proposed Project. The indirect impacts are primarily attributable to the use of Haul Roads. For further information on the road network see Volume 3, Chapter 11: Traffic and Transport.

Rail Network

The proposed Project is to upgrade/eliminate level crossings along the Iarnród Éireann network. The Level Crossing IDs that will be upgraded/eliminated are identified in Volume 2, Chapter 3: Project Description.

Canal Network

There are no anticipated effects on the Canal Network throughout the proposed Project locations.

Recreational facilities and amenities

A number of recreational facilities have been identified throughout the proposed Project. Volume 3, Chapter 6: Population and Human Health identifies the effects on these recreational facilities and amenities. It is not anticipated that there will be any significant effects on recreational facilities and amenities.

Public Utilities

Information has been provided by a number of utility providers and relevant local authorities which details the locations of infrastructure and utilities. The impact on public utilities is addressed in Volume 2, Chapter 3: Project Description.

Pedestrian Ways

There will be minor impacts throughout the proposed Project such as temporary pathway during construction and amended pathways and footways for when construction is complete. All existing level crossings are Public Rights of Way and these will be 'stopped up' permanently. At all but XC187, these will be either replaced with new PROWs (new bridge over rail) or pedestrians will be diverted to a different, existing bridge over rail crossing point. Further information on the impacts on pedestrian ways can be found in Volume 3, Chapter 6: Population and Health and Chapter 11: Traffic and Transport.

Baseline Environment - Material Assets of Natural Origin

Land resources

The majority of the proposed Project will be located in agricultural lands within the two counties of Cork and Limerick. The potential impacts of the proposed Project on agricultural lands have been assessed in Volume 3, Chapter 6: Population & Human Health and Chapter 8: Soils, Geology and Hydrogeology.

Geological Resource

Volume 3, Chapter 8: Soils, Geology and Hydrogeology identifies that geological impacts are Negligible or Negligible to Slight for deposits. Loss to a mineral resource is expected to have a potential Negligible / Slight significance of impact.

Natural Amenities

Natural amenities (e.g. watercourses) are considered and assessed in Volume 3, Chapter 7: Biodiversity, Chapter 9 (Water) and in Volume 5, Appendix 7H (Natura Impact Statement (NIS)).

Raw Materials

Raw materials required for the construction of the proposed Project are assessed in Volume 3, Chapter 14: Resource Use and Waste Management.

16.3.5 Methodology

Relevant Guidelines, Policy and Legislation

The Material Assets Assessment was prepared in accordance with relevant European Union and Irish legislation and guidance, including the requirements of Annex IV of Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (Environmental Impact Assessment (EIA) Directive) and in accordance with Schedule 6 of the Planning and Development Regulations 2001 as amended (S.I. No. 600 of 2001) and conforms to the relevant requirements as specified therein. However, the overarching legislation applicable to the proposed Project is set out at Volume 2, Chapter 4: EIA Process and Methodology.

The following guidelines were referred to and complied with:

- Guidelines on the Information to be Contained in Environmental Impact Statements (Environmental Protection Agency (EPA) (EPA 2002) (and revised and draft guidelines 2015/2017 (EPA 2015a; 2017));
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA 2003) (and revised advice notes (EPA 2015b); and

- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of the Environment, Community and Local Government 2013).

16.3.6 Impact Assessment

Characteristics of the proposed Project, associated with both the construction and operational phases, have the potential to impact on the material assets of the area. In particular, the following issues are considered:

- Utilisation of land required for the construction of the proposed Project;
- Effects of the proposed Project on road/rail/canal network and pedestrian ways;
- Public Utilities and the need to provide adequate protection to them during construction activities; and
- Use of raw materials and availability of same.

Impact Assessment Criteria

This assessment uses the generic methodology for impact assessment and determining significance as outlined in Volume 2, Chapter 4: Methodology.

16.3.7 Predicted Impacts

Do Nothing' Scenario

Should the construction of the proposed Project not occur, there will be no impact on any of the major utilities and natural features nearby.

Therefore, the potential impact of the do-nothing scenario is neutral.

Construction and Operational Phase Impacts

Table 16.11 and Table 16.12 outline the potential impacts on Material Assets from the proposed Project.

Table 16.11 Potential Impacts during Construction

Construction Phase	
Material Assets of Human Origin	
Material Asset	Effect
Existing Properties	Indirect and direct effects on existing properties from construction activities are considered and assessed in Volume 3, Chapter 6: Population and Human Health. Chapter 6 also incorporates the effects from noise, traffic and transport landscape and visual and dust identified within Volume 3, Chapter 10: Noise and Vibration, Chapter 11: Traffic and Transport, Chapter 13 Landscape and Visual and Chapter 15: Air Quality. It is not considered that there will be any significant land take from existing properties throughout the proposed Project. Any effects identified within Chapter 6: Population and Human Health are associated with potential severance to the residents of the properties. However, it has been identified that there will be no significant effects from severance.
Road Network	There will be significant effects during construction on the road network at XC201 Thomastown, XC211 Newtown and XC212 Ballcoskery, XC215 Shinanagh and XC219 Buttevant. The majority of these effects are due to the predicted number of HGVs on the roads during the construction phase. These effects will be short-term and temporary. They are considered and addressed within Volume 3, Chapter 11: Traffic and Transport.

Construction Phase	
Rail Network	<p>The phasing of the rail line closures / possessions required for the bridge lift and installation will be considered and there will be early engagement with the possession access team to link the construction delivery programme to avoid unnecessary down time.</p> <p>No closures are anticipated as being required for XC187 Fantstown, XC211 Newtown and XC215 Shinanagh, all of which are being 'stopped up'. XC209 Ballyhay is an upgrade to a CCTV controlled crossing; some limited closure may be required. At the crossings where a new bridge is proposed, XC201 Thomastown, XC212 Ballycoskery and XC219 Buttevant, the bridges will be installed during a Saturday night, when the railway line would be closed already. Each bridge would take the full night to install, so there would be four separate Saturday night installations. This would have no impact on the Rail Network</p>
Canal Network	There will be no direct or indirect impacts on the canal network arising from the construction phase of the proposed Project.
Recreational Facilities	Volume 3, Chapter 6: Population and Human Health identifies potential effects on recreational facilities for each site of the proposed Project. It is considered that where a potential effect will occur to a recreational facility this will only be temporary and therefore not significant.
Public Utilities	Potential negative effects on public utilities could arise due to severing of existing utility networks during the construction phase of the proposed Project. The potential effects are considered to be temporary significant negative during the construction phase.
Pedestrian Ways	Volume 3, Chapter 6: Population and Human Health identifies potential effects on pedestrian ways for each site of the proposed project. There are no identified Public Rights of Way (PRoWs) at any of the seven sites. During construction, no significant effects are expected across any of the sites on WCH users. Any minor effects are likely to be localised and would therefore not combine to create a significant effect across the wider study area.
Material Assets of Natural Origin	
Material Asset	Effect
Land Resource	There will be a direct short term imperceptible negative impact on land utilisation arising from the construction phase. The impact arises from the temporary change of use of land for temporary construction compounds during the construction phase. This impact is rated as being imperceptible and short-term. Volume 3, Chapter 6: Population and Human Health also assesses the effects on property, agricultural and community development land. It is considered that the land take impacts are expected to be minor resulting in no significant effects on agricultural land. Also, as mentioned above no significant residential land take will be envisaged and during construction, there is no permanent land take of community or development land or significant effects as a result of severance. In addition, existing roads leading up to the level crossings, and which will become superfluous following their closures, will be broken up, and given to existing landowners. Any minor effects are expected to be localised and would therefore not combine to create a significant effect across the wider study area.
Geological Resource	There will be no direct or indirect impacts on geological resources arising from the construction phase of the proposed Project.
Natural Amenities	All potential effects are considered and assessed in Volume 3, Chapter 7: Biodiversity, Chapter 9: Water and in Volume 5, Appendix 7H (Natura Impact Statement (NIS)).

Construction Phase	
Raw Materials	There is the potential for impacts to raw materials as the proposed Project will require the use of non-renewable materials. However, consideration will be given to the sustainable sourcing of all materials and materials will be reused where possible. Methodologies have been chosen at design stage to decrease the amount of imported material required. There will be an imperceptible, negative impact on raw materials as a result of the proposed Project.

Table 16.12 Potential Impacts During Operation

Operation	
Material Assets of Human Origin	
Material Asset	Effect
Existing Properties	Direct and indirect effects on existing properties from the operation of the proposed Project are considered and assessed in Volume 3, Chapter 6: Population and Human Health. Chapter 6 also incorporates the effects in terms of noise, traffic and transport, landscape and visual and dust identified within Chapter 10: Noise and Vibration, Chapter 11: Traffic and Transport, Chapter 13 Landscape and Visual and Chapter 15: Air Quality. The only potentially significant effects identified within Chapter 6: Population and Human Health are associated with severance to one local business at XC187 Fantstown. However, the nature and frequency of use of the crossing by that business is such that the severance impact has been determined to be not significant.
Road Network	The proposed Project will require rerouting/diversion of traffic at XC187 Fantstown, XC211 Newtown, XC215 Shinanagh and XC219 Buttevant. The rerouting of traffic will not result in significant effects. The overall upgrading of all the crossings is to provide better safety in relation to reducing traffic collisions that currently exist at the crossings which will be a long-term beneficial effect.
Rail Network	The overall aim of the upgrade/elimination of the railway crossings are to ensure a permanent improvement in the health and safety for the users of these crossings. Improving the health and safety of the users of these crossings will therefore have a beneficial long-term effect.
Canal Network	There will be no direct or indirect impacts on the canal network arising from the operation phase of the proposed Project.
Recreational Facilities	Volume 3, Chapter 6: Population and Human Health identifies potential effects on recreational facilities for each site of the proposed project. It is considered that there will be no permanent negative effects on recreational facilities throughout the proposed Project. There will be positive permanent effects at XC211 Newtown and XC212 Ballycoskery, particularly for those travelling to Ballyhea National School and the users of the Kilmallock Cycle Hub as a result of improved pedestrian provision and redistribution of traffic. During operation the local primary school will benefit from a new car park located directly adjacent to the building as a result of the Project.
Public Utilities	There will be no direct or indirect impacts on the public utilities arising from the operation phase of the proposed Project.
Pedestrian Ways	Volume 3, Chapter 6: Population and Health identifies potential effects on pathways. During operation, before mitigation, there is a potential for slight effects on a number of pedestrian ways however these are not considered to be significant. There are minor beneficial effects to pedestrian ways within XC211 Newtown and XC212 Ballycoskery. Further information on pedestrian ways can be found within Volume 3, Chapter 6: Population and Human Health identifies potential effects on pedestrian ways for each site of the proposed Project.
Material Assets of Natural Origin	
Material Asset	Effect

Operation	
Land Resource	There will be no direct or indirect impacts on the land resource arising from the Operational Phase of the Proposed Project.
Geological Resource	There will be no direct or indirect impacts on the land resource arising from the Operational Phase of the Proposed Project.
Natural Amenities	All potential effects are considered and assessed in Volume 3, Chapter 7: Biodiversity, Chapter 9: Water and in Volume 5, Appendix 7H (the Natura Impact Statement (NIS)).
Raw Materials	Within Volume 3, Chapter 14: Resource Use and Waste Management it is considered that the operation of all sites would require similar types of resource use. General repair and maintenance of the roads and bridges, fences and landscaping will occur. It is impossible to quantify these amounts; however, it is anticipated that they would be negligible in magnitude and so any effects would be imperceptible and therefore not significant.

16.3.8 Mitigation Measures

Following assessment of the potential impacts, the proposed Project was methodically reviewed, and mitigation methods were developed that will avoid, prevent or reduce any negative impacts on the environment as a result of the proposed Project.

Table 16.13 and Table 16.14 outline the mitigation measures associated with the potential impacts as identified above.

Table 16.13 Mitigation Measures associated with potential impacts of the proposed Project

Construction Phase	
Material Assets of Human Origin	
Material Asset	Mitigation Measure
Existing Properties	Mitigation measures in Volume 3, Chapter 11: Traffic and Transport, Chapter 10: Noise and Vibration, Chapter 15: Air Quality and Chapter 13: Landscape and Visual will be adhered to during the construction phase.
Road Network	<p>Prior to commencement of construction, the appointed contractor will prepare a CTMP for the proposed Project. The purpose of the CTMP is to set out management and mitigation measures to prevent or minimise the transport impacts during the construction phase of the proposed Project. Other mitigation measures for the road network as per Volume 3, Chapter 11: Traffic and Transport include:</p> <ul style="list-style-type: none"> ▪ Traffic Management Plan to help reassure the local community which will detail ways to reduce the construction traffic effects; ▪ A construction specific Travel Plan which will provide the mechanism to support and promote sustainable travel for staff, contractors and visitors travelling to the proposed Project sites; and ▪ Existing good practice such as dropped kerbs flush with road surface, double transition kerbs, tactile surfaces etc.
Rail Network	A detailed construction plan and schedule will be developed for the proposed Project to ensure that the construction phasing allows for maximum efficiency while minimising potential for environmental impact. Detailed information in regard to the construction programme for the proposed Project is set out at Volume 3, Chapter 3: Project Description.
Canal Network	No specific mitigation measures are required during the construction phase.

Construction Phase	
Material Assets of Human Origin	
Recreational Facilities	Mitigation measures in Volume 3, Chapter 11: Traffic and Transport, Chapter 10: Noise and Vibration, Chapter 15: Air Quality and Chapter 13: Landscape and Visual will be adhered to during the construction phase.
Public Utilities	<p>The following general measures will be implemented:</p> <ul style="list-style-type: none"> ▪ Communication and consultation will be conducted with public utility providers ahead of construction commencement; ▪ Underground surveying techniques are a key method of understanding the below ground conditions and confirming the presence of utility services. The Principle Contractor will confirm the location of known services and will undertake ground scans in advance of excavations and construction work; ▪ Method Statements shall be developed for the construction phase by the appointed Contractor to ensure that all underground services are located manually and carefully protected. The CEMP, prepared by the Principle Contractor and approved by CIE shall outline a methodology and procedure for carrying out such detection surveys; and ▪ An avoidance policy shall be adopted where possible in relation to all services and appropriate protection shall be provided for all above and below ground services as necessary.
Pedestrian Ways	Mitigation measures in Volume 3, Chapter 6: Population & Human Health; Chapter 10: Noise and Vibration; Chapter 11: Traffic and Transport; Chapter 13: Landscape and Visual; and Chapter 15: Air Quality and will be adhered to during the construction phase.
Material Assets of Natural Origin	
Land Resource	Mitigation measures relevant to recreational facilities are outlined in the chapters on which this topic depends including Volume 3, Chapter 6: Population & Human Health; Chapter 10: Noise and Vibration; Chapter 11: Traffic and Transport; Chapter 13: Landscape and Visual; and Chapter 15: Air Quality and will be adhered to during the construction phase.
Geological Resource	No specific mitigation measures are required during the Construction Phase.
Natural Amenities	Mitigation measures outlined in Volume 3, Chapter 7: Biodiversity and Chapter 9: Water as well as Volume 5, Appendix 7H Natura Impact Statement will be adhered to throughout the construction phase.
Raw Materials	Mitigation measures for the handling and minimisation of raw materials, outlined in Volume 3, Chapter 14: Resource Use and Waste Management will be adhered to throughout the construction phase.

Table 16.14 Operational Phase Mitigation Measures

Operation	
Material Assets of Human Origin	
Material Asset	Mitigation Measure
Existing Properties	Mitigation measures in Volume 3, Chapter 11: Traffic and Transport, Chapter 10: Noise and Vibration, Chapter 15: Air Quality and Chapter 13: Landscape and Visual will be adhered to during the operation phase.
Road Network	No specific mitigation measures are required during the operation phase.
Rail Network	No specific mitigation measures are required during the operational phase.

Operation	
Canal Network	No specific mitigation measures are required during the operational phase.
Recreational Facilities	Mitigation measures in Volume 3, Chapter 11: Traffic and Transport, Chapter 10: Noise and Vibration, Chapter 15: Air Quality and Chapter 13: Landscape and Visual will be adhered to during the operation phase.
Public Utilities	Method Statements shall be developed by contractors engaged to carry out maintenance or other works in the roads and bridges during operational to ensure that any underground services are located manually and carefully protected during any excavation works.
Pedestrian Ways	No mitigation measures are required during the operational phase that have not already been designed into the proposed Project.
Material Assets of Natural Origin	
Land Resource	Where access to individual parcels of agricultural land is restricted as a result of the proposed Project, new access arrangements will be provided.
Geological Resource	No specific mitigation measures are required during the operational phase.
Natural Amenities	No specific mitigation measures are required during the operational phase.
Raw Materials	No specific mitigation measures are required during the operational phase.

16.3.9 Residual Impacts

Construction

Following the implementation of the mitigation measures set out above, no significant residual effects are predicted for any material asset during construction, except potentially for Raw Materials. This is addressed in Volume 3, Chapter 14: Resource Use and Waste Management.

Operation

Following the implementation of the mitigation measures set out above, no significant residual effects are predicted for any material asset during operation.

16.3.10 Interactions

There are a number of interactions between the various topics of the EIAR and Material Assets. Where these occur, they have been detailed within the primary assessment. No further interactions are identified.

16.3.11 Cumulative Impacts

Of the 33 projects identified in the screening of developments within a 5km radius of the proposed Project, only one is significant enough to have the potential for cumulative impacts: the M20 road project. There will be no cumulative impacts during the construction stage as the construction programmes for the two projects do not overlap. During the operational stage, there is the potential for cumulative impacts in relation to road infrastructure only. Here the impact is anticipated to be positive; continued dialogue with the M20 project team during the design of the proposed Project has resulted in updates to the design to ensure a smooth transition with any interfaces with the N20/M20 and the road-over-rail bridge at XC201 Thomastown has been made wider to facilitate future growth in traffic using this route which may occur as a result of the M20 project as well as other developments in the area. This was at the request of Limerick County Council.

16.3.12 Difficulties Encountered in Compiling Information

Despite being a largely rural area, material assets at each of the seven sites are substantial and varied, and difficult to quantify without detailed surveys, which were not considered proportionate for this assessment. As a result, an assessment covering all sites of the proposed Project was carried out to compensate for the lack of details at each site; that is, except for where direct impacts on assets were predicted to occur, these have been quantified using aerial images and GIS tools, and are detailed in the assessment.

16.4 Climatic Factors

16.4.1 Introduction

This section sets out the methodology used to identify and determine the significance of impacts on greenhouse gas (GHGs) emissions and assesses both the vulnerability of the proposed Project to climate change and whether it has the potential to affect future resilience strategies for other developments and operations. The predicted impacts are described as well as any mitigation measures to avoid or reduce those impacts where they are considered to be significant.

16.4.2 Study Area

Due to the nature of climatic effects, GHG emissions have the potential to impact Ireland’s commitments and targets under various EU Climate Agreements and other international agreements. Therefore, the study area can be classed as Ireland in terms of GHGs.,

In terms of vulnerability and resilience, predicted climate impacts are not provided at a local geographical scale, such as the Statistics Office Small Areas; however, they can be focused on infrastructure and specific types of risk to and from infrastructure. Therefore, the study area includes the footprint of the proposed Project and the immediate surrounding road and rail network up to 1km radius. The 1km radius is set by Professional Judgement; it is considered unlikely that the proposed project would affect or be affected by climate impacts beyond this range.

16.4.3 Consultation

The key issues raised during consultation with prescribed bodies and other consultees in relation to Climatic Factors are broadly summarised below in Table 16.15.

Table 16.15 Consultation Submissions and Response

Consultee Comments	Response
<p>Limerick County Council EIAR to include point on eventual electrification of the railway line and how that will help in regard to climate issues</p>	<p>This is addressed in Volume 3, Chapter 2: Project Need and Alternatives.</p>

16.4.4 Methodology

Relevant Guidelines, Policy and Legislation

The amended EIA Directive 2014/52/EU Article 13 (See Volume 2, Chapter 4: EIA Process and Methodology) sets out the required approach to climate change within EIA as follows:

“In this regard, it is appropriate to assess the impact of projects on climate (for example greenhouse gas emissions) and their vulnerability to climate change”

The assessment of climate will be conducted with consideration of the relevant legislation and guidance including:

- EIA
 - Assessing Greenhouse Gas emissions and Evaluating their Significance (IEMA. 2017);
 - Guidelines on the Information to be contained in Environmental Impact assessment reports. Draft August 2017 (EPA 2017);
 - Climate Change Impacts and Adaptation/Resilience;
 - AR5 Synthesis Report: Climate Change 2014 (IPCC 2014);

- The Status of Ireland's Climate (EPA, 2012);
- National Adaptation Framework: Planning for a Climate Resilient Ireland (DCCAIE, 2018); and
- Climate Change Sectoral Adaptation Framework: Transport (DTTS, 2019).
- Climate Change and Greenhouse Gas Emissions
 - European Commission (EC) (2014) 2030 Climate and Energy Policy Framework (EC 2014);
 - National Policy Position on Climate Action and Low Carbon Development (DCCAIE 2014);
 - Climate Action and Low Carbon Development Act (Act. No. 46 of 2015); and
 - Transport Infrastructure Ireland (TII) (2011) Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes (TII 2011).
- Local Authority climate and planning guidance:
 - Limerick County Development Plan 2010-2016; and
 - Cork County Development Plan 2014.

International Climate Agreements

There have been three key international agreements on climate change:

- The United Nations Framework Convention on Climate Change (UNFCCC): in April 1994 this was ratified and now has 197 countries as its members. The ultimate objective of the Convention is to stabilize greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system."
- The Kyoto Protocol was agreed in 1997 and it operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries to limit and reduce greenhouse gases (GHG) emissions in accordance with agreed individual targets.
- The Paris Agreement was signed by member countries in December 2015 at COP21: its central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C.

Ireland is a member of the UNFCCC and ratified the Paris Agreement on 4 November 2016; it is legally bound to fulfil the commitments made in Paris.

The Paris Agreement recognises the role of both adaptation and mitigation measures and in particular, acknowledges that greater levels of mitigation (reductions in greenhouse gas emissions in order to achieve the temperature goals) can reduce the need for additional adaptation efforts. Article 7.1 of the Agreement specifically recognises the importance of adaptation as well as mitigation and establishes a goal of "enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change".

National Policies and Definitions: Mitigation

The National Policy Position on Climate Action and Low Carbon Development, adopted in 2014, establishes the national objective of "achieving transition to a competitive, low carbon, climate-resilient and environmentally sustainable economy by 2050". Specifically, it envisages that policy development will be guided by a long-term vision based on:

- an aggregate reduction in carbon dioxide (CO₂) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors; and
- in parallel, an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production.

The Climate Action and Low Carbon Development Act 2015 provides the statutory basis for the national transition objective. Climate change mitigation is defined by the Climate Action and Low Carbon Development Act as "[...]

any human intervention aimed at reducing harmful influences on the earth's climate system, including action aimed at reducing emissions and creating or enhancing sinks".

National Policies and Definitions: Adaptation

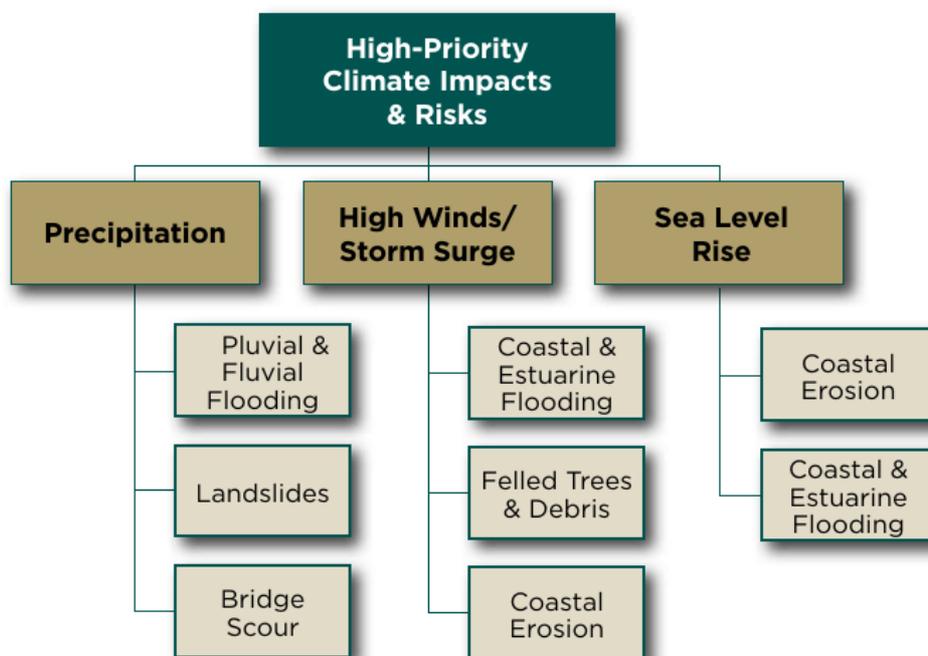
The National Adaptation Framework (2018) defines climate resilience as "...the capacity of a system, whether physical, social or ecological, to absorb and respond to climate change and by implementing effective adaptation planning and sustainable development (including governance and institutional design) to reduce the negative climate impacts while also taking advantage of any positive outcomes".

The Climate Action and Low Carbon Development Act, 2015 defines climate change adaptation as "[...] any adjustment to

- (a) any system designed or operated by human beings, including an economic, agricultural or technological system, or
- (b) any naturally occurring system, including an ecosystem, that is intended to counteract the effects (whether actual or anticipated) of climatic stimuli, prevent or moderate environmental damage resulting from climate change or confer environmental benefits".

Priority Impact Chains for the Transport Sector are identified in the Climate Change Adaptation Framework for Transport. It was determined that the sector is most vulnerable to flooding, high winds (storms) and storm surges as a result of projected climate change. Flooding, landslides and subsidence are of notable concern to land transport infrastructures. Inset Figure 16.1 shows the highest priority impacts and risks for the transport sector and is drawn from the Sectoral Framework.

Inset Figure 16.1 High Priority Impacts and Risks (Source Climate Change Adaptation Framework: Transport)



Greenhouse Gas Emissions Assessment Methods

Calculating Greenhouse Gas Emissions

For the purposes of this assessment, the definition outlined in Council Directive 2009/28/EC for greenhouse gases has been used. In Annex V, C. Methodology Point 5 the relevant greenhouse gases are defined as carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). CO₂ accounted for 63.8% of total greenhouse gas emissions in

2017 while CH₄ and N₂O combined accounted for 34.2%. The main source of CH₄ and N₂O is from the agriculture sector.

Greenhouse gases (GHGs) have different efficiencies in retaining solar energy in the atmosphere and different lifetimes in the atmosphere. In order to compare different GHGs, emissions are calculated on the basis of their Global Warming Potential (GWPs) over a 100-year period, giving a measure of their relative heating effect in the atmosphere. The Intergovernmental Panel on Climate Change (IPCC) 4th assessment report (AR4) sets out GWP100 for carbon dioxide (CO₂) is the basic unit (GWP = 1) whereas methane gas (CH₄) has a global warming potential equivalent to 25 units of CO₂ and nitrous oxide (N₂O) has a GWP100 of 298.

F-Gases, unlike the three pollutants above are man-made and are used in refrigeration, air conditioning and semiconductor manufacture. These gases comprise HFCs (Hydrofluorocarbons), PFCs (Perfluorocarbons), SF₆ (Sulphur Hexafluoride) and NF₃ (Nitrogen Trifluoride) and accounted for 2% of the CO₂eq in Ireland in 2017. They are much more potent than the naturally occurring greenhouse gas emissions.

For the purposes of calculating GHG emissions CO₂, CH₄ and N₂O (as CO₂equivalent (CO₂e)) will be considered as there are no significant sources of F-gases from the proposed Project.

Greenhouse gas emissions (CO₂e) for the proposed Project have been calculated using a new carbon assessment tool, developed and published by Transport Infrastructure Ireland (TII). It's release date was July 2020. The tool has been specifically designed to allow for the carbon footprint of road and light rail projects to be calculated, as required by the revised Environmental Impact Assessment (EIA) Directive 2014/52/EU. The tool is customised for road and light rail projects in Ireland. Given the nature of the proposed Project, which comprises new roads and road-over-rail bridges, which are to be designed and constructed to TII Standards, it was considered appropriate to use this tool in the assessment.

The tool considers all phases of a projects and the various carbon related elements at each phase, as follows:

- Before use:
 - Pre-construction (site clearance);
 - Embodied carbon (raw materials);
 - Construction (activities); and
 - Waste.
- Use – operational carbon consumption, including maintenance.
- End of Life (demolition).

For each site, details were added to the tool as appropriate. The 'Use' phase focuses on maintenance only for the proposed Project as the assessment in Volume 3, Chapter 11: Traffic & Transport determined there would be no significant increase in vehicles using the crossing, as compared to the baseline. The 'End of Life' phase has been scoped out; it is not considered likely that these structures will require to be replaced in the foreseeable (up to 100 years) future.

In addition, construction traffic has not been included in the assessment; there is currently no information on the routes and distances that are likely to be travelled by construction workers. It is likely that this would be a very small contributor to the overall carbon emissions for the proposed Project and therefore Not Significant.

Determining Significance

In its recent guidance on Greenhouse Gas Emissions and Significance in EIA, IEMA sets out three principles that support its opinion that climate change as one of the defining environmental policy drivers of the future and that action to address GHG emissions is essential. These are:

- The GHG emissions from all projects will contribute to climate change; the largest inter-related cumulative environmental effect.

- The consequences of a changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive (See Volume 2, Chapter 4: EIA Process and Methodology) – e.g. Population, Fauna, Soil, etc.
- GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant.

There are no established significance criteria or defined thresholds for greenhouse gas emissions, yet. However, these principles mean that, in the absence of these, it might be considered that all GHG emissions are significant and an EIA should ensure the project addresses their occurrence by taking mitigating action.

IEMA states in its guidance that: *“Under the principle that all GHG emissions might be considered significant, and the ongoing research of how to measure significance, it is down to the practitioner’s professional judgement on how best to contextualise a project’s GHG impact.”*

In contrast, the UK DMRB Guidance LA 114 Climate identifies significance criteria by assessing the calculated GHGs for a project against the Overseeing Organisation (In this case Republic of Ireland) Carbon Budget.

In terms of 2030 reduction targets the EU Effort Sharing Regulation (ESR) requires that Ireland reduce its non-Emissions Trading Scheme (ETS) emissions by 30% on 2005 levels by 2030. This gives Ireland a carbon budget of 378.3 MtCO_{2e}. The annualised average carbon budget is 37.83 Mt CO_{2e}.

DMRB Guidance states that *“The assessment of projects on climate shall only report significant effects where increases in GHG emissions will have a material impact on the ability of Government to meet its carbon reduction targets.”* The determination of material impact is through professional judgement, no thresholds are provided.

The total carbon emissions for the proposed Project will be compared against Ireland’s carbon budget using annualised emissions over a 100 year period (the predicted lifetime of the proposed Project).

Vulnerability and Resilience

In order to determine impacts on vulnerability, the high-risk impacts identified in the Transport Adaptation Framework are used as a starting point and consideration given as to whether the proposed Project is at risk from these impacts or increases the likelihood of these impacts occurring.

16.4.5 Baseline Environment

Observed and Predicted Climate Impacts in Ireland

The Status of Ireland’s Climate Report (2012) described observed changes in Ireland’s climate as being consistent with regional and global trends with some local patterns of change also evident. The annual average surface air temperature in Ireland has increased by approximately 0.8 degrees Celsius over the last 110 years. This is just one of the changes in climate documented in the report, which sets out 40 variables known as ‘Essential Climate Variables’ (ECVs) across the atmospheric, oceanic and terrestrial domains.

These changes are acknowledged to be as a result of cumulative emissions of Greenhouse Gases from anthropogenic sources causing global mean surface warming. Four scenarios of further warming by the late 21st century and beyond are projected by the IPCC, based on scenarios of greenhouse gas emissions which depend on both socio-economic development and climate policy. The proposed GHG concentration trajectories are known as Representative Concentration Pathways (RCPs) and were adopted by the IPCC for its Fifth Assessment Report (AR5) in 2014. The four pathways are named RCP2.6, RCP4.5, RCP6 and RCP8.5.

AR5 describes the RCPs as including a stringent mitigation scenario (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0) and one scenario with very high GHG emissions (RCP8.5). Scenarios without additional efforts to constrain emissions (‘baseline scenarios’) lead to pathways ranging between RCP6.0 and RCP8.5. RCP2.6 is representative of a scenario that aims to keep global warming likely below 2°C above pre-industrial temperatures.

The Adaptation Framework for the Transport sector sets out the observed and predicted impacts for those indicators of particular relevance and risk to the sector, under the RCPs and this is set out in Table 16.16.

Table 16.16 Observed and Predicted Climate Impacts

Variable	Observed Impacts	Projected Mid-Century Impacts
Atmosphere		
Air Temperature	<p>Mean annual surface air temperatures have increased by about 0.8°C over the period 1890–2012; an average of about 0.07 °C per decade.</p> <p>The number of warm days (over 20°C) has increased while the number of cold days (below 0°C) and annual frost days has decreased.</p>	<p>Mean annual temperatures will rise by about 1°C - 1.6°C (RCP4.5 scenario) by mid-century compared to the 1961–1990 average; highest increase in the east.</p> <p>Increase in extreme warm temperature (up to 2.6°C summer maximums & up to 3.1°C in winter depending on emissions scenario).</p> <p>Average number of frost days will further decrease (by 50%).</p>
Precipitation Average	<p>Annual national precipitation over the period 1981–2010 has increased by 5% relative to the period 1961–1990.</p> <p>The largest increases are observed over the west of the country.</p> <p>The likelihood of an extreme dry summer has doubled over the last century.</p>	<p>Wetter winters (14% increase in precipitation for RCP8.5 scenario by mid-century); drier summers (between 3 - 20% reduction for the RCP4.5 and RCP8.5 scenarios respectively by mid-century).</p> <p>Increase in intense rainfall (≥20mm/day) especially in winter and autumn by ~ 20%.</p> <p>12% -40% increase in 'dry periods', for both RCP4.5 and RCP8.5 scenarios together with longer average duration (5 days with <1mm rain).</p>
Wind Speed and Storms	<p>There is no evidence of a sustained long-term trend in wind speed or direction, but evidence exists of an increase in the frequency of days with heavy rain (10mm or more) over the period 1981–2010, relative to the period 1961–1990 (EPA, 2009).</p> <p>The number and intensity of storms in the North Atlantic has increased by approximately 3 storms per decade since 1950.</p>	<p>Slightly fewer storms, but more intense ones. Projections indicate an overall decrease in wind speed but an increase in extreme wind speeds, particularly during winter.</p> <p>The number of very intense storms is projected to increase over the North Atlantic region and the tracks of intense storms are projected to extend further south.</p> <p>Increased storm surge (Atlantic coastal retreat rates likely to increase from current 0.5-1m/year).</p>
Humidity	<p>In the period since 1961 the trend has been for a slight increase in summer and decrease in winter RH (relative humidity) values.</p>	<p>An increase in RH is likely, especially during winter months, while decreases in summer are projected, mainly in the South and East.</p>
Oceans		
Sea Levels and Sea Surface Temperatures	<p>1993-2017 sea level rise of c. 35mm per decade (currently c. 3.4mm/year) has been observed. Tide gauge records pre-1990 show sea level rise of 1–2mm/year.</p> <p>Sea surface temperatures have increased by 0.85°C since 1950, with 2007 the warmest year in Irish coastal records.</p>	<p>Rise of c. 550–600mm to 2100 (based on IPCC RCPs 2.6–4.5 and other medium-scale climate warming scenarios).</p> <p>Regional Sea Level Rise of c.25cm (Dublin/east coast of Ireland), c.44cm (Sligo/central western coasts) and c. 40cm (south-west Ireland) by 2080–2100</p> <p>Sea surface temperatures are projected to continue warming for the coming decade. For the Irish Sea, projections indicate a warming of 1.9°C by the end of the century.</p>
Terrestrial		

Variable	Observed Impacts	Projected Mid-Century Impacts
Phenology	<p>Trees and plants: evidence of change in timing of phenological phases such as bud burst, leaf unfolding, flowering, fruiting, leaf colouring and leaf fall in some trees and plants.</p> <p>Growing season has extended by one week.</p>	<p>Projections suggest that bud burst of birch will continue to advance until 2100; rate of advance will vary with the north-east region showing the greatest advance.</p> <p>Growing season to extend by up to 35 days.</p>

Greenhouse Gas Emissions

Ireland's GHG emissions increased in the period from 1990 to 2001 where it peaked at 70,475 kt CO₂ equivalent, before displaying a downward trend to 2014. Emissions have increased by 3.7% and 3.5%, respectively in the years, 2015 and 2016 and decreased by 0.9 per cent in 2017. In 2017 total national GHG emissions amounted to 60,744 kt CO₂ equivalent, which is 9.6 per cent higher than 1990 emissions.

In relation to the greenhouse gases, carbon dioxide (CO₂) accounted for 64% of the total, with methane (CH₄) and nitrous oxide (N₂O) contributing 23% and 11.0% as CO₂ equivalent, respectively and F-gases contributing 2% of the total as CO₂ equivalent. In 2017, the energy industries, transport and agriculture sectors accounted for 72.4% of total GHG emissions.

Transport was responsible for 20.1% of Ireland's Greenhouse Gas emissions in 2018. The final GHG inventory figures estimate transport emissions increased by 1.6% in 2018 or 0.20 Mt CO₂eq compared to 2017 emissions. This is the fifth year out of the last six (2012-2018) with increased emissions in transport.

Emissions from the Railway Sector have fluctuated since 1990, reaching an all-time low of 120.53kt CO₂ equivalent in 2014; since then there have been four years in a row of increases. Notwithstanding this, the emissions for 2018 were 130.49kt CO₂ equivalent which is a 12% decrease on 1990 levels.

16.4.6 Predicted Impacts

Greenhouse Gas Emissions

It is anticipated that the proposed Project will help to improve the efficiency of the Dublin-Cork Railway Line and facilitate the eventual electrification of the line. There are no current estimates of the energy likely to be saved by this and so this has not been taken into account in the predicted GHGs from the proposed Project, however it is likely to have a positive, mitigating effect on the GHGs associated with the proposed Project.

Impacts are predicted for the construction phase of the proposed Project only. There are no additional traffic movements during operation and embodied energy is accounted for as part of the construction phase. There are no other sources of GHGs. Table 16.18 provides the outputs from the Carbon Assessment Tool for the proposed Project. The detailed embodied carbon materials analysis for each site is provided in Appendix 16A. Table 16.18 provides an assessment of the potential effect of the proposed Project GHG emissions on the annual carbon budget for Ireland to 2030.

Table 16.17 TII Carbon Assessment Tool Outputs for proposed Project

LX	Name	Before Use (kgCO ₂ e)				Use (kgCO ₂ e)	Total (kgCO ₂ e)
		Pre-Construction	Embodied Carbon	Construction Activities	Construction Waste		
XC201	Thomastown	88	185747	45679	126	85619	317258
XC211	Newtown	923	112959	14711	2790	95880	227263
XC209	Ballyhay	18	9528	6730	178	12678	29132
XC212	Ballycoskery	1081	686801	68072	1375	189384	946713
XC215	Shinanagh	2511	462477	47331	958	254029	767306
XC219	Buttevant	1129	282635	58987	233	106074	449058
Totals		5749	1740147	241510	5659	743664	2736729

Table 16.18: Potential Impact on Ireland Annual Carbon Budget

Project Stage	Annualised average carbon budget Ireland (MtCO ₂ e) (2020 to 2030)	Net CO ₂ project GHG emissions (MtCO ₂ e) per year (assuming 100 year lifespan)	Impact on annual ceiling (%age of budget)
Construction	37.8	0.02	0.053
Operation	37.8	0.007	0.020
Total	37.8	0.027	0.073

Whilst it is acknowledged that all GHG emissions are potentially significant, adding as they do to the national emissions inventory, it is considered that a percentage of 0.07% of the national carbon budget each year for the next 100 years is not significant.

Vulnerability to Climate Impacts

Impacts in relation to vulnerability are considered under the key risk areas identified in the Adaptation Framework for Transport and for each site.

Flooding, high winds (storms) and storm surges which may also lead to landslides and subsidence are high priority risks from climate change identified for the land-based transport sector in Ireland.

Of these risks, the proposed Project is most at risk from flooding and storms, with potentially consequential landslides or subsidence.

The Flood Risk Assessment (FRA) at Volume 5, Appendix 9A, concluded that six of the seven sites are considered to be 'less vulnerable development' (local transport infrastructure) and are at low risk of flooding from all sources. The baseline assessment of flood risk showed that XC219 Buttevant is high for fluvial flood risk and low from all other sources.

In response to this, the hydraulic design of the new road-over-rail bridge over the Pepperhill tributary has been developed to design out increase in flood risk to the area (embedded mitigation). The key features of this structure are:

- A new 6m clear span concrete box culvert on the main Pepperhill tributary with embedment depth of 0.5m;
- A new 3m clear span concrete box culvert on the side channel immediately upstream of the R522 with embedment depth of 0.5m;

- Both culverts are aligned to the existing natural channel to avoid artificial modification of the planform;
- Freeboard of greater than 0.3m above the 1% AEP flood level including climate change in line with OPW guidance; and
- Removal of the existing culvert on the side channel beneath the R522.

Detailed hydraulic modelling of the proposed Project has identified a maximum increase in water levels of 0.002m (2mm) in the study area. As such, no compensatory flood storage is proposed as part of the scheme.

In addition, the introduction of new impermeable areas could potentially increase the volume and peak flow of surface runoff reaching watercourses and could therefore contribute to an increase in flood risk. This potential impact has been assessed and designed out (embedded mitigation) through the proposed drainage strategy.

16.4.7 Mitigation Measures

Greenhouse Gas Emissions

The emissions of GHGs across the proposed Project are not significant and therefore there no mitigation measures are proposed.

Vulnerability to Climate Impacts

Drainage Strategy

No drainage works are proposed at XC187 Fantstown as no construction is proposed there; none is required either at XC209 Ballyhay as limited construction is proposed to take place there and the CCTV infrastructure does not require drainage or any alterations to existing drainage systems.

For the remaining sites, in keeping with *NRA TB 13 – Revised Road Drainage Standards*, over the edge drainage is proposed in the design for all locations, supplemented with additional features to accommodate the presence of structures or site constraints where necessary. New swale ditches are proposed, located at the toe of the road embankment, that will then drain back to the low points to maximise attenuation and pollution control as part of a SuDS management chain.

The swale features will be grassed, with shallow side slopes and a long-wetted perimeter to reduce flow rates and velocities. Typically, they will be underlain by a filter material and perforated pipe to provide a second stage of treatment. The width of the swale varies between 3 and 7 metres depending on the site, and the depth (including 0.15 metres freeboard) is up to 0.75 metres and typically less than 0.5 metres. See TII Publication Number CC-SCD-00525 for typical details. Where agricultural or local access must be maintained, a short section of culvert will be constructed beneath the respective junction to ensure connectivity of the swale ditches either side of the access.

The swale ditches will outfall directly or indirectly into water bodies within the River Mague or River Awbeg sub-catchments respectively, with further detail provided under each site below. The maximum outflow of the swales will be capped at greenfield runoff rates.

Swale ditches are not proposed at XC219 Buttevant within the existing floodplain as there is a potential for these to be overwhelmed in a fluvial flood event, resulting in a direct pathway between untreated runoff from the highway and the receiving watercourse (Pepperhill). Instead, a gully and pipe network is detailed which will capture surface runoff from the highway. This will discharge into the Pepperhill (indirectly via existing ditches) through an interceptor.

16.4.8 Residual Impacts

Greenhouse Gas Emissions

The emissions of GHGs across the proposed Project is not significant and therefore there are no residual impacts.

Vulnerability to Climate Impacts

Following the implementation of the drainage strategy, not residual impacts are anticipated.

16.4.9 Interactions

Climatic factors interact with all topics indirectly, as climate change has the potential to affect all aspects of the environment, especially ecosystems, flood risk, water quantity and quality, air quality and the landscape. Specifically, there is a direct interaction with traffic and air quality impacts in relation to greenhouse gas emissions and resource use in the form of embodied carbon.

16.4.10 Cumulative Impacts

Of the 33 projects identified in the screening of developments within a 5km radius of the proposed Project, only one is significant enough to have the potential for cumulative impacts: the M20 road project. There will be no cumulative impacts during the construction stage as the construction programmes for the two projects do not overlap. During the operational stage, there is potential for cumulative impacts on climatic factors as a result of proposed new roads and alignments. The findings of the FRA have been built into the drainage design for the proposed Project and therefore no significant impacts on flood risk are identified; and in terms of operational carbon emissions from the proposed Project, these would not be significantly different from existing emissions. As a result, there is no likelihood of cumulative impacts with other projects including the M20.

16.4.11 Difficulties Encountered in Compiling Information

At this stage of the proposed Project it is difficult to accurately estimate exact quantities and interpret the carbon tool categories in regard to greenhouse emissions. However, all reasonable efforts have been made to be as concise in providing estimations as possible.

16.5 References

Department of Defence (2017) A National Risk Assessment for Ireland 2017

DEHLG (2000) National Climate Change Strategy

DEHLG (2003) Strategy to Reduce Emissions of Trans-boundary Pollution by 2010 to Comply with National Emission Ceilings - Discussion Document

DEHLG (2004) National Programme for Ireland under Article 6 of Directive 2001/81/EC for the Progressive Reduction of National Emissions of Transboundary Pollutants by 2010

DEHLG (2006) Ireland's Pathway to Kyoto Compliance - Review of the National Climate Change Strategy

DEHLG (2007a) Update and Revision of the National Programme for Ireland under Article 6 of Directive 2001/81/EC for the Progressive Reduction of National Emissions of Transboundary Pollutants by 2010

DEHLG (2007b) National Climate Change Strategy 2007-2012

Department of Environment, Heritage and Local Government (DoEHLG) (2010) A Guide to Risk Assessment in Major Emergency Management

Directive 85/337/EEC of 27

DoEHLG (2010) Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities

DoEHLG (2010) A Guide to Risk Assessment in Major Emergency Management

Department of the Environment, Climate and Communications (2014) National Policy Position on Climate Action and Low Carbon Development. Accessed at: <https://www.gov.ie/en/publication/6f393-national-climate-policy-position/>

Department of the Taoiseach (2018) National Risk Assessment 2018 Overview of Strategic Risks

EEA (2011) NEC Directive Status Reports 2010

Environmental Protection Agency (EPA) (2002) Guidelines On Information To Be Contained in Environmental Impact Statements

EPA (2003) Advice Notes On Current Practice (In The Preparation Of Environmental Impact Statements)

EPA (2013) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment

EPA (2014) Guidance on Assessing and Costing Environmental Liabilities

EPA (2017) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports Accessed at: <https://www.epa.ie/pubs/advice/ea/EPA%20EIAR%20Guidelines.pdf>

EPA (2017) 'What impact will climate change have for Ireland'
<http://www.epa.ie/climate/communicatingclimatescience/whatisclimatechange/whatimpactwillclimatechangehaveforireland/>

EPA (2017) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (Draft)

EPA (2018b) Ireland's Provisional Greenhouse Gas emissions 1990-2017

EPA (2018a) Ireland's Greenhouse Gas Emissions Projections.

ERM (1998) Limitation and Reduction of CO₂ and Other Greenhouse Gas Emissions in Ireland

EIA Directive 2014/52/EU

Fehily Timoney & Company (2012) Best Practice Guidelines for the Irish Wind Energy Industry

FCCC (1999) Ireland - Report on the in-depth review of the second national communication of Ireland

IPCC (2006) Guidelines for National Greenhouse Gas Inventories Volume 4: Agriculture, Forestry and Other Land Use, Chapter 7 Wetlands

Planning and Development Regulations 2001 as amended

Transport Infrastructure Ireland (2011) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes

Transport Infrastructure Ireland (2009) Guidelines for Assessment of Ecological Impacts of National Roads Schemes (Rev. 2, National Roads Authority, 2009)

Transport Infrastructure Ireland (2020) TII's Standards. Accessed at: <https://www.tiipublications.ie/Current-Documents-March-2020.pdf>

UK DEFRA (2001) DMRB Model Validation for the Purposes of Review and Assessment

UK DEFRA (20016a) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM.TG(16)

UK DEFRA (20016b) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. PG(16)

UK Department of the Environment, Transport and Roads (UK DETR) (1998) Preparation of Environmental Statements for Planning Projects That Require Environmental Assessment - A Good Practice Guide, Appendix 8 - Air & Climate

UK Highways Agency (2012) Updated air quality advice on the assessment of future NO_x and NO₂ projections for users of DMRB Volume 11, Section 3, Part 1 'Air Quality

UK Highways Agency (2007) Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 - HA207/07 (Document & Calculation Spreadsheet)