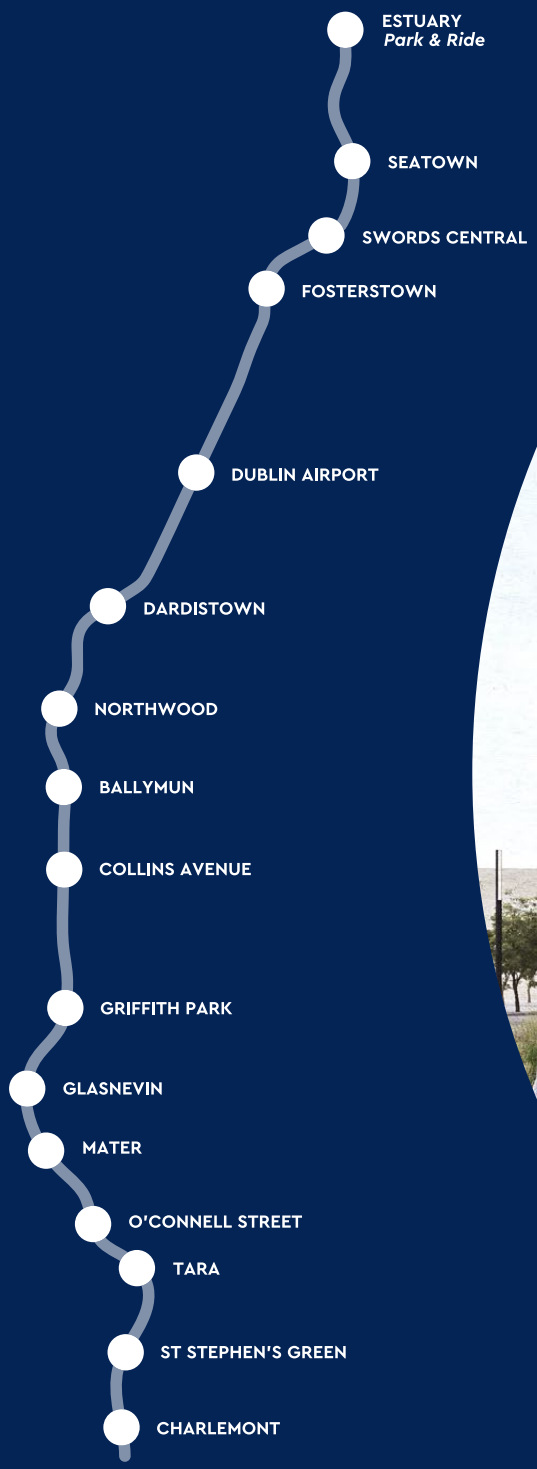


28 Risk of Major Accidents and Disasters

Contents

Table of Acronyms

Acronym	Meaning
ALARP	As low as reasonably practicable
AZ	Assessment Zone
CBTC	Communications-based train control
CEMP	Construction Environmental Management Plan
CRR	Commission for Railway Regulation
DART	Dublin Area Rapid Transit
DoEHLG	Department of the Environment, Heritage and Local Government
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPA	Environmental Protection Agency
EU	European Union
GSI	Geological Survey of Ireland
HGV	Heavy Goods Vehicles
IAA	Irish Aviation Authority
IEMA	Institute of Environmental Management and Assessment
IFI	Inland Fisheries Ireland
ISO	International Organization for Standardization
MAND	Major accident and/or natural disaster
OPW	Office of Public Works
PSZ	Public Safety Zone
SAC	Special Area of Conservation
TBM	Tunnel Boring Machine
TII	Transport Infrastructure Ireland
TMP	Traffic Management Plan

28. Risk of Major Accidents and Disasters

28.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) assesses the potential significant adverse impacts of the MetroLink Project (hereafter referred to as the proposed Project), deriving from its vulnerability to risks of Major Accidents and/or Natural Disasters (MANDs) during the Construction Phase and Operational Phase.

In accordance with the requirements of Directive 2011/92/EU as amended by Directive 2014/52/EU (Environmental Impact Assessment (EIA) Directive), it describes and assesses '*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*'. Annex IV, point 8 of the EIA Directive also provides that the EIAR should contain *"A description of the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or disasters which are relevant to the project concerned."* Relevant information available and obtained through risk assessments pursuant to Union legislation such as Directive 2012/18/EU of the European Parliament and of the Council (14) or Council Directive 2009/71/Euratom (15) or relevant assessments carried out pursuant to national legislation may be used for this purpose provided that the requirements of this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.

The assessment is based on a reasonable worst-case scenario with respect to MANDs arising from the proposed Project as described in Chapter 4 (Description of the MetroLink Project) to Chapter 6 (MetroLink Operations & Maintenance) of this EIAR. The proposed Project description is based on the design prepared to inform the planning stage of the proposed Project and to allow for a robust assessment as part of the EIA process.

The underlying objective of considering the risk of MANDs is to ensure that appropriate precautionary measures are taken for those projects with a likelihood of creating '*significant environmental impacts*' (Environmental Protection Agency (EPA) 2022) and with a focus on '*low likelihood but potentially high consequence events*' in accordance with guidance provided by the Institute of Environmental Management and Assessment (IEMA 2020). A further objective is to ensure that the EIAR identifies measures to mitigate harm that could arise from those unlikely scenarios and ensure that it addresses preparedness and response planning.

This Chapter outlines how the potential for MANDs (Recital 15 of the EIA Directive) relevant to the proposed Project have been identified and how those risks will be managed and/or controlled. Based on the requirements of the EIA Directive, this Chapter considers:

- The relevant MANDs, if any, that the proposed Project could be vulnerable to;
- The potential for these MANDs to result in likely significant adverse environmental effects on people and local communities, and the natural, built and historic environments; and
- The existing and proposed mitigation and management measures to prevent and mitigate the likely significant adverse effects of such events on the environment.

28.1.1 Outline Project Description

A full description of the proposed Project is provided in the following chapters of this EIAR:

- Chapter 4 (Description of the MetroLink Project);
- Chapter 5 (MetroLink Construction Phase); and
- Chapter 6 (MetroLink Operations & Maintenance).

Limits of deviation have been set for the proposed Project and this is addressed in the Wider Effects Report annexed at Appendix A5.19.

Table 28.1 presents an outline description of the key proposed Project elements which are appraised in this Chapter.

Diagram 28.2 presents an outline of the main elements of the Operational Phase of the proposed Project that are appraised in this Chapter.

This Chapter should be read in conjunction with the following Chapters, and their Appendices, which expand upon aspects of the proposed Project:

- Chapter 15 (Biodiversity);
- Chapter 17 (Climate);
- Chapter 18 (Hydrology);
- Chapter 20 (Soils & Geology);
- Chapter 22 (Infrastructure & Utilities); and
- Chapter 31 (Summaries of the Route Wide Mitigation & Monitoring).

Table 28.1: Outline Description of the Principal Project Elements

Project Elements	Outline Description
Permanent Project Elements	
Tunnels	It is proposed to construct two geographically separate, single-bore tunnels, using a Tunnel Boring Machine (TBM). Each section of tunnel will have an 8.5m inside diameter and will contain both northbound and southbound rail lines within the same tunnel. These tunnels will be located as follows: ▪ The Airport Tunnel: running south from Dublin Airport North Portal (DANP) under Dublin Airport and surfacing south of the airport at Dublin Airport South Portal (DASP) and will be approximately 2.3km in length; and ▪ The City Tunnel: running for 9.4km from Northwood Portal and terminating underground south of Charlemont Station.
Cut Sections	The northern section of the alignment is characterised by a shallow excavated alignment whereby the alignment runs below the existing ground level. Part of the cut sections are open at the top, with fences along the alignment for safety and security. While other sections are "cut and cover", whereby the alignment is covered.
Tunnel Portals	The openings at the end of the tunnel are referred to as portals. They are concrete and steel structures designed to provide the commencement or termination of a tunnelled section of route and provide a transition to adjacent lengths of the route which may be in retained structures or at the surface. There are three proposed portals, which are: ▪ DANP; ▪ DASP; and ▪ Northwood Portal. There will be no portal at the southern end of the proposed Project, as the southern termination and turnback would be underground.
Stations	There are three types of stations: surface stations, retained cut stations and underground stations: ▪ Estuary Station will be built at surface level, known as a 'surface station'; ▪ Seatown, Swords Central, Fosterstown Stations and the proposed Dardistown Station will be in retained cutting, known as 'retained cut stations'; and ▪ Dublin Airport Station and all 10 stations along the City Tunnel will be 'underground stations'.

Project Elements	Outline Description
Intervention Shaft	An intervention shaft will be required at Albert College Park to provide adequate emergency egress from the City Tunnel and to support tunnel ventilation. Following the European Standard for safety in railway tunnels TSI 1303/2014: Technical Specification for Interoperability relating to 'safety in railway tunnels' of the rail system of the European Union, it has been recommended that the maximum spacing between emergency exits is 1,000m. As the distance between Collins Avenue and Griffith Park is 1,494m, this intervention shaft is proposed to safely support evacuation/emergency service access in the event of an incident. This shaft will also function to provide ventilation to the tunnel. The shaft will require two 23m long connection tunnels extending from the shaft, connecting to the main tunnel. At other locations, emergency access will be incorporated into the stations and portals or intervention tunnels will be utilised at locations where there is no available space for a shaft to be constructed and located where required (see below).
Intervention Tunnels	In addition to the two main 'running' tunnels, there are three shorter, smaller diameter tunnels. These are the evacuation and ventilation tunnels (known as Intervention Tunnels): ▪ Airport Intervention Tunnels: parallel to the Airport Tunnel, there will also be two smaller diameter tunnels; on the west side, an evacuation tunnel running northwards from DASP for about 315m, and on the east side, a ventilation tunnel connected to the main tunnel and extending about 600m from DASP underneath Dublin Airport Lands. In the event of an incident in the main tunnel, the evacuation tunnel will enable passengers to walk out to a safe location outside the Dublin Airport Lands. ▪ Charlemont Intervention Tunnel: The City Tunnel will extend 320m south of Charlemont Station. A parallel evacuation and ventilation tunnel is required from the end of the City Tunnel back to Charlemont Station to support emergency evacuation of maintenance staff and ventilation for this section of tunnel.
Park and Ride Facility	The proposed Park and Ride Facility next to Estuary Station will include provision for up to 3,000 parking spaces.
Broadmeadow and Ward River Viaduct	A 260m long viaduct is proposed between Estuary and Seatown Stations, to cross the Broadmeadow and Ward Rivers and their floodplains.
Proposed Grid Connections	Grid connections will be provided via cable routes with the addition of new 110kV substations at DANP and Dardistown. (Approval for the proposed grid connections to be applied for separately but are assessed in the EIAR).
Dardistown Depot	A maintenance depot will be located at Dardistown. It will include: ▪ Vehicle stabling; ▪ Maintenance workshops and pits; ▪ Automatic vehicle wash facilities; ▪ A test track; ▪ Sanding system for rolling stock; ▪ The Operations Control Centre for the proposed Project; ▪ A substation; ▪ A mast; and ▪ Other staff facilities and a carpark.
Operations Control Centre	The main Operations Control Centre (OCC) will be located at Dardistown Depot and a back-up OCC will be provided at Estuary.
M50 Viaduct	A 100m long viaduct to carry the proposed Project across the M50 between the Dardistown Depot and Northwood Station.
Temporary Project Elements	
Construction Compounds	There will be 34 Construction Compounds including 20 main Construction Compounds, 14 Satellite Construction Compounds required during the Construction Phase of the proposed Project. The main Construction Compounds will be located at each of the proposed station locations, the portal locations and the Dardistown Depot Location (also covering the Dardistown Station) with satellite compounds located at other locations along the alignment.

Project Elements	Outline Description
	Outside of the Construction Compounds there will be works areas and sites associated with the construction of all elements of the proposed Project, including an easement strip along the surface sections.
Logistics Sites	The main logistics sites will be located at Estuary, near Pinnock Hill east of the R132 Swords Bypass and north of Saint Margaret's Road at the Northwood Compound. (These areas are included within the 14 Satellite Construction Compounds).
Tunnel Boring Machine Launch Site	There will be two main tunnel boring machine (TBM) launch sites. One will be located at DASP which will serve the TBM boring the Airport Tunnel and the second will be located at the Northwood Construction Compound which will serve the TBM boring the City Tunnel.

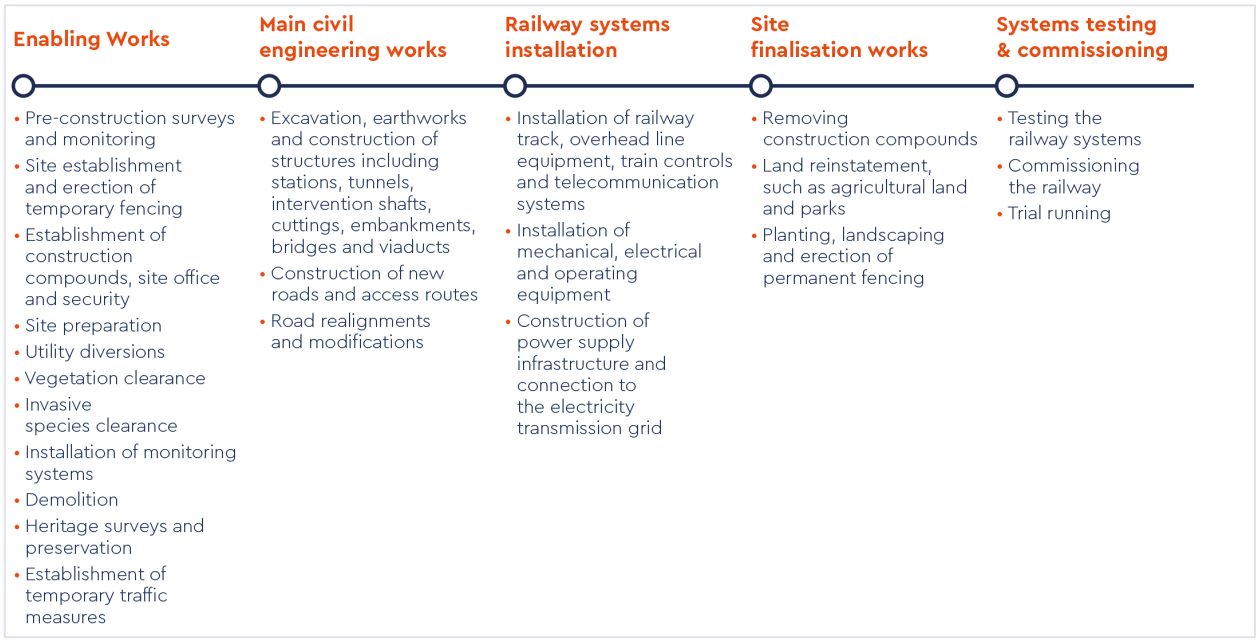


Diagram 28.1 Summary of the Key Activities during the Construction Phase of the Proposed Project

Diagram 28.2 Summary of Key Activities during the Operational Phase of the Proposed Project

28.2 Assessment Methodology

28.2.1 Scope and Content

The scope and methodology presented in this chapter is based on the provisions of the EIA Directive, Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA 2022), Chemicals Act (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2015

(S.I. No. 209 of 2015) ((COMAH Regulations), European Commission (2017) guidance, IEMA (2020) guidance and other published risk assessment methodologies and professional judgement (referenced in Section 28.2.2.2).

The identification, control and management of risk is an integral part of the design and assessment process throughout all stages of a project lifecycle. The scope and methodology of this assessment is centred on the understanding that the proposed Project will be designed, built and operated in line with best international current practices and guidelines. As a result, major accidents resulting from the proposed Project will be very unlikely.

The elements of the proposed Project incorporate technologies and measures that are designed to reduce and eliminate the occurrence of accidents during the Construction and Operational Phase of the proposed Project. Measures to mitigate risks associated with Construction Phase activities are incorporated in the outline Construction Environmental Management Plan (CEMP) (Appendix A5.1). Measures to control risks associated with Operational Phase activities will be incorporated into the Operational Strategy by the Principal Contractor in accordance with the requirements outlined in this EIAR and any Railway Order (RO) granted by An Bord Pleanála.

A risk analysis-based methodology that covers the identification of risks and considers their likelihood to occur and the potential consequences of MANDs has been used for this assessment (see Section 28.2.3). The criteria considered for this risk assessment seek to determine:

- The risk events that have the potential to result in a MAND that the proposed Project may be vulnerable to or which the proposed Project could contribute to; and
- The consequent impacts and significance of such incidents in relation to population, human health and the receiving natural, built and historic environments.

Such risks may be present at the Construction Phase and Operational Phase of the proposed Project. It is not anticipated that this proposed Project will have a Decommissioning Phase as metro systems are usually rehabilitated and maintained in a long service life.

28.2.1.1 Receptors

The assessment of significant adverse effects considers all factors defined in Article 3 of the EIA Directive, namely population and human health, biodiversity with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC, land (for example land take), soil (for example organic matter, erosion, compaction, sealing), water (for example hydromorphological changes, quantity and quality), air and climate (for example greenhouse gas emissions, impacts relevant to adaptation) and material assets, cultural heritage including architectural and archaeological aspects and the landscape and the interaction between the factors. For the purpose of assessment, an environmental receptor is therefore considered to be any of the following relevant receptors:

- Members of the public and local communities;
- Infrastructure, including traffic, transport and utilities and the built environment;
- The natural environment, including ecosystems, land and soil quality, climate, air quality, surface and groundwater resources and landscape; and
- The historic environment, including archaeology and built heritage.

28.2.2 Relevant Guidelines, Policy and Legislation

28.2.2.1 EIA Directive

The following paragraphs set out the requirements of the EIA Directive in relation to MANDs.

Recital 15 of Directive 2014/52/EU (amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment) states that:

'In order to ensure a high level of protection of the environment, precautionary actions need to be taken for certain projects which, because of their vulnerability to major accidents, and/or natural disasters (such as flooding, sea level rise, or earthquakes) are likely to have significant adverse effects on the environment. For such projects, it is important to consider their vulnerability (exposure and resilience) to major accidents and/or disasters, the risk of those accidents and/or disasters occurring and the implications for the likelihood of significant adverse effects on the environment. In order to avoid duplications, it should be possible to use any relevant information available and obtained through risk assessments carried out pursuant to Union legislation, such as Directive 2012/18/EU of the European Parliament and the Council (13) and Council Directive 2009/71/Euratom (14), or through relevant assessments carried out pursuant to national legislation provided that the requirements of this Directive are met'.

Article 3 of the EIA Directive requires that the EIAR shall identify, describe and assess in the appropriate manner, the direct and indirect significant effects on population and human health, land, soil, water, air and climate, material assets, cultural heritage and landscape deriving from (amongst other things) the '*vulnerability of the project to risks of major accidents and/or disasters that are relevant to the project concerned'.*

The information relevant to MANDs to be included in the EIAR is set out in paragraph 8 of Annex IV of the EIA Directive as follows:

'A description of the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or disasters which are relevant to the project concerned. Relevant information available and obtained through risk assessments pursuant to Union legislation such as Directive 2012/18/EU of the European Parliament and of the Council (14) or Council Directive 2009/71/Euratom (15) or relevant assessments carried out pursuant to national legislation may be used for this purpose provided that the requirements of this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.'

The Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA 2022) states, in Section 3.7.3: that the purpose of the MANDs assessment is:

'To address unforeseen or unplanned effects the Directive further requires that the EIAR takes account of the vulnerability of the project to risk of major accidents and /or disasters relevant to the project concerned and that the EIAR therefore explicitly addresses this issue. The extent to which the effects of major accidents and / or disasters are examined in the EIAR should be guided by an assessment of the likelihood of their occurrence (risk). This may be supported by general risk assessment methods or by systematic risk assessments required under other regulations e.g., a COMAH (Control of Major Accident Hazards involving Dangerous Substances) assessment'.

The Major Accidents and Disasters in EIA: A Primer (Institute of Environmental Management & Assessment (IEMA) 2020) describe a major accident and/or disasters assessment as covering:

'The assessment of potentially significant adverse effects of a development on the environment deriving from its vulnerability to risks of relevant major accidents and/or disasters.'

28.2.2.2 Other Relevant Legislation – Railway Safety

The design, management, operation and maintenance of the proposed Project must comply with current Irish legislation, standards and European Union (EU) regulations, therefore ensuring that risk mitigation is embedded within the design process and reducing the risk and/or vulnerability of the proposed Project to a major accident and/or natural disaster.

- The Commission for Railway Regulation (CRR) was established on 1st January 2006 under the provisions of the Railway Safety Act (RSA) 2005. It is the independent regulator of both the heavy and light rail organisations and under the Railway Safety Directive (EU Directive 2004/49/EC), as

reflected in S.I. No.444 of 20131. The CRR is the National Safety Authority for the railway sector in the Republic of Ireland and no one is allowed to operate a railway or manage railway infrastructure unless they have obtained the appropriate safety certificate or authorisation from the CRR as the national safety authority. Therefore, railway system design must be in line with the Irish Railway Standards published by the CRR and all proposed safety management systems are evaluated through a conformity assessment process carried out in compliance with Directive (EU) 2016/798 of 11 May 2016 on railway safety (Railway Safety Directive) and Railway Safety Act 2005 (No. 31 of 2005) amended by European Union (Railway Safety) Regulations 2013 (S.I. 444 of 2013). The CRR provides the overview and authorisation and will review and approve Applications for Acceptance (AFA) at different stages of a rail project. The CRR set out a detailed list of parameters related to railway design, both civil infrastructure and systems, operation and maintenance activities and rolling stock requirements, all with safety assessment in mind. These lists have been generated through consideration of current legislation, good industry practice and industry expert knowledge. The parameters are linked to Requirements or Codes of Practice relevant to each discipline and at each stage of the design the Applicant (TII in this case) has to be able to demonstrate that the proposed Project complies with the requirements and provide traceable evidence to design documentation. This ensures that at each stage of the design the appropriate safety concerns have been addressed through evidence of design or safety assessments which allow progression to the next assessment phase from Concept to Preliminary Design, to Detailed design, to Testing, to Interim Operation and finally Operation. The Design team have provided the required documents and evidence for the Safety Plan, Hazard Record and Safety & Compliance Matrix to the CRR and have held a number of meetings with them in support of TII to collate and present the evidence required at this design stage of the proposed Project. Further engagement and approvals from CRR will be required throughout and subsequent to the RO application process.

28.2.2.3 Guidelines and Reference Material

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

- Advice Notes for Preparing Environmental Impact Statements Draft (EPA 2015b);
- A Code of Practice for Risk Management of Tunnel Works (The International Tunnelling Insurance Group 2012);
- A Guide to Risk Assessment in Major Emergency Management (Department of Environment, Heritage and Local Government (DoEHLG 2010);
- A National Risk Assessment for Ireland 2020 (Government of Ireland 2020);
- COMMISSION REGULATION (EU) No 1303/2014 of 18 November 2014 concerning the technical specification for interoperability relating to 'safety in railway tunnels' of the rail system of the European Union;
- CRR-G-032-B CRR Guideline for the Application for Acceptance for New Light Rail Works or New Light Rail Rolling Stock. (CRR 2020);
- CRR-G-033-C Guideline for Application for Acceptance of New Light Rail Works (CRR 2020);
- CRR-G-016-C Guideline for Application for Acceptance of Light Rail Rolling Stock (CRR 2020);
- Directive 2012/18/EU of the European Parliament and of the Council of July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC;
- Guidelines on the Information to be contained in Environmental Impact Assessment Reports; (EPA May 2022);
- EU Regulation 402/2013 (as amended) on the Common Safety Method on Risk Evaluation and Assessment (CSM-RA) (as amended by Regulation EU 2015/1136);
- Flood Risk Management Plan: Liffey & Dublin Bay (Office of Public Works (OPW) 2018a);
- Flood Risk Management Plan: Nanny – Delvin (OPW 2018b);
- Guidance on Assessing and Costing Environmental Liabilities (EPA 2014);
- Health and Safety Authority Guidance on Technical Land-use Planning Advice for Planning Authorities and Operators of Establishments under the COMAH establishments;
- Iarnród Éireann Safety Report 2016 (Iarnród Éireann 2017);
- Number 10 of 2005 - Safety, Health and Welfare at Work Act 2005 (hereafter referred to as the Safety, Health and Welfare at Work Act);

- Major Accidents and Disasters in EIA: A Primer (IEMA 2020) (IEMA 2020);
- Major Emergency Plan 2015 (Dublin City Council 2015);
- Major Emergency Plan of Fingal County Council (Fingal County Council 2011);
- National Risk Assessment for Ireland 2020 (Government of Ireland 2020: Railway Safety Performance in Ireland 2018 (CRR 2019) and CRR Annual Report 2018 (CRR 2019);
- Revised Guidelines on the Information to be Contained in Environmental Impact Statements (EPA 2015a);
- S.I. No. 138/2012 - Building Regulations (Part A Amendment) Regulations 2012;
- S.I. No. 291 of 2013 – Safety, Health and Welfare at Work (Construction) Regulations 2013 (hereafter referred to as the Safety, Health and Welfare (Construction) Regulations);
- S.I. No. 299/2007 - Safety, Health and Welfare at Work (General Application) Regulations 2007 (hereafter referred to as the Safety, Health and Welfare at Work (General Application) Regulations);
- Safe Evacuation for All: A Planning and Management Guide (National Disability Authority 2011);
- Seveso III Directive;
- S.I. No. 209 of 2015 - A Guide to the Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015; and
- International Organization for Standardization 31000:2018 Risk Management.

Transport Infrastructure Ireland's (TII's) strategies and procedures:

- Business Continuity Management – Process, Plans and Teams;
- Business Continuity Plans; and
- Incident Management Plans.

28.2.3 Risk Assessment Methodology

The impact assessment methodology is risk based and involves three stages:

- Identification and screening of potential risk events (Section 28.2.3.1);
- Risk classification (Section 28.2.3.2); and
- Risk evaluation (Section 28.2.3.3).

28.2.3.1 Identification and Screening

The first stage of the assessment was to identify potential risk events that the proposed Project may cause or may be vulnerable to. Consultation was undertaken with competent specialists, the design team, stakeholders and TII, further details about meetings/consultations with stakeholders can be found in Chapter 8 (Consultation). An initial list of relevant hazards which may make the proposed Project vulnerable to major accidents and/or disasters that could potentially result in MANDs were identified and 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 (i.e., that meets the definition of a MANDs). The following risks were screened out of the assessment according to the following criteria:

- MANDs that have already been assessed in other areas of this EIAR, for example flood risk. These are summarised and referenced in this Chapter.
- MANDs associated with Construction Phase and Operational Phase activities that fall within the Regulations and Codes of Practice made under the Safety, Health and Welfare at Work Act and associated obligations, for example risks associated with working at height and within confined space.
- MANDs where no source-pathway-receptor linkage exists. Examples include incidents that cannot be plausibly associated with the proposed Project, such as volcanic activity and risk of nuclear accidents.

- Accidents that possess low likelihood and low consequence, as they do not meet the criteria of the assessment as being a MAND, for example the risk of minor traffic accidents on the road network causing delays.

28.2.3.2 Risk Classification

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 followed that used in A Guide to Risk Assessment in Major Emergency Management (DoEHLG 2010) combined with guidance from IEMA Primer (IEMA 2020) and guidelines provided in the EPA Guidelines (EPA 2022). The EPA Guidelines state that the risk assessment must be based on a 'worst case' approach. Therefore, the consequent rating assumes that all embedded design mitigation measures and safety procedures have failed to prevent the MANDs.

The classification and rating of likelihood and consequence are provided in Table 28.2 and Table 28.3, these apply to both the Construction Phase and Operational Phase.

Table 28.2: Classification of Likelihood (source DoEHLG 2010)

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 28.3: Classification of Consequence

Rating	Classification	Description (Defining significance)
1	Slight Effects	▪ Geographic extent: effects within the development boundary only; no credible source-pathway-receptor linkage; localised effects. ▪ Severity: <€0.5m, small number of people affected; no fatalities and small number of minor injuries with first aid treatment; no contamination. ▪ Duration: limited duration; slight localised disruption to community services or infrastructure (<6 hours). ▪ Effort required to remediate the environment: no substantial clean-up or restoration efforts required.

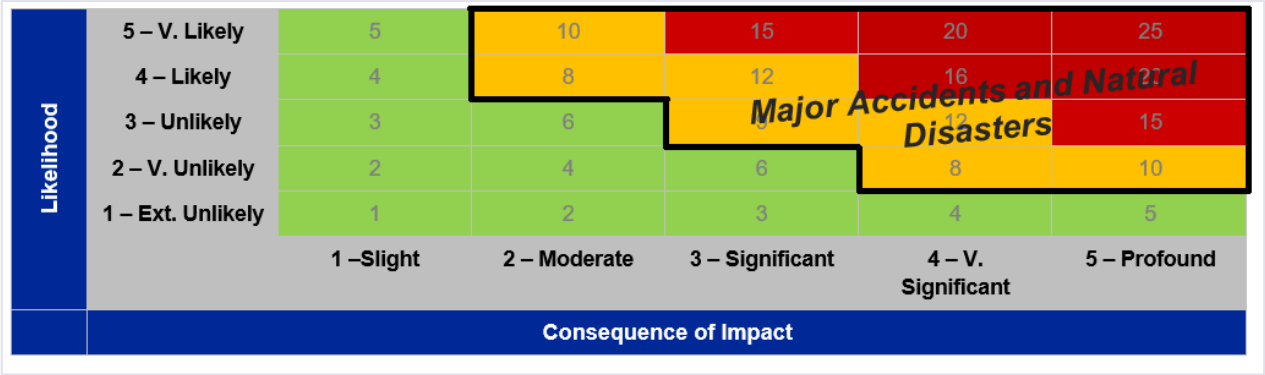
Rating	Classification	Description (Defining significance)
2	Moderate Effects	▪ Geographic extent: localised displacement of a small number of people; no credible source-pathway-receptor linkage ▪ Severity: €0.5M-3M; single fatality; limited number of people affected; a few serious injuries with hospitalisation and medical treatment required; simple contamination. ▪ Duration: localised effects of short duration (for 6-24 hours). ▪ Effort required to remediate the environment: personal support satisfied through local arrangements; normal community functioning with some inconvenience.
3	Significant Effects	▪ Geographic extent: widespread effect; community only partially functioning, some services available; credible source-pathway-receptor linkage to sensitive receptors. ▪ Severity: €3M-10M; significant number of people in affected area impacted with multiple fatalities (<5); multiple serious or extensive injuries (20); significant hospitalisation; up to 500 evacuated; loss of life or permanent injury; or permanent or long-lasting damage to an environmental receptor; simple contamination. ▪ Duration: extended duration; large number of people displaced for 6-24 hours or possibly beyond. ▪ Effort required to remediate the environment: effects requiring substantial clean-up or restoration efforts; external resources required for personal support.
4	Very Significant Effects	▪ Geographic extent: localised effects of extended duration; credible source-pathway-receptor linkage to sensitive receptors. ▪ Severity: €10M-25M; heavy contamination; 5 to 50 fatalities, up to 100 serious injuries; up to 2,000 evacuated; community functioning poorly; minimal services available. ▪ Duration: extended duration >24hrs. ▪ Effort required to remediate the environment: effects requiring substantial clean-up or restoration efforts; external resources required for personal support.
5	Profound Effects	▪ Geographic extent: widespread effects of extended duration; credible source-pathway-receptor linkage to sensitive receptors. ▪ Severity: €>25M; very heavy contamination; large numbers of people impacted with a significant number of fatalities (>50); injuries in the hundreds; more than 2,000 evacuated. ▪ Duration: extended duration; disruption to or loss of key services for prolonged period. ▪ Effort required to remediate the environment: effects requiring substantial clean-up or restoration efforts; community unable to function without significant support; external resources required for personal support.

28.2.3.3 Risk Evaluation

Using guidelines provided by the DoEHLG (2010) and amended by the provisions set out in the IEMA Primer (IEMA 2020), the MANDs were evaluated against 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 28.4.

- **High Risk** – Scenarios that have an evaluation score of 15 to 25, as indicated by the Red Zone in Table 28.4.
- **Medium Risk** – Scenarios that have an evaluation score of 8 to 12, as indicated by the Amber Zone in Table 28.4.
- **Low Risk** – Scenarios that have an evaluation score 1 to 6, as indicated by the Green Zone in Table 28.4.

Table 28.4: Levels of Significance (derived from DoEHLG (2010); EPA (2022) and IEMA (2020))



Significant impacts resulting from MANDs are adverse impacts that are described as 'Significant', 'Very Significant' or 'Profound' under the EPA Guidelines (EPA 2022). Therefore, significant adverse impacts that fall within the Amber Zone and Red Zone are brought forward for further consideration and assessment for further mitigation. The IEMA Primer (IEMA 2020) recommends that the MAND assessment focuses on low likelihood but potentially high consequence events, therefore for the purposes of this assessment and to also bring this in line with DoEHLG's (2010) guidance, it can be assumed that the Red Zone is high likelihood/high consequence, and the Amber Zone is low likelihood/high consequence.

As per the IEMA Primer (IEMA 2020) low-consequence events have been scoped out as they are not considered to be a MANDs. Where relevant these risks to the environment are addressed under other topics in the EIAR, for example the risk of invasive species has been assessed and mitigated in Chapter 15 (Biodiversity) and in the outline Invasive Species Management Plan (ISMP) (Appendix A15.8).

28.3 Baseline Environment

28.3.1 Sensitive Receptors

As described in detail throughout the technical environmental chapters of this EIAR (Chapters 9 to 27), there are a number of sensitive receptors located along or near the alignment of the proposed Project that may be vulnerable to major risks and/or natural disasters. These include the following:

- The high-density population located along the alignment, as discussed and assessed under Chapter 10 (Human Health) and Chapter 11 (Population & Land Use). These not only include residential properties but also include education facilities, places of worship, recreational areas, sports grounds, hospitals and other buildings with sensitive activities.
- There are numerous historic buildings and structures of architectural heritage along the proposed Project alignment. These have been detailed and assessed in Chapter 25 (Archaeology & Cultural Heritage) and Chapter 26 (Architectural Heritage).
- Sensitive habitats and protected designated European sites are detailed and assessed in Chapter 15 (Biodiversity) and the Natura Impact Statement, and while the proposed Project will not be directly located within a European site, the Broadmeadow River provides a hydraulic link to Malahide Estuary Special Area of Conservation (SAC) (Site Code 000205) and Malahide Estuary Special Protection Area (Site Code 004025). Protected sites located within 15km of the proposed Project have been illustrated in Volume 4 of this EIAR.
- Water resources are detailed in Chapter 18 (Hydrology) and Chapter 19 (Hydrogeology). The proposed Project alignment crosses a number of rivers including the Broadmeadow and Ward Rivers at the Broadmeadow and Ward Viaduct.
- Climate, traffic and air quality are discussed in Chapter 17 (Climate), Chapter 16 (Air Quality) and Chapter 9 (Traffic & Transport).
- Land quality, agriculture, soil and geology have been detailed and assessed in Chapter 20 (Soils & Geology) and Chapter 23 (Agronomy).
- Landscape and visual sensitive receptors have been assessed and detailed in Chapter 27 (Landscape & Visual).

28.3.2 Hazards

28.3.2.1 Natural Hazards

28.3.2.1.1 Flood Risk

Ireland's geographic location means it is less vulnerable to natural disasters such as earthquakes or tsunamis, which might pose a risk to projects of this nature and scale in other locations around the world. However, in recent times there has been an increase in the number of severe weather events in the country, particularly those leading to flooding and flash flood incidents.

For example, severe weather conditions have resulted in flooding events at water crossings along the proposed Project alignment. There are records of fluvial flooding at Estuary with a reported incident in 2002 and records at Seatown of fluvial flooding with historical flood events reported in 1982, 2002 and 2008. Flood risk relating to the proposed Project is further detailed in Chapter 18 (Hydrology) and Catchment Flood Risk Assessment Management flood mapping can be viewed in Figure 28.1 of this EIAR.

With regards natural disasters, severe weather conditions pose one of the most common risks to Ireland and to the proposed Project. Furthermore, climate change may change the likelihood of a natural disaster occurring. Climate effects on the proposed Project have been assessed in further detail in Chapter 17 (Climate).

28.3.2.1.2 Geo-stability Hazards

Ground conditions generally comprise limestone derived tills with some smaller areas of alluvium, and made ground in urban areas, overlying carboniferous limestones. Topography varies from sea level at the River Liffey to around 70m above mean sea level at Dublin Airport with, on the whole, gentle gradients. An overall 'low' landslide susceptibility classification has been assigned by Geological Survey of Ireland (GSI) for the area of the proposed Project; no landslides have been recorded according to GSI data, and karst landforms are not present. Seismic activity is also considered a low risk, particularly in the Dublin region. Soil and geology are detailed and assessed in Chapter 20 (Soils & Geology).

28.3.2.2 Anthropogenic Hazards

Potential MANDS can also result due to anthropogenic activity in the vicinity of the proposed Project. These are discussed below in the context of Industrial sites including Seveso sites and adjacent major infrastructure.

28.3.2.2.1 Industrial Sites

There are four industrial sites within one kilometre of the proposed Project alignment, which are subject to Industrial Emissions Directive (IED) Licences from the EPA. A potential risk with industrial sites is the existence of a source-pathway-receptor linkage, a 1km distance is determined to ensure any potential risks don't have an opportunity to have an effect on the proposed Project or for the proposed Project to have an effect on them. Working from north to south, these are:

- SK Biotek – located in Swords, upstream of the Ward River and west of the proposed Project alignment;
- Arch Chemicals BV – located in Swords, adjacent to SK Biotek, upstream of the Ward River and west of the proposed Project alignment;
- CLH Aviation Limited – located north-east of Dublin Airport Station; and
- Independent Newspapers Ltd. – located south-west of O'Connell Street Station and west of alignment.

28.3.2.2.2 Seveso Sites

Two of the IED sites above, SK Biotek and Exolum Aviation Ireland, are designated as 'Seveso sites' in the Fingal County Council local authority area. These are sites subject to the Seveso III Directive

(2012/18/EU) and relate to the control of major accident hazards involving dangerous substances. The Chemicals Act (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2015 (S.I. No. 209 of 2015) (the "COMAH Regulations"), implements the Seveso III Directive (2012/18/EU) (refer to Figure 28.1). This classification as a Seveso site identifies the facilities as being industrial establishments where dangerous substances are used or stored in large quantities. The occurrence of a major emission, fire or explosion resulting from a Seveso site has the potential to give rise to a major accident or disaster, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances.

There are two tiers of establishment, which are related to the quantities of dangerous substances present, in this case, both facilities are lower tier establishments. The Health & Safety Authority is the Central Competent Authority that provides advice where appropriate in respect of planning applications within a certain distance of the perimeter of these sites. Seveso Site Consultation Distances are specified in the Planning & Development Regulations, 2001 (As amended) and vary depending on the nature of activity at the site. The Consultation distance for the SK Biotek site is 1km and the Consultation distance for Exolum Aviation Ireland Ltd is 500m.

The operator is required to provide a pre-operation safety report that covers the relevant Major Accident Prevention Policy (MAPP) and safety management system (SMS) requirements of the COMAH Regulations prior to start of operations. The safety report should describe the operator's arrangements for reporting major accidents, incidents and near misses and the Environmental Risk Tolerability for COMAH Establishments.

In addition, there are 12 Seveso sites located at Dublin Port. However, these are not considered a risk to the proposed Project due to the distance from the alignment.

28.3.2.2.3 Vandalism or anti-social behaviour on the trains or within the stations.

- The proposed Project has been designed as an open system for passengers, so that people can walk through the station and onto the platforms without obstruction. The platform screen doors will stop people accessing the line from the stations. A security fence will be installed along the whole of the above ground sections of the railway and at the tunnel portals. One of the outcomes of the architectural and urban realm design is to discourage anti-social behaviour, for example through the development of an attractive setting, use of public lighting, open sightlines, and avoidance of areas where individuals and groups of people can hide. Vandalism and anti-social behaviour on the trains and within the stations will be observed through CCTV and if required staff sent to diffuse the situation. The Access Control and Intrusion Detection (ACID) system will also identify intruders trying to enter locations where unauthorised access is prohibited. ACID will cover the platform doors to the track (surface and retained cut stations) and to the tunnel (underground stations); entrances to technical rooms, the station incident rooms, and stations (outside operational hours); access to the mainline tracks; entrances to facilities at Dardistown depot (test racks, workshops, garages, Operational Control Centre (OCC), technical rooms, storage areas, offices, and emergency doors); the back-up OCC: electricity sub-stations; tunnel portals; shafts and ventilation shafts and emergency doors. The ACID system will be integrated with the telephone system, CCTV, SCADA, Fire Alarm System and the Central Clock System to prevent anti-social behaviour.

28.3.2.2.4 Transport Infrastructure

Transport infrastructure is detailed in Chapter 9 (Traffic & Transport) of this EIAR. Some key transport infrastructures that could pose a risk to or from the proposed Project includes:

- Existing railway infrastructure including Iarnród Eireann tracks at Glasnevin (where the proposed Glasnevin interchange is located) and Tara Station and elevated track adjacent to the proposed Tara Station;
- Elevated Luas line at Charlemont;
- Section of motorway where the proposed Project crosses the M50 Motorway on a viaduct;
- R132 Swords Bypass adjacent to the proposed Project alignment;

- Dublin Airport; and
- Royal Canal Way.

These locations have been highlighted in Figure 28.1.

28.3.2.2.5 Utilities Infrastructure

The proposed Project will cross and directly impact on existing utilities during the Construction Phase. Utilities including gas, the MetroLink grid connections, power and water services are detailed in Chapter 22 (Infrastructure & Utilities).

28.3.2.2.6 Railway Infrastructure Baseline Performance

The Commission for Railway Regulation was established on the 1st of January 2006 under the Railway Safety Act 2005. It is the independent railway safety and market regulator for the conventional railway system in Ireland, a role largely defined in the European Union Regulatory framework for the Single European Railway Area. Under the Railway Safety Directive (EU Directive 2016/798/EC), as transposed in S.I. No.476 of 20202, the CRR is the National Safety Authority for the conventional railway in Ireland. The CRR is also the railway safety regulator for the light rail systems, heritage systems and the public highway interfaces with industrial rail systems. These systems are regulated under the provisions of the Railway Safety Act and are not within scope of the European Union Regulatory framework.

A review of Railway Safety Performance Report in Ireland 2020 (CRR 2020) for the existing level of MANDs on railway performance in Ireland, including railway safety trends in Europe and worldwide, indicates the following:

- The safety performance of the Irish railway sector is broadly positive, both when compared against previous years and European statistics.
- There were no passenger fatalities on Irish railways in 2020. However, tragically there were eight fatal occurrences on the conventional and light rail networks, one less than in the preceding year. Seven of these occurred on the Iarnród Éireann network and one on the Dublin Light Railway (Luas). Looking wider to Europe, Ireland continues to perform well in terms of the number of accidents. Ireland performs less well when it comes to precursor events such as Signals Passed at Danger (SPADs), wrong side signalling failures, track buckles and broken rails.

A number of accidents on railways in other countries during 2020 reminds us that despite many indicators showing improvement in overall safety performance, potential still exists for serious accidents with catastrophic outcomes.

In August 2020 in Carmont, Aberdeenshire, United Kingdom a passenger train collided with debris washed onto the track near Carmont, Aberdeenshire, following heavy rainfall. The subsequent derailment resulted in the death of three people, injuries to the six other people in the train and catastrophic damage. This tragic event highlights the impact of major weather events on the railway, the effectiveness of automatic train protection, crash protection systems on modern trains and the dangers of unauthorised access to the railway line.

It should be noted that a metro system has not been built in Ireland before, a metro system will differ from existing heavy rail and light rail (such as commuter trains, DART and Luas) in its operation due to its isolated and predominately underground or subsurface nature (i.e. it will not require any railway crossings and the track will be isolated and protected from the public and public roads).

28.4 Predicted Impacts

As described in Section 28.2, the predicted impacts in this section assume a reasonable worst-case scenario as per the IEMA Primer, which does not consider the implementation of mitigation measures or Emergency Response Plans that are implemented to reduce the impact of any MANDs.

A MANDS Risk Register has been developed which contains the reasonable worst-case scenarios identified as presenting a probabilistic risk during the Construction Phase and Operational Phase of the proposed Project, and the risks have been evaluated using the criteria in Section 28.2. This is provided in Table 28.5 (Construction Phase) and Table 28.6 (Operational Phase).

The key objective of this risk register is to identify whether additional mitigation and/or management measures are required (above those mitigation measures that have already been embedded in the current design) to manage the identified risks to the environment to be as low as reasonably practicable (ALARP). It is important to reiterate that this assessment will typically focus on '*low likelihood but potentially high consequence events'* (IEMA 2020).

Due to the size and scale of the proposed Project, some risk events which have the same potential consequence have been grouped for clarity of presentation.

Table 28.5: Rating of Construction Phase MANDS in the Absence of Mitigation

Risk ID	Risk Event	Source and/or pathways	Reasonable worst consequence if event did occur	Zone	Proposed Project Element	Likelihood Rating	Consequence Rating	Resulting Risk Category	Could this lead to MANDs?
C1	**Train derailment of adjacent Iarnród Éireann (IE) and Luas** (Due to construction activities on or adjacent to existing railway)	Settlement subsidence under existing track and surrounding infrastructure due to underground tunnelling and/or adjacent station construction works at the proposed Glasnevin Interchange Station, Tara Station, the Luas line at Charlemont, O'Connell Street and Eden Quay. Falling objects cause train derailment.	Major rail derailment accident resulting in fatalities and injury. Costly infrastructure damage and delays to public transport network. Potential for environmental impacts depending on location of derailment (e.g., contamination, impacts on the Royal Canal and Grand Canal, impacts on protected heritage and local biodiversity).	AZ4	Glasnevin interchange & City Centre locations above the underground alignment	1 – Ext. Unlikely	4 – V. Significant	4 – Low	No – embedded design measures ensure the risk is ALARP and will not constitute a MAND. The design measures are in accordance with best practice and in compliance with all Standard, International, EN Eurocodes and TII guidelines including but not limited to the following: ▪ CC-SPW-00600: Specification for Road Works Series 600 - Earthworks (including Erratum No. 1, dated June 2013); ▪ EN 1990: Basis of Structural Design; ▪ AFTES 1999: Settlements induced by Tunnelling; ▪ BTS (The British Tunnelling Society) Closed Face Tunnelling Machines and Ground Stability, A Guideline of Best Practice, ▪ IS EN 1997-1 embankments, Settlement analysis has been completed for buildings and utilities along the alignment in the Building Damage Report (Appendix A5.17), Chapter 5 (MetroLink Construction Phase), Chapter 20 (Soils & Geology) and Chapter 21 (Land Take). The construction measures outlined in the outline CEMP will ensure risk is ALARP and will include management practices to ensure the risk of objects falling on the track are mitigated and any incidents will be managed based on emergency response procedures to be developed as part of the outline CEMP.
C2	**Ground/building/structure damage or collapse as a result of significant soil settlement**	TBM and deep station excavation may lead to settlement and fluctuation in the water table resulting in impacts to structures and settlement collapse of soil on the surface. Construction of retained cut (piling) beside adjacent buildings.	In extreme situations buildings/structures over the tunnel, and/or adjacent the tunnel and deep stations, may collapse leading to injury and/or fatalities. Serious damage to protected historical buildings in Dublin City Centre. Collapse of the proposed Project infrastructure during construction.	All	Tunnel, retained cut	2 – V. Unlikely	4 – V. Significant	8 – Medium	Yes – this will require mitigation to ensure the risk is ALARP, refer to Table 28.09.
C3	**Collapse of proposed Project railway buildings and/or railway structures**	Construction works such as TBM entry into station box, and other construction activities that cause vibrations.	Risk of the proposed Project building/station box and/or structure collapsing, resulting in deaths and injuries to workers. Failure of the crane during the construction of the M50 Viaduct causing precast sections of the bridge to be deposited onto the M50 Motorway, resulting in a major traffic accident and possibly leading to deaths and injuries to both the public and to workers. Direct impact on major transport route for an extended duration. Collapse or failure of plant during the construction of the Broadmeadow and Ward Viaduct during construction leading to pollution impacts and damage to Broadmeadow and Ward Rivers.	AZ2, AZ3, AZ4	Underground stations, tunnel portal, viaduct	2 V – Unlikely	3 Significant	6 – Low	No -– this is not considered a MAND. The main works contracts (MWC) will be procured such that the contractors comply with the Joint Code of Practice for Risk Management of Tunnel works. This code is designed to promote and secure best practice for the minimisation and management of risks associated with the design and construction of tunnels, caverns, shafts and associated underground structures. TII will specify and ensure contractors comply with the requirements of this code and other controlling documentation (e.g., the Health and Safety Authority's S.I. No. 291/2013 Safety, Health and Welfare at Work (Construction) Regulations and BS6164 Code of Practice for Health and Safety in Tunnelling in the Construction Industry) and the full suite of documents will be included in the contracts. MWCs will be required to produce an overarching Construction Management Plan that details how these risks will be managed and a Safety Management Plan. The Construction Management Plan shall demonstrate how the Contractor will coordinate the safe advance of temporary and permanent works and detail proposed methodology and constructability issues relating to the design including construction

Risk ID	Risk Event	Source and/or pathways	Reasonable worst consequence if event did occur	Zone	Proposed Project Element	Likelihood Rating	Consequence Rating	Resulting Risk Category	Could this lead to MANDs?
			Collapse of adjacent river walls and river basins.						sequencing requirements. Additionally, the contractors will be required to produce numerous subsidiary plans including: ▪ TBM Management Plan ▪ Ground Movement Management Plan ▪ Groundwater Monitoring Plan ▪ Interface Management Plan ▪ Risk Management Plan ▪ Construction Method Statements and ▪ Risk Assessments. Embedded design measures ensure the risk is ALARP and will not constitute a MAND. The structures will be designed to have adequate structural resistance, serviceability, and durability having regard to best practice Internal, National and TII guidance documents including but not limited to the following: ▪ I.S. EN 1992 to I.S. EN 1999; ▪ AM-STR-06020 – TII Management of Buried Concrete Box Structures; ▪ Stations to be constructed in accordance with Part B1 to B5 of the Building Regulations and NFPA 130 or equivalent; ▪ EN 1990: Basis of Structural Design; Design of Earthworks Drainage, ▪ EN 1998-2:2005: Bridges; ▪ Network Drainage, Attenuation & Pollution Control, TII, March 2015; ▪ The SuDS Manual (C753), CIRIA, March 2015; ▪ CIRIA report C750: Groundwater control design and practice; and ▪ AFTES 1999: Settlements induced by Tunnelling.
C4	**Hydrological – heavy rain and prolonged flooding leading to collapse of embankments, settlement release, and flooding of tunnel and deep excavation.**	Extreme weather (rain/flood) Heavy rain and prolonged flooding leading to embankment failure and flooding from adjacent watercourse. Blockage of siphons or culverts. Extreme weather event resulting in sediment load runoff during construction exceeding attenuation pond settlement capacity near watercourse. Prolonged periods of heavy rainfall at surface works including open and deep excavations.	Extreme weather events leading to a breach in the embankments of water crossings along the proposed Project. Most notably at areas of high flood risk at Broadmeadow and Ward Rivers. Possible collapse of structure or temporary structures. During construction this may lead to flooding and result in flooded construction sites and property damage and contaminated runoff into watercourses. Impacts on the aquatic environment and protected European sites downstream. Prolonged flooding leading to collapse of embankment and potential clashes of temporary construction equipment/materials against Lissenhall bridge which is a protected National Monument. Runoff from attenuation pond resulting in uncontrolled releases of untreated water into the watercourse. Flooding of tunnel portals, box excavations, tunnel and retained cut excavation.	AZ1, AZ3	Broadmeadow and Ward Viaduct, alignment at Fosterstown Overbridge and Sluice River, M50 Viaduct, Royal Canal Wall at Glasnevin.	1–Ext.- Unlikely	3 – Significant	3 – Low	No – this is not considered a MAND. During construction, the risk of accidental release to surface water will be reduced by the development and implementation of a Water Management Plan, a Water Quality Management Plan, Construction Flood Protection Plan and Emergency Response Plans as part of the final outline CEMP. The flood risk to structures on a construction site can be mitigated through the design of the structure and programming of construction activities. This can be done through alternations to the permanent design, changing the construction sequence or programming activities to weather events, temporary mitigations such as sheet piling and cofferdams, sandbags, mobile barriers and plant, equipment and material mitigation. During Construction the Contractor is required to assess the risk of flood inundation and submit all proposals for protection of the works against flooding to the Project Manager for acceptance. Additionally, the contractor shall ensure that all shafts and tunnels are protected from inundation by physical means. During construction, specific flooding risks will be maintained within the risk database to ensure up to date mitigations are recorded and acted upon – the construction stage risk register. These will be managed in each area in accordance with the area Risk Management Plan. The Contractor shall prepare a plan for construction works detailing his sequences and methods of construction and include proposals to manage the risk of flooding of the works. Refer to Chapter 18 (Hydrology) and the outline CEMP for further detail. The Principal Contractor is required to use ISO 14001 EMS and will develop and implement a detailed Pollution Control Plan, Emergency Response Plan and Method Statements for working near waterbodies, drafted in agreement with Inland Fisheries Ireland (IFI) and other

Risk ID	Risk Event	Source and/or pathways	Reasonable worst consequence if event did occur	Zone	Proposed Project Element	Likelihood Rating	Consequence Rating	Resulting Risk Category	Could this lead to MANDs?
			Breach of the Royal Canal Wall at Glasnevin leading to flooding of the Irish Rail line.						relevant authorities, and having regard to best practice measures and relevant pollution prevention guidelines including but not limited to: Design of Earthworks Drainage, Network Drainage, Attenuation & Pollution Control, TII, March 2015; Drainage Systems for National Roads, TII, June 2015; CIRIA report C750: Groundwater control design and practice; and The SuDS Manual (C753), CIRIA, March 2015. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA 2009); Use of temporary construction methods from the following CIRIA publications (including C532: Control of water pollution from construction sites, C648: Control of water pollution from linear construction projects: technical guidance and C649: Control of water pollution from linear construction projects: site guide); Office of Public Works (OPW) Guidelines for Planning Authorities: The Planning System and Flood Risk Management (OPW and DoEHLG 2009). Monitoring required of weather forecasts to enable advanced warnings. Flood protection barriers around sites with deep excavation such as underground stations and portals. Use robust systems such as attenuation barriers around shaft and tunnel entrance. Designed in accordance with International, National and TII guidance. Cooperation with the relevant authorities, such as the local authorities and the OPW.
C5	**Unknown wells intersected by TBM**	During TBM tunnel excavation, there is a risk there may be wells present in the tunnel alignment.	Pressurized water and mud present in the front tunnel will be injected in the well, outcropping at the surface like a geyser. Water injection can cause damage at the surface.	AZ2, AZ4	Tunnel	3 – Unlikely	2 – Moderate	6 – Low	No – this is not considered a MAND. Mitigations prior to main works contractor: ▪ Review historic records to identify previous land use ▪ Identify risk of previous boreholes on tunnel alignment where casings may remain or not adequately backfilled ▪ Identify risk of historic wells or extraction boreholes from records ▪ Identify baseline conditions in GBR and inform MWC of requirements. ▪ Identify all known records in the site information supplied to contractor. ▪ Procure contractor in accordance with the Code of Practice for Risk Management of Tunnel works. Mitigations by contractor: ▪ Ensure that the risks identified above are included for in the tender return with appropriate mitigation embedded Dependant on the risks identified the contractor will need to: - ▪ review existing data, ▪ decommission / backfill any known obstructions on the alignment or redesign to suit, ▪ undertake additional surveys as needed to ascertain any anomalies or areas of risk ▪ log locations and include into tunnel process so that high risk zones are known to TBM team ▪ the TBM Management Plan will detail the response in case of sudden loss in pressure
C6	**Fire and/or explosion, or release of harmful gas**	Blasting works misfire. Presence of former landfill sites along alignment. Presence of unexploded ordnance.	Contamination of water resources resulting from runoff of fire water. Drift from fire into public property with resulting damage to property and/or loss of crops.	All	Throughout	2 – V. Unlikely	3 – Significant	6 – Low	No – this is not considered a MAND. A Specific Blasting Strategy has been developed for the project to ensure there are no significant effects arising from blasting (Refer to Chapter 14 Groundborne Noise & Vibration and in Appendix A5.20 (Blasting Strategy Report).

Risk ID	Risk Event	Source and/or pathways	Reasonable worst consequence if event did occur	Zone	Proposed Project Element	Likelihood Rating	Consequence Rating	Resulting Risk Category	Could this lead to MANDs?
		Presence of ground gas along alignment. Presence of gas transmission pipelines along the alignment. Fuel storage at construction compounds. Construction works requiring hot work. Accidental ignition of combustible materials. Electrical faults. Vandalism. Theft of explosive materials. Emission of dielectric gas, sulphur hexafluoride (SF6) from Substations.	Risk of fire in tunnel leading to fatalities of workers. Risk of fire from extreme drought during surface construction works, taking into account climate change. High winds and dry conditions may spread fire into proposed Project construction sites. Misuse of explosive materials resulting in injury, fatalities and environmental impacts. SF6 is also a highly potent greenhouse gas which the IPCC Fifth Assessment Report (AR5) stated has a GWP of 23,500 (IPCC 2015)).						It is currently assumed that there will be no storage of explosives at the construction sites and that material will be transported from an existing licenced facility to the sites as required in accordance with the Carriage of Dangerous Goods by Road Act 1998 (No 43 of 1998) and associated Regulations and the Explosives Act, 1875 (as amended by the Criminal Justice Act 2006). Potential emissions of SF6 have not been quantified as the gas will require the implementation of strict protocols within the design for construction and maintenance, including leak detection measures, to avoid fugitive emissions. Hence, even with the high GWP value, emissions are considered to be negligible, refer to Chapter 17 Climate. In addition, all other construction works in the vicinity of combustible material will be managed in line with the outline CEMP and any incidents will be managed based on emergency response procedures to be developed as part of the outline CEMP. TII will liaise with and coordinate risks associated with fire and/or explosion, or release of harmful gas with all relevant Stakeholders. Other measures to control these risks include the following: ▪ Fire loading to be minimised by good housekeeping, and the Fire Safety Strategy to be maintained and revised as construction proceeds. ▪ Hot work permit procedure will be developed for all hot works. ▪ Areas will be kept clear of combustible materials, with dedicated areas for waste processing. ▪ Power distribution systems to be purpose designed. ▪ 24-hour security will be on all sites.
C7	**Impact on critical infrastructure due to construction works including settlement**	Construction works and settlement directly impacting on underground and aboveground services.	Water Services – Risk of damaging strategic critical infrastructure such as water/foul pipes, resulting in flooding of adjacent properties, flooding of excavation and risk of damage to equipment. Risk of soil and groundwater contamination from sewer and associated environmental impacts. Energy supply – Risk of damaging underground and overhead cables resulting in power outage, risk of electrification and explosion. Risk of damaging gas mains resulting in supply outage and risk of explosion resulting in fatality and/or injury to workers and public. Fibre Telecommunications - Risk of damaging underground cables resulting in outages on phone and data networks leading to businesses and residents not being able to operate.	All	Throughout	3 –Unlikely	3 – Significant	9– Medium	Yes – further mitigation and management plans are required to ensure risk is ALARP, refer to Table 28.09.
C8	**Major road traffic accident**	Increase in traffic and Heavy Goods Vehicles (HGVs) using construction haul routes and site access points. Structures/debris/temporary props/ construction	Major road traffic accident resulting from construction works affecting vehicular, pedestrian and cycle traffic resulting in damage to property and injury and/or fatality. Multiple-vehicle collision on the M50 Motorway due to unexpected	All	Throughout	3 – Unlikely	3 – Significant	9 – Medium	Yes – further mitigation and management plans are required to ensure risk is ALARP, refer to Table 28.09.

Risk ID	Risk Event	Source and/or pathways	Reasonable worst consequence if event did occur	Zone	Proposed Project Element	Likelihood Rating	Consequence Rating	Resulting Risk Category	Could this lead to MANDs?
		equipment/vehicles falling onto busy roadway (M50). Unsecure large objects/material falling from HGVs. Collapse of bridges adjacent to work sites from vibrations and ground works.	falling objects from the M50 Viaduct during construction or from HGVs during transport of materials/equipment. Collapse of bridges such as Cross Guns Bridge during adjacent deep excavation works or tunnelling leading to major traffic accident and potential injury and/or fatality.						
C9	**Aviation incident**	The proposed Project is vulnerable to the risk of aviation/airport incident in both the inner and outer Public Safety Zone (PSZ) during the Construction Phase of the Dublin Airport South Portal (DASP) and surface works in Dardistown area. Electromagnetic interference.	Aviation crash in the PSZs that overlaps with the proposed DASP and track, resulting in injury and fatalities. Aviation crash could result in environmental impacts from contamination to soil and runoff to the Mayne River. Electromagnetic interference with airport critical systems causing aviation incident.	AZ1, AZ2, AZ3	Dublin Airport South Portal, Dublin Airport Station, alignment south of Dublin Airport	1 – Ext. Unlikely	5 – Profound	5 – Low	No – this is not considered a MAND. TII will liaise with daa and coordinate risks associated with Dublin Airports Operations for works in the area. The main works contractors will develop their Construction Management Plan and interface with daa to identify and mitigate the risks to either party. A specific Dublin Airport Interface Management Plan will be developed by the main works contractor. Regular interface meetings will be convened to assure that risks remain current and mitigations valid. Electromagnetic Compatibility Testing will be undertaken by the contractor.
C10	**Significant release event or long-term seepage of pollutants into watercourse**	Working over or adjacent to watercourses.	Pollution event leading to environmental damage, particularly associated with the potential release of silt to the aquatic environment (e.g., truck carrying items has an accident or temporary bridge collapses and releases silt into watercourses). Pollution of groundwater resulting from ground investigations and/or construction work underground. Potential for pollution event on European sites downstream of Broadmeadow and Ward Rivers.	All	Throughout	2– V. Unlikely	4 – V. Significant	8 – Medium	Yes – further mitigation and management plans are required to ensure risk is ALARP, refer to Table 28.10.
C11	**Industrial incident** – incident at nearby Seveso site involving release of dangerous substances	Fire/explosion and equipment/infrastructure failure at nearby Seveso site in Swords impacting the proposed project. The nearest licensed Seveso sites to the proposed Project are SK Biotek and CLH Aviation Ireland. The Seveso site in Swords has a hydraulic connection to the crossing of the proposed Project at Ward River.	Risk of occurrence of a major emission, fire or explosion resulting in off-site environmental impact.	AZ1	Broadmeadow and Ward Viaduct, Balheary alignment, Estuary Station and Park and Ride Facility	2 – V. Unlikely	2 –Significant	4– Low	No – embedded design measures ensure the risk is ALARP and will not constitute a MAND. Facilities are subject to management under the Chemicals Act (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2015 (S.I. No. 209 of 2015 (COMAH regulations). TII will liaise and coordinate risks associated with the Health and Safety Authority of Ireland with regard the Seveso sites. The main works contractors will develop their Construction Management Plan and interface with the Health and Safety Authority of Ireland to identify and mitigate the risks to either party. A specific Seveso Interface Management Plan will be developed by the main works contractor. Regular interface meetings will be convened to assure that risks remain current and mitigations valid.

Risk ID	Risk Event	Source and/or pathways	Reasonable worst consequence if event did occur	Zone	Proposed Project Element	Likelihood Rating	Consequence Rating	Resulting Risk Category	Could this lead to MANDs?
C12	**Tunnel damage/collapse**	Works being undertaken by third parties. Failure to communicate exact location of proposed Project infrastructure.	Risk of damage to tunnel during third party works, e.g., piling. Risk of injury and/or fatality to construction staff located in the tunnel and costly damage to the tunnel. Furthermore, the tunnel could collapse leading to settlement on the surface resulting in damage/collapse to buildings/structures. Risk of injury or fatality.	A2, AZ4	Tunnel	1 – Ext. Unlikely	4 – Significant	4 – Low	No – Any activity above the tunnel will be controlled, will comply with relevant guidelines and best practice and require consultation with TII. The land required for the proposed Project is to be safeguarded. TII will monitor 3rd party planning applications within the limits of deviation of the project to ensure no new developments are approved that increase risk to the proposed Projects Assets. During construction visual inspections will be undertaken along the alignment to provide further assurance.

Table 28.6: Rating of Operational Phase MANDs in the Absence of Mitigation

Risk ID	Risk Event	Hazard Source - Pathway	Reasonable Worst-Case Scenario	Zone	Proposed Project Element	Likelihood Rating	Consequence Rating	Resulting Risk Category	Could this lead to MANDs?
O1	**Metrolink Train Derailment**	▪ Power failure ▪ Electromagnetic interfaces ▪ Signalling ▪ Control centre/communications failure ▪ Cyber security threat ▪ Unknown obstruction or trespasser on railway ▪ Terrorist incident ▪ Failure of crossover ▪ Structural collapse (of M50 Viaduct or Broadmeadow and Ward Viaduct) ▪ Rolling stock failure ▪ Electrical infrastructure failure (including due to lightning or high winds) ▪ Settlement leads to track problems ▪ Poor track adhesion	▪ Major rail derailment accident resulting in death and infrastructure damage and potential for environmental impacts depending on location of derailment (e.g., Broadmeadow Viaduct connected to SAC). ▪ Severe disruption to rail transportation. ▪ The risk of errant vehicle entering track resulting in collision between rolling stock and road vehicle. ▪ Terrorist attack leading to explosion and derailment. This could result in fatalities, injury and potential for damage to the tunnel resulting in subsidence on the surface. ▪ Impact on existing roadway carriage causing major traffic accident. ▪ Spillage of pollutants. ▪ Emergency response impacts on environmental receptors.	All	Track	3 – Unlikely	4 – V. Significant	12 Medium	Yes – further mitigation and management plans are required to ensure risk is ALARP, refer to Table 28.10.
O2	**Fire and/or explosion, either direct or indirect harm**	▪ Overheating of tunnels ▪ Maintenance activities ▪ Risk of wildfire from extreme drought, taking into account climate change, high winds and dry conditions ▪ Electrical faults on train ▪ Unexploded ordnance adjacent to alignment ▪ Explosive gases within drainage system ▪ Terrorist incident ▪ Fire causes degradation to track/ infrastructure – secondary effect	▪ Contamination of water resources resulting from runoff of fire water. ▪ Drift from fire into public property with resulting damage to property and/or loss of crops. ▪ Risk of fire in the stations, tunnels or train causing risk to passengers; risk of passengers being struck by the train; and risk of train continuing to travel into an area of fire. ▪ On-board fire detection system fails resulting in injury and/or death to passengers. ▪ Risk of fire from extreme drought during operation, taking into account climate change, high winds and dry conditions may spread fire into proposed Project	All	Throughout	2 – V. Unlikely	4 – V. Significant	8– Medium	Yes – further mitigation and management plans are required to ensure risk is ALARP, refer to Table 28.10.
O3	**Collapse of embankment**	▪ Extreme weather (rain/flood) ▪ Heavy rain and prolonged flooding leading to embankment failure ▪ Blockage of siphons or culverts	▪ Extreme weather events or prolonged flooding leading to a breach in the embankments of water crossings along the proposed Project. Most notably at areas of high flood risk at Broadmeadow and Ward Rivers or potentially at Glasnevin with a breech of the Royal Canal wall and flooding of Irish Rail lines. Leading to collapse of viaduct and/or track on the embankment. ▪ Pollution and silt runoff into watercourse that could potentially impact on protected European sites downstream.	AZ1, AZ3	Broadmeadow and Ward Viaduct, alignment at Fosterstown Overbridge and Sluice River, M50 Viaduct, Royal Canal wall and flooding of Irish Rail lines.	3 – Unlikely	3 – Significant	9 – Medium	Yes – this will require mitigation to ensure the risk is ALARP, refer to Table 28.10.

Risk ID	Risk Event	Hazard Source - Pathway	Reasonable Worst-Case Scenario	Zone	Proposed Project Element	Likelihood Rating	Consequence Rating	Resulting Risk Category	Could this lead to MANDs?
O4	**Aviation incident**	▪ At the Dardistown location, the proposed Project is vulnerable to the risk of aviation/airport accident in the outer PSZ, such as loss of control of commercial aircraft. ▪ Electromagnetic interference from the electrical systems in the tunnel and station could have adverse effects on aviation equipment.	▪ Aviation crash in PSZ that overlaps with the proposed Project portal and track. Resulting in injury and fatalities. ▪ Serious aviation incident as a result of electromagnetic interference.	AZ2, AZ3	Dublin Airport Station, tunnel and the alignment at Dardistown	1 – Ext. Unlikely	5 – Profound	5 – Low	No – TII will liaise with and coordinate risks associated with Dublin Airports Operations. ▪ The Dublin Airport Interface Management plan developed during Construction will require regular interface meetings to assure that risks remain current and mitigations valid. Electromagnetic compatibility Testing will be undertaken.
O5	**Industrial incident – incident at nearby Seveso site involving release of dangerous substances**	▪ Fire/explosion and equipment/ infrastructure failure at nearby Seveso site in Swords. Hydraulic link exists along the Ward River.	▪ Risk of occurrence of a major emission, fire or explosion resulting in off-site environmental impact.	AZ	Surface section at the northern end of the proposed Project.	2 – V. Unlikely	2–Significant	4 – Low	No - Facilities are within consultation zone but are subject to management under the Chemicals Act (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2015 (S.I. No. 209 of 2015 (COMAH regulations)
O6	**Infectious disease**	▪ Staff and passengers are vulnerable to the risk of virus outbreak.	▪ The proposed Project is vulnerable to the risk of virus outbreak resulting in service disruption and widespread contamination leading to illness and fatalities.	All	Throughout	2– V. Unlikely	5 – Profound	10 – Medium	Yes – further mitigation and management plans are required to ensure risk is ALARP, refer to Table 28.10.
O7	**Hydrological event – heavy and prolonged rainfall entering tunnel, portal and stations and adjacent lands and watercourses**	▪ Presence of embankments leads to alteration of flood patterns. ▪ Extreme rainfall entering tunnels, portal and/or stations. ▪ Overflow of attenuation ponds near watercourses. ▪ Flooding of underpasses.	▪ Heavy rain and prolonged rainfall entering tunnel, portals and stations. ▪ Flooding causing emergency evacuation of vehicles resulting in potential injury to passengers. ▪ Flooding adjacent properties/land. ▪ Flooding of underpasses. ▪ Untreated water entering nearby watercourse, particularly from overloaded attenuation ponds at Balheary.	All	Throughout	– 2- V. Unlikely	4 –V. Significant	8 – Medium	Yes – further mitigation and management plans are required to ensure risk is ALARP, refer to Table 28.10.
O8	**Lightning strike**	▪ Major lightning strike on Control and Communication Systems.	▪ Signal failure between control centre and rolling stock. ▪ Security risk to passengers ▪ Metro service stops ▪ Unable to control and manage an emergency situation resulting in injury to staff/passengers.	All	Throughout	2 – V. Unlikely	1 – Slight	2 – Low	No – embedded design measures in the mast, such as a lightning rod/conductor built into it to conduct electricity away to the ground, ensure the risk is ALARP and will not constitute a MAND.
O9	**Vandalism or anti-social behaviour on the trains or within the stations.**	▪ Staff and passengers are vulnerable to the risk of crowd violence, arson or antisocial behaviour.	▪ The proposed Project is vulnerable to the risk of vandalism resulting in service disruption and injury or fatalities to staff and/or passengers.	All	Throughout	2 – V. Unlikely	2–Significant	4 – Low	No – this is not considered a MAND. ▪ MetroLink has been designed as an open system for passengers, so that people can walk through the station and onto the platforms without obstruction. The platform screen doors will stop people accessing the line from the stations. A security fence will be installed along the whole of the above ground sections of the railway and at the tunnel portals. ▪ Vandalism and anti-social behaviour on the trains and within the stations will be observed through the CCTV and if required staff sent to diffuse the situation. The Access Control and Intrusion Detection (ACID) system will

Risk ID	Risk Event	Hazard Source - Pathway	Reasonable Worst-Case Scenario	Zone	Proposed Project Element	Likelihood Rating	Consequence Rating	Resulting Risk Category	Could this lead to MANDs?
									also identify intruders trying to enter locations where unauthorised access is prohibited. The ACID system will be integrated with the telephone system, CCTV, SCADA, Fire Alarm System and the Central Clock System to prevent anti-social behaviour. The trains will be equipped with emergency panels to be used by passengers in the case of an emergency and passengers can call for help using Passenger Help Points and Emergency Help Points at the stations which connect with an operator at the OCC. ▪ Safety features have been incorporated into the design of the stations and the tunnels to minimise the risk of fire and facilitate evacuation for staff and passengers, including passengers with restricted mobility. The rolling stock will incorporate safety features, such as evacuation via emergency doors from both ends of the train, use of fire-retardant materials in the body of the train and soft furnishings, door unlocking devices, CCTV and Operational staff will be trained in emergency evacuation protocols. ▪ A Fire Safety Strategy summarised below for the proposed Project has been developed in liaison with Dublin Fire Brigade. ▪ In the case of a Hostile Vehicle Attack, the entrances to all stations have been designed to include Hostile Vehicle Mitigation Bollards which will stop any vehicle entering the stations. ▪ In the event of a train losing all communications, if it is in a station, it will be held there and if it is moving the emergency brakes will be applied. The section of track will be declared unsafe to the signalling system so that other trains will avoid entering it and staff will be sent to the train to check whether the emergency handle has been opened automatically or manually to effect evacuation. Reference Chapter 6 (MetroLink Operations & Maintenance) for further detail.

The results from the evaluation have been applied to Table 28.7 to determine the levels of significance. All risk events that could potentially result in a MAND have been brought forward for further consideration.

Table 28.7: Evaluation of Levels of Significance in the Absence of Mitigation

Likelihood	**5 – V. Likely**					
	4 – Likely					
	3 – Unlikely		C5	C8, O3	O1	
	2 – V. Unlikely	O8		C3C6, C11, O5, O9	C10, C2, C7, O2, O7	C9, O6
	1 – Ext. Unlikely			C4,	C1, C12	O4, C9
		1 – Slight	**2 – Moderate**	**3 – Significant**	**4 – V. Significant**	**5 – Profound**
	Consequence of Impact					

From examining the plausible risks presented in Table 28.7, Risk IDs C1, C3, C4, C5, C6, C9, C11, C12, O4, O5, O8 and O9 are considered as being below the threshold of significance set for the purposes of this assessment. Risk IDs C2, C7, C8, C9, C10, O1, O2, O6 and, O7 fall within the high consequence threshold and are therefore brought forward for further consideration and assessment of mitigation measures.

28.5 Mitigation Measures

The design of the proposed Project has been developed to best international practice and standards and complies with the relevant design standards which include provisions to reduce the likelihood of risk events occurring (e.g. structures have been designed to avoid the risk of collapse, drainage systems have been designed to cater for increased rainfall events and so forth). The design of the proposed Project will continue to be developed by the appointed Contractor to best international practice and standards.

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 into account the General Principles of Prevention as listed in Schedule 3 of the Safety, Health and Welfare at Work Act.

In addition to the duties imposed by Regulation 15 of the Safety, Health and Welfare at Work (Construction) Regulations 2013, designers must comply with Section 17(2) of the Safety, Health and Welfare at Work Act 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 (Part A Amendment) 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 addition, Safe Evacuation for All: A Planning and Management Guide (National Disability Authority 2011) was taken into account with regard to the evacuation of people with disabilities during emergencies.

IS0130001:2018 Risk Management clause 6.5 provides detail on risk treatment or mitigation stating: 'Selecting the most appropriate risk treatment option(s) involves balancing the potential benefits

derived in relation to the achievement of the objectives against costs, effort or disadvantages of implementation'.

Furthermore, the Railway Regulations detailed in Section 28.2.2 will ensure that the proposed Project is designed, built and operated in line with EU safety standards.

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 Registers and Assessments.

The design of the proposed Project incorporates mitigation measures that have been embedded into the design of the proposed Project elements or which have been specified as part of this EIAR. Chapter 31 (Summaries of the Route Wide Mitigation & Monitoring Proposed) presents the route wide mitigation and monitoring measures for the proposed Project.

Risks identified as being capable of leading to a MAND were subject to further assessment and determination of risk, post-implementation of mitigation measures. The results are presented in Table 28.8 and Table 28.9.

For those 'high consequence events', procedures need to be developed to manage and/or control their potential consequence and/or control their potential effects. Therefore, additional mitigation measures and response strategies have been identified for high consequence events, to demonstrate that risks would be managed to be ALARP.

Table 28.8 and Table 28.9 also show where impacts occur across multiple environmental disciplines. The ticks beneath the chapter headings indicate which disciplines are affected and the chapters where further mitigation measures are described to manage the risk to be ALARP.

Table 28.8: MANDs – Construction Phase Assessment of Mitigation Measures

ID	Risk Event Worst Case Scenario	Pre-Mitigation Risk Score	Ch. 9 Traffic & Transport	Ch. 10 & 11 Human Health & Population and Land use	Ch. 12 Electromagnetic Compatibility and Stray Current	Ch. 13 & 14 Airborne Noise & Vibration & Ground-borne Noise & Vibration	Ch. 15 Biodiversity	Ch. 16 & 17 Air Quality & Climate	Ch. 18 & 19 Hydrology & Hydrogeology	Ch. 20 & Ch.21 Soils & Geology & Land Take	Ch. 22 Infrastructure & Utilities	Ch. 23 Agronomy	Ch. 25 & 26 Archaeology & Cultural Heritage & Architectural Heritage	Key Risk Management and Mitigation Measures to Demonstrate Risks to be ALARP	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category	Is the residual ALARP?
C2	**Ground/building/ structure damage as a result of significant soil settlement.** In extreme situations buildings/structures over the tunnel, and/or adjacent the tunnel and deep stations, may collapse leading to injury and/or fatalities. Collapse or serious damage to protected historical buildings in Dublin City Centre. Collapse of the proposed Project infrastructure during construction.	8- Medium		✓						✓	✓		✓	Tunnel design and construction methods include risk assessment for overlying structures and monitoring or mitigation if required. Stakeholder consultation with potentially sensitive building/structures owners. Early intervention (pre-tunnelling) such as the use of ground treatments in the areas which are expected to give rise to settlement, reference the Building Damage Report (Appendix A5.17), Chapter 5 (MetroLink Construction Phase), Chapter 20 (Soils & Geology) and Chapter 21 (Land Take). Groundwater extraction will be used as required prior to construction works of stations. This will require detailed monitoring of excavation, groundwater levels, surface and building monitoring and pumping tests. Appropriate mitigation measures will be put in place to secure buildings at risk during construction including buildings props, reinforcement and monitoring. Settlement analysis has been completed for buildings and utilities along the alignment, reference the Building Damage Report (Appendix A5.17), Chapter 5 (MetroLink Construction Phase), Chapter 20 (Soils & Geology) and Chapter 21 (Land Take). Waterproof excavations by using watertight retaining walls (diaphragm walls) to prevent water inflow into the station and the risk of settlement. The Contractor will manage the risk and if the risk was too great at a specific location, they could: Pre-treat the ground to prevent loss of "loose" ground; Increase the density of bentonite support fluid; Shorten the length of the panel so that there is less ground open and for a shorter time, which leads to reduce risk of movement or collapse; and/or Use secants or sheets to minimise risk of excessive ground movement. Risk will be managed via the outline CEMP and Emergency Response Plans. Enhanced monitoring of TBM control parameters. For example, when the TBM is in slurry mode, TBM drives require monitoring of the TBM face pressure which can be adjusted as necessary to resist water inflow and	1 – Ext. Unlikely	2- Moderate	3- Low	Yes

ID	Risk Event Worst Case Scenario	Pre-Mitigation Risk Score	Ch. 9 Traffic & Transport	Ch. 10 & 11 Human Health & Population and Land use	Ch. 12 Electromagnetic Compatibility and Stray Current	Ch. 13 & 14 Airborne Noise & Vibration & Ground-borne Noise & Vibration	Ch. 15 Biodiversity	Ch. 16 & 17 Air Quality & Climate	Ch. 18 & 19 Hydrology & Hydrogeology	Ch. 20 & Ch.21 Soils & Geology & Land Take	Ch. 22 Infrastructure & Utilities	Ch. 23 Agronomy	Ch. 25 & 26 Archaeology & Cultural Heritage & Architectural Heritage	Key Risk Management and Mitigation Measures to Demonstrate Risks to be ALARP	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category	Is the residual ALARP?
														movement of the ground immediately adjacent to the drive face and before the tunnel lining rings are installed and the cavity around them grouted. This is standard practice to reduce settlement risks. In locations where there is more risk of settlement issues, either due to driving through less sound material, water bearing material or where there are buildings nearby that are more susceptible to settlement, then there would be increased monitoring and adjustment of the TBM face pressures to ensure least impact on settlement. Where tunnel drives are in more competent material or settlement is less of an issue (e.g., open fields) then it is not necessary to be constantly checking and balancing the face pressure. Increase frequency of surface monitoring. These are monitored via survey instruments to monitor for movement associated with the tunnelling nearby. As the TBM passes by the building, the frequency of monitoring for movement of the building increases. Limits on the amount of settlement/movement expected will have been calculated beforehand and the survey can provide a continuous monitoring of the building to provide early warning of potential unexpected settlement issues allowing mitigation action to be taken if required. Reference the Building Damage Report (Appendix A5.17) and Chapter 5 (MetroLink Construction Phase). Carry out works in accordance with A Code of Practice for Risk Management of Tunnel Works (The International Tunnelling Insurance Group 2012).				
C7	**Impact on critical infrastructure** Water Services – Risk of damaging strategic critical infrastructure such as water/foul pipes, resulting in flooding of adjacent properties, flooding of excavation and risk of damage to equipment. Risk of soil and groundwater contamination from sewer and associated	8 – Medium		✓					✓	✓	✓			Best practice measures for the protection of 3rd party assets will be specified by TII and implemented by the contractors on site. Where the works would directly impact on an asset, diversion strategies have been developed and agreed with asset owners. Where the works could potentially impact on assets through ground movements associated with the works ground movement assessments have been prepared and will be developed further by the contractors prior to construction. Any required mitigations will be designed and agreed with the asset owner. The contractors will prepare, inter alia: Ground Movement Management Plans; Groundwater Monitoring Plans;	1 – Ext. Unlikely	2– Moderate	3– Low	Yes

ID	Risk Event Worst Case Scenario	Pre-Mitigation Risk Score	Ch. 9 Traffic & Transport	Ch. 10 & 11 Human Health & Population and Land use	Ch. 12 Electromagnetic Compatibility and Stray Current	Ch. 13 & 14 Airborne Noise & Vibration & Ground-borne Noise & Vibration	Ch. 15 Biodiversity	Ch. 16 & 17 Air Quality & Climate	Ch. 18 & 19 Hydrology & Hydrogeology	Ch. 20 & Ch.21 Soils & Geology & Land Take	Ch. 22 Infrastructure & Utilities	Ch. 23 Agronomy	Ch. 25 & 26 Archaeology & Cultural Heritage & Architectural Heritage	Key Risk Management and Mitigation Measures to Demonstrate Risks to be ALARP	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category	Is the residual ALARP?
	environmental impacts. Energy supply – Risk of damaging underground and overhead cables resulting in power outage, risk of electrification and explosion. Risk of damaging gas mains resulting in supply outage and risk of explosion resulting in fatality and/or injury to workers and public. Fibre Telecommunications - Risk of damaging underground cables resulting in outages on phone and data networks leading to businesses and residents not being able to operate.													Instrumentation and Monitoring Plans. Protective measures will be undertaken to keep the risk of utilities settlement to a minimum. It is intended that the primary form of mitigation will be to use good tunnelling practice, including continuous working, erecting linings immediately after excavation and providing tight control of the tunnelling process to reduce the magnitude of settlement. For the majority of utilities, they would be monitored, inspected on completion of the works and any damage repaired. Where this approach is deemed insufficient to mitigate the risk of damage to utilities, then intrusive mitigation measures will need to be considered in conjunction with the utility owner. These may include direct works on the utilities and possibly ground treatment measures around and beneath and structural measures. These measures would require works to the utility similar to those regularly undertaken by utility providers to maintain or upgrade existing assets. They would be undertaken either by the utility provider or by the proposed Project contractors in conjunction with the utility provider under their existing powers. Refer to Chapter 22 (Infrastructure & Utilities). The settlement for each tunnel section and station/portal excavation along the alignment was determined using the methodology described in Appendix A22.1.				
C8	Major road traffic accident Major road traffic accident resulting from construction works affecting vehicular, pedestrian and cycle traffic resulting in damage to property and injury and/or fatality. Multiple-vehicle collision on the M50 Motorway due to unexpected falling	8 – Medium	✓	✓										Managed via Traffic Management Plans and STMP. Safety awareness training will be undertaken for all HGV drivers on sites including compliance with CC-GSW-01500- TII Guidance on Specification for Traffic Control and Communications. Designated haul routes defined in the STMP to be followed. Blind spot detection will be compulsory for HGVs in order to identify vulnerable road users. All HGV loads will be covered or tied securely before leaving and coming to site. Industry standards including but not limited to: EN 1991-2:2003: Traffic Loads on Bridges;	3 – Unlikely	2 – Moderate	6 – Low	Yes

ID	Risk Event Worst Case Scenario	Pre-Mitigation Risk Score	Ch. 9 Traffic & Transport	Ch. 10 & 11 Human Health & Population and Land use	Ch. 12 Electromagnetic Compatibility and Stray Current	Ch. 13 & 14 Airborne Noise & Vibration & Ground-borne Noise & Vibration	Ch. 15 Biodiversity	Ch. 16 & 17 Air Quality & Climate	Ch. 18 & 19 Hydrology & Hydrogeology	Ch. 20 & Ch.21 Soils & Geology & Land Take	Ch. 22 Infrastructure & Utilities	Ch. 23 Agronomy	Ch. 25 & 26 Archaeology & Cultural Heritage & Architectural Heritage	Key Risk Management and Mitigation Measures to Demonstrate Risks to be ALARP	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category	Is the residual ALARP?
	objects from the M50 Viaduct during construction or from HGVs during transport of materials/equipment. Collapse of bridges such as Cross Guns Bridge during adjacent deep excavation works or tunnelling leading to major traffic accident and potential injury and/or fatality.													EN 1991-3:2006: Actions Induced by Cranes and Machinery; AM-STR-06024- TII General Principles for the Design and Construction of Bridges - Use of BS 5400 : Part 1 : 1988; and EN 1998-2:2005: Bridges; Refer to on the Scheme Traffic Management Plan.				
C10	**Spillage or long-term seepage of pollutants into watercourse** Pollution event leading to environmental damage, particularly associated with the potential release of silt to the aquatic environment (e.g., truck carrying items has an accident or temporary bridge collapses and releases silt into watercourses). Pollution of groundwater resulting from ground investigations and/or construction work underground Potential for pollution event on European sites downstream of	9 – Medium		✓			✓		✓	✓				Refer to mitigation and management measures outlined in Risk ID C4 and Chapter 18 (Hydrology). These measures and others will be included in a water management plan and outline CEMP to be developed by the contractor having regard to best practice guidance including the following: Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA 2009); Road Drainage and the Water Environment (TII, 2015); Design of Earthworks Drainage, Network Drainage, Attenuation & Pollution Control, TII, March 2015; Use of temporary construction methods from the following CIRIA publications (including C532: Control of water pollution from construction sites, C648: Control of water pollution from linear construction projects: technical guidance and C649: Control of water pollution from linear construction projects: site guide); Office of Public Works (OPW) Guidelines for Planning Authorities: The Planning System and Flood Risk Management (OPW and DoEHLG 2009). Inland Fisheries Ireland (IFI) Guidelines on the Protection of Fisheries During Construction Works and Adjacent to Waters 2016; IFI Biosecurity Protocol for Field Survey Work 2010; NRA's Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes; and	2 – V. Unlikely	3 – Significant	6 – Low	Yes

ID	Risk Event Worst Case Scenario	Pre-Mitigation Risk Score	Ch. 9 Traffic & Transport	Ch. 10 & 11 Human Health & Population and Land use	Ch. 12 Electromagnetic Compatibility and Stray Current	Ch. 13 & 14 Airborne Noise & Vibration & Ground-borne Noise & Vibration	Ch. 15 Biodiversity	Ch. 16 & 17 Air Quality & Climate	Ch. 18 & 19 Hydrology & Hydrogeology	Ch. 20 & Ch.21 Soils & Geology & Land Take	Ch. 22 Infrastructure & Utilities	Ch. 23 Agronomy	Ch. 25 & 26 Archaeology & Cultural Heritage & Architectural Heritage	Key Risk Management and Mitigation Measures to Demonstrate Risks to be ALARP	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category	Is the residual ALARP?
	Broadmeadow and Ward Rivers.													NRA's Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes. For further detail refer to the outline CEMP, Water Quality Management Plan.				

Table 28.9: MANDs – Operational Phase Assessment of Mitigation Measures

ID	Risk Event Worst Case Scenario	Pre-Mitigation Risk Score	Ch. 9 Traffic & Transport	Ch. 10 & 11 Human Health & Population	Ch. 12 Electromagnetic	Ch. 13 & 14 Noise & Vibration	Ch. 15 Biodiversity	Ch. 16 & 17 Air Quality & Climate	Ch. 18 & 19 Hydrology & Hydrogeology	Ch. 20 Soils & Geology and Ch.21 Land Take	Ch. 22 Infrastructure & Utilities	Ch. 23 Agronomy	Ch. 25 & 26 Cultural Heritage	Key Risk Management and Mitigation Measures to Demonstrate Risks to be ALARP	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category	Is the residual ALARP?
O1	MetroLink train derailment Major rail derailment accident resulting in death and infrastructure damage and potential for environmental impacts depending on location of derailment (e.g., Broadmeadow Viaduct connected to SAC). Severe disruption to rail transportation. The risk of errant vehicle entering track resulting in collision between rolling stock and road vehicle. Impact on existing roadway carriage causing major traffic accident. Spillage of pollutants. Emergency response impacts on environmental receptors. Loss of Power.	12– Medium	✓	✓	✓		✓		✓	✓	✓		✓	Design measures accepted by the regulator (CRR) to manage risks to be ALARP in order for licence to be granted including: CRR-G-033C Guideline for Application for Acceptance of New Light Rail Works; CRR-G-016-C Guideline for Application for Acceptance of New Light Rail Rolling Stock; and CRR-G-032-B Guideline for Application for Acceptance of New Light Rail Works or New Light Rail Rolling Stock. All equipment will be compliant with Electromagnetic Compatibility and Interference (EMC and EMI) standards as required under the relevant EU standards. Mitigate by design and periodic inspections and maintenance as part of the Operational Strategy. Operation and maintenance manuals communicated early, robust, maintained and complete. Training to be provided, sufficient resources to be in place and compliance with best practice guidelines and procedures including compliance with EN 1991-1-7:2006: General Actions: Accidental Action and Road Drainage and the Water Environment (TII, 2015). Safe system of working. Design to appropriate environmental parameters (i.e. wind and water), including designed-in consideration of climate change including compliance with EN 1991-1-4:2005: General Actions: Wind Actions and International and National guidance and best practice. Design of line side features (i.e. bridge supports) in line with code of practice including but not limited to: EN 1990: Basis of Structural Design;	1 – Ext. Unlikely	5 – Profound	5 – Low	Yes

ID	Risk Event Worst Case Scenario	Pre-Mitigation Risk Score	Ch. 9 Traffic & Transport	Ch. 10 & 11 Human Health & Population	Ch. 12 Electromagnetic	Ch. 13 & 14 Noise & Vibration	Ch. 15 Biodiversity	Ch. 16 & 17 Air Quality & Climate	Ch. 18 & 19 Hydrology & Hydrogeology	Ch. 20 Soils & Geology and Ch.21 Land Take	Ch. 22 Infrastructure & Utilities	Ch. 23 Agronomy	Ch. 25 & 26 Cultural Heritage	Key Risk Management and Mitigation Measures to Demonstrate Risks to be ALARP	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category	Is the residual ALARP?
														EN 1998-2:2005: Bridges; and CIRIA report C750: Groundwater control design and practice. The power system is designed with several levels of redundancy, with several substations, a ring network, standby transformers, batteries and UPS for the most critical elements. Equipment failure will be corrected as quickly as possible and the action taken dependent on the nature of the failure. Critical on-board and lineside systems needed to ensure evacuation will be powered for at least 90 minutes through back-up supplies. This includes emergency lighting, PSDs, the PAVA system, CCTV, dynamic signage, doors unlocking and opening, emergency communication, and on-board smoke exhaust. The only exception is the ventilation in the tunnels which will be ensured through equipment redundancy. Appropriate back up procedures. Application of current regulations specific to cybersecurity and security software installed. Strict software control, no external connections and robust testing at commissioning CCTV installation at tunnel portals, tunnels, stations and cut and cover sections, front of cab of rolling stock monitoring open section lines for real time monitoring. High integrity of safety critical functions required in reference and detailed design. Reinforcement of the passenger visual signalling and the security in the fencing surrounding the metro access and the operational line. Crossover and turnbacks will be controlled by an interlocking device guaranteeing safety in movements. The software that manages the interlocking will be sufficiently tested. This will be				

ID	Risk Event Worst Case Scenario	Pre-Mitigation Risk Score	Ch. 9 Traffic & Transport	Ch. 10 & 11 Human Health & Population	Ch. 12 Electromagnetic	Ch. 13 & 14 Noise & Vibration	Ch. 15 Biodiversity	Ch. 16 & 17 Air Quality & Climate	Ch. 18 & 19 Hydrology & Hydrogeology	Ch. 20 Soils & Geology and Ch.21 Land Take	Ch. 22 Infrastructure & Utilities	Ch. 23 Agronomy	Ch. 25 & 26 Cultural Heritage	Key Risk Management and Mitigation Measures to Demonstrate Risks to be ALARP	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category	Is the residual ALARP?
														regularly checked and included as part of the maintenance regime. Adequate breaking specification. Provision of a secure boundary, security and CCTV. A dedicated MetroLink Major Incident Management Plan will be developed by TII that will identify the appropriate Emergency Response Plans				
O2	Fire and/or explosion, either direct or indirect harm Contamination of water resources resulting from runoff of fire water. Drift from fire into public property with resulting damage to property and/or loss of crops. Fire causing risk of passengers evacuating into direction of fire; risk of passengers being struck by train in opposite direction; and train continuing to travel into area of fire. On-board fire detection system fails resulting in injury and/or death to passengers. Risk of fire from extreme drought during operation, taking into account climate change, high winds and dry conditions may spread fire into proposed Project	8– Medium		✓			✓	✓	✓			✓	✓	All construction materials used will be required to meet the requirements of BS EN 13501-1 Fire Classification of Construction Products and Building Elements. The constructed elements will be subject to fire testing in line with the requirements of Fire Resistance Test – General Requirements (BS EN 1363-1:2020 and EN 1992-1-2:2004 General Rules. Structural Fire Design. Ongoing consultation with Dublin Fire Brigade was undertaken to develop the Fire Safety Strategy for the proposed Project. The fire strategy includes the following details: Safety features at stations to minimise the risk of fire; Safety lineside features within tunnels and other sections such as, but not limited, to ventilation, CCTV, signage, lighting, firefighting water supply systems; Proposed emergency evacuation protocols to be adopted for emergency events along the railway line and at stations; Station specific information including drawings and evacuation calculations; Safety systems and features to be adopted as part of the formal tender requirements for rolling stock;	1 – Ext. Unlikely	5 – Profound	5 – Low	Yes

ID	Risk Event Worst Case Scenario	Pre-Mitigation Risk Score	Ch. 9 Traffic & Transport	Ch. 10 & 11 Human Health & Population	Ch. 12 Electromagnetic	Ch. 13 & 14 Noise & Vibration	Ch. 15 Biodiversity	Ch. 16 & 17 Air Quality & Climate	Ch. 18 & 19 Hydrology & Hydrogeology	Ch. 20 Soils & Geology and Ch.21 Land Take	Ch. 22 Infrastructure & Utilities	Ch. 23 Agronomy	Ch. 25 & 26 Cultural Heritage	Key Risk Management and Mitigation Measures to Demonstrate Risks to be ALARP	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category	Is the residual ALARP?
														Fire safety information relating to the depot at Dardistown and the park and ride at Estuary; Justification for the maximum distance between evacuation / intervention shafts in the single-bore tunnel sections. This includes a risk assessment in accordance with NFPA 130; Findings from Computational Fluid Dynamics (CFD) for smoke simulations and passenger evacuations; A comprehensive list of design standards which have been used in the development of the design. This includes Irish, European an American standards and guidelines; and Information relating to the rationale for the Heat Release Rate (HRR) to be adopted for the project. The proposed Project design is in compliance with best practice, International, National and TII guidance. The tunnel design and station or intervention shaft spacing have taken regard to the European Commission Implementing Regulation 402/2013 (as amended) on the common safety method on risk evaluation and assessment and the European Railway Agency guidance and the EU Technical Specifications for Interoperability Regulation of Safety in Railway Tunnels. These documents specifically address fire and emergency evacuation needs for passengers should there be an incident in the tunnel to ensure that evacuation to a place of safety can be achieved within required timelines.				
O3	Collapse of embankment or breach of the Royal Canal wall at Glasnevin with potential risk of flooding of Irish Rail lines.	9 – Medium		✓			✓		✓	✓				Embankment design has included an allowance for extreme weather and climate change. Design is in compliance	1 – Ext. Unlikely	3 – Significant	3 – Low	Yes

ID	Risk Event Worst Case Scenario	Pre-Mitigation Risk Score	Ch. 9 Traffic & Transport	Ch. 10 & 11 Human Health & Population	Ch. 12 Electromagnetic	Ch. 13 & 14 Noise & Vibration	Ch. 15 Biodiversity	Ch. 16 & 17 Air Quality & Climate	Ch. 18 & 19 Hydrology & Hydrogeology	Ch. 20 Soils & Geology and Ch.21 Land Take	Ch. 22 Infrastructure & Utilities	Ch. 23 Agronomy	Ch. 25 & 26 Cultural Heritage	Key Risk Management and Mitigation Measures to Demonstrate Risks to be ALARP	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category	Is the residual ALARP?
	Extreme weather events or prolonged flooding leading to a breach in the embankments of water crossings along the proposed Project. Most notably at areas of high flood risk at Broadmeadow and Ward Rivers. Leading to collapse of viaduct and/or track on the embankment. Pollution and silt runoff into watercourse that could potentially impact on protected European sites downstream.													with best practice and International, National and TII guidance including: DN-STR-03001: Specification for Road Works Series 600 - Earthworks (including Erratum No. 1, dated June 2013); Road Drainage and the Water Environment (TII, 2015); Office of Public Works (OPW) Guidelines for Planning Authorities: The Planning System and Flood Risk Management (OPW and DoEHLG 2009); and NRA's Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes; Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013). Designed to accommodate 1 in 100 annual probability floods plus climate change and remain safe during a 1:1000 annual probability flood. Drainage design including track drainage to comply with standards which includes climate change. Regular inspections and maintenance in accordance with best practice International, National and TII guidelines.				
O6	Infectious disease The proposed Project is vulnerable to the risk of virus outbreak resulting in service disruption and widespread contamination leading to illness and fatalities.	10 – Medium		✓			✓					✓		A dedicated MetroLink Major Incident Management Plan will be developed by the Contractor that will identify the appropriate Emergency Response Plans prior to the start of the Operational Phase. The operator prior to start of operations will develop and follow strict biosecurity measures as part of the final outline CEMP. All guidance, standard operating procedures and control measures issued by the Government will be strictly adhered to.	2 – V. Unlikely	4 – V. Significant	8 – Medium	Yes – the operation of the proposed Project can be managed to reduce the overall consequence.

ID	Risk Event Worst Case Scenario	Pre-Mitigation Risk Score	Ch. 9 Traffic & Transport	Ch. 10 & 11 Human Health & Population	Ch. 12 Electromagnetic	Ch. 13 & 14 Noise & Vibration	Ch. 15 Biodiversity	Ch. 16 & 17 Air Quality & Climate	Ch. 18 & 19 Hydrology & Hydrogeology	Ch. 20 Soils & Geology and Ch.21 Land Take	Ch. 22 Infrastructure & Utilities	Ch. 23 Agronomy	Ch. 25 & 26 Cultural Heritage	Key Risk Management and Mitigation Measures to Demonstrate Risks to be ALARP	Post Mitigation Likelihood	Consequence of Impact	Resulting Risk Category	Is the residual ALARP?
O7	Hydrological event – heavy and prolonged rainfall entering tunnel, portal and stations and adjacent lands and watercourses Heavy rain and prolonged rainfall entering tunnel, portals and stations. Flooding causing emergency evacuation of vehicles resulting in potential injury to passengers. Flooding adjacent properties/land. Flooding of underpasses. Untreated water entering nearby watercourse, particularly from overloaded attenuation ponds at Balheary.	12 – Medium		✓			✓	✓	✓		✓	✓	✓	A dedicated MetroLink Major Incident Management Plan will be developed by TII that will identify the appropriate Emergency Response Plans. Drainage design includes allowances for climate change ensuring that the proposed Project is protected from significant flood events. Refer to the Chapter 18 (Hydrology). Cooperation with the relevant authorities, such as the local authorities and the OPW will be undertaken. Regular inspections and maintenance of drainage system and attenuation ponds will be undertaken.	2 – V. Unlikely	3 – Significant	6 – Low	Yes

Table 28.10 summarises the residual risks after the mitigation and management measures identified in Table 28.8 and Table 28.9 have been applied. Section 28.6 describes the residual risks in further detail.

Table 28.10: Risk Evaluation Post Mitigation Measures

Likelihood						
	5 – V. Likely					
	4 – Likely					
	3 – Unlikely		C8			
	2 – V. Unlikely			C4, C10, O7	O6	
	1 – Ext. Unlikely		C2	O3		O1, O2,
		1 – Slight	**2 – Moderate**	**3 – Significant**	**4 – V. Significant**	**5 – Profound**
	Consequence of Impact					

28.5.1 Construction Environmental Management Plan

An outline CEMP has been prepared as part of this EIAR (Appendix A5.1). Before works start, each Contractors appointed will be required to have contract specific outline CEMPs in place. The outline 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 described in Chapter 5 (MetroLink Construction Phase) and the mitigation measures set out in this EIAR, in addition to any relevant conditions contained in the planning consent. The Principal Contractor will develop a series of detailed plans for the construction of the proposed Project. This will include (but will not be limited to) the following:

- Traffic Management Plan;
- An Emergency Response Plan;
- Invasive Species Management and Control Plan;
- Construction Flood Protection Plan; and
- Water Quality Management Plan;

28.5.1.1 Traffic Management Plan

The risk of Major Accidents and Natural Disasters resulting from a road traffic accident associated with the proposed Project will be reduced by the development and implementation of a Construction Phase Traffic Management Plan (TMP) as described in Chapter 9 (Traffic & Transport). A Scheme Traffic Management Plan (STMP) has been prepared as part of the EIAR (Appendix A9.5) and this will be further developed by the Principal Contractor for the construction of the proposed Project. Preparation of a STMP is a normal part of such construction projects. The STMP will be a 'live document'. Therefore, any changes which may occur in the planning process and in the detailed construction programme can be incorporated, as can input from the Principal Contractor, the detailed design team and TII. The commitments included within the EIAR are the minimum commitments that the Principal Contractor shall follow, and others will be developed during the Construction Phase in consultation with the various stakeholders, including the local authorities.

The primary objectives of the STMP are to outline the minimum road safety measures to be undertaken at site access/egress locations during the Construction Phase, including approaches to such access/egress locations.

The implementation and organisation of traffic management along the specified haul routes is a critical component of the works to be undertaken and will be given the highest priority during the Construction Phase of the proposed Project. This will reduce the potential for any major accidents directly associated with the proposed Project.

28.5.1.2 Emergency Response Plan

An Emergency Response Plan has been developed as part of Appendix A5.1 (outline CEMP). This will be further developed by the Principal Contractor, in consultation with the emergency services and other relevant third parties and will be submitted to TII for approval.

The Emergency Response Plan 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 (locations, number and type) of emergency response equipment maintained on site.

28.5.1.3 Invasive Species Management and Control Plan

The introduction and/or spread of invasive species will be avoided by adopting appropriate mitigation measures as per the following guidance documents:

- Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (National Roads Authority (NRA) 2010);
- Guidelines for the Management of Waste from National Road Construction Project (NRA 2014); and
- Invasive Species Ireland (http://invasivespeciesireland.com).

Any invasive plant material noted on-site will be removed off site and disposed of at an appropriate licensed waste disposal facility. Any invasive species found to occur within 15m of working areas will require a specialist Method Statement for its control to avoid the spread of the invasive species, in compliance with the European Communities (Birds and Natural Habitats) Regulations 2011 [S.I. No. 477 of 2011].

All plant and equipment employed on the construction site (e.g., excavator, footwear) will be thoroughly cleaned down using a power washer unit prior to arrival on-site and prior to leaving site, to prevent the spread of invasive aquatic/riparian species in accordance with the Office of Public Works (OPW) Environmental Standard Operating Procedures, Inland Fisheries Ireland (IFI) Biosecurity Protocols. A sign-off sheet will be maintained to confirm cleaning. Staff involved in the works will be informed as to the presence of invasive species in the area. All staff working on the proposed Project shall be familiar with the sections within the document 'Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads' (NRA 2010) which detail the treatment necessary for the aforementioned species, together with the required reporting procedure if encountered.

28.5.1.4 Water Quality Management Plan

The risk of MAND resulting from the potential release of pollutants associated with the proposed Project to watercourses, including the potential release of sediments and untreated wastewater, will be reduced by the development and implementation of a Water Quality Management Plan and will form part of the final outline CEMP. All potential impacts of the proposed Project on the surrounding water environment have been assessed in detail, including mitigation measures, in Chapter 18 (Hydrology) and Chapter 19 (Hydrogeology).

Settlement/attenuation lagoons have been strategically located, will be adequately sized to ensure that they meet the requirements of a particular location and will include controls such as filter drains to

collect runoff and direct it to lagoons. In addition to these settlement/attenuation lagoons, localised attenuation ponds will be required to manage land runoff and for groundwater control. These are particular to the appointed Contractor's method of working but will be managed in the same manner as a lagoon which will require a detailed Pollution Control Plan, Emergency Response Plan and Method Statements, drafted in agreement with IFI and other relevant authorities, and having regard to relevant pollution prevention guidelines, in particular the IFI document 'Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters' (IFI 2016).

Sediment will be removed from the surface water prior to discharge through measures as per the CIRIA guidance on the 'Control of water pollution from linear construction projects' (CIRIA 2006) (for example silt screens or hay bales).

All construction equipment will arrive on-site clean and free of weeds, soil and debris and wash-down facilities will be provided as appropriate. Biosecurity measures will be implemented to minimise the spread of soil-borne diseases and weeds during the Construction Phase of the proposed Project. It will be necessary for a full clean down of all appointed Contractor's equipment, machinery, vehicles and footwear before entering farm premises. Biosecurity measures will be implemented to minimise the spread of soil-borne diseases and weeds during the Construction Phase of the proposed Project.

28.5.1.5 Construction Flood Protection Plan

In terms of managing the potential for flood risk, Construction compounds will not be set up on lands designated as Flood Zone A or B in accordance with the OPW 'Planning System and Flood Risk Management Guidelines' (November 2009). All watercourses within compound areas will be fenced off at a minimum distance of 5m.

The contractor will be required to obtain updated modelled water levels from the OPW as well as updated information on the required standard of protection for flood defences and is required to ensure that flood risk is managed safely throughout the construction period and that all designs comply with the flood risk assessed in the EIAR and include provision of a safe refuge for flood events.

The contractor is required to generate a flood risk compliance procedure as part of the Water Management Plan/ Flood Protection Plan and this will take a risk-based precautionary approach, using the source-pathway-receptor concept, and will apply to temporary and permanent works.

Temporary mitigation measures will be employed to mitigate the risk of flooding to structures on a construction site. These can be installed for the duration of the works or at a time where flood risk has increased and include sheet piling and cofferdams, sandbags and mobile and inflatable barriers. Existing flood defences will be monitored for stability for surface construction, tunnelling, dewatering, filtration and river works.

28.6 Residual Impacts

Following the implementation of mitigation measures, there remains a risk of significant impacts associated with the proposed Project being vulnerable to infectious disease.

During the Operational Phase, for those vulnerable risks that cannot be completely designed-out, emergency plans will be available to deal with the response to an emergency in order to minimise the significance of any impacts.

The classification of consequence has been set as 'Very Significant' in acknowledgement of the significant impacts an outbreak of infectious diseases, like the pandemic of COVID-19, can have.

During the Operational Phase, in the event of an incident such as the COVID-19 pandemic, it is anticipated that all non-essential maintenance work and walkovers/inspections would be postponed. Services would be reduced, with reduced capacity and being used by essential workers only or as required by the Government. All guidance and direction provided by the relevant Department (i.e.,

Department of Health) would be followed and any required additional biosecurity measures or restrictions would be implemented.

Overall, it can be considered that the risk of impacts from an infectious disease will be managed to be ALARP.

28.6.1 Monitoring

The MetroLink Major Incident Management Plan will be a live document that undergoes monitoring, review and update throughout the lifetime of the proposed Project. The risk of MANDs will be assessed on an ongoing basis throughout the planning, detailed design, Construction Phase and Operational Phase of the proposed Project.

The outline CEMP will ensure that all mitigation measures and monitoring requirements are carried out, ensuring that risk does not increase over time on the site and ensuring all potential risks are kept to ALARP.

All proposed monitoring measures are outlined in Chapter 31 (Summaries of the Route Wide Mitigation & Monitoring Proposed).

28.7 Conclusions

Given the processes that will be in place, and the resulting measures that will be introduced to avoid and/or reduce the vulnerability of the proposed Project to MANDs, it is considered that the risks of any such event occurring will be managed to be ALARP. The application of the ALARP principle for the management of railway safety risks is an accepted principle used widely by the CRR and Health and Safety Authority.

As a result, it is considered that there will not be any likely significant environmental effects arising from the vulnerability of the proposed Project to MANDs.

As required under the Commission for Railway Regulation (2019) and in accordance with Directive 2012/34/EU of the European Parliament and of the Council of 21 November 2012 establishing a single European railway area (as amended), the CRR will only authorise the proposed Project once appropriate safety certifications have been obtained from the CRR as the national safety authority.

The measures in place to avoid and/or reduce the vulnerability of the proposed Project to MANDs will be considered and be subject to review under other legislative processes in addition to those put in place by the RO.

28.7.1 Difficulties Encountered

No difficulties were encountered during the writing of this Chapter.

28.8 Glossary

Term	Definition
As Low As Reasonably Practicable (ALARP)	Involves weighing a risk against the trouble, time and money needed to control it. Thus, ALARP describes the level to which risks are typically controlled.
Disaster	May be a natural hazard (such as an earthquake) or a man-made/external hazard (such as an act of terrorism) with the potential to cause an event or situation that meets the definition of a major accident.
Hazard	Any phenomenon with the potential to cause direct harm to members of the community, the environment or the physical infrastructure, or being potentially damaging to the economic and social infrastructure. Hazards can include natural hazards such as storms and flooding, civil hazards such as infectious diseases and loss of critical infrastructure; transportation hazards such as rail or road; and technological hazards such as industrial incidents and fire.
Likelihood	In risk management terminology, the word "likelihood" is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically (such as a probability or a frequency over a given time period).
Magnitude of Impact	The magnitude of an impact is typically defined by the following factors: ▪ Geographic extent – the area over which the effect occurs; ▪ Duration – the time for which the effect occurs; ▪ Frequency – how often the effect occurs; and ▪ Severity – the degree of change relative to existing environmental conditions.
Major Accident	Events that threaten immediate or delayed serious environmental effects to human health, welfare and/or the environment and require the use of resources beyond those of the client or its appointed representatives to manage. Whilst malicious intent is not accidental, the outcome (e.g., train derailment) may be the same and therefore many mitigation measures will apply to both deliberate and accidental events.
Major Accident (In Relation to Chemical Sites)	'Major accident' means an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment covered by the Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015 as amended and leading to serious danger to human health or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances.
Reasonable Worst-Case Scenario	A challenging manifestation of the scenario after highly implausible scenarios are excluded.
Risk	The likelihood of an impact occurring, combined with the effect or consequence(s) of the impact on a receptor if it does occur.
Risk Event	An unidentified, unplanned event, which is considered relevant to the development and has the potential to result in a major accident and/or disaster, subject to assessment of its potential to result in a significant adverse effect on an environmental receptor.
Risk Mitigation	The purpose of risk mitigation or treatment as defined in ISO31000:2018, is to select and implement options for addressing risk. Risk treatment involves an iterative process of: ▪ Formulating and selecting risk treatment options; ▪ Planning and implementing risk treatment; ▪ Assessing the effectiveness of that treatment; ▪ Deciding whether the remaining risk is acceptable; and ▪ If not acceptable, taking further treatment.
Sensitivity	The sensitivity of a receptor is a function of its value, and capacity to accommodate change reflecting its ability to recover if it is affected. It is typically defined by the following factors:

Term	Definition
	▪ Adaptability – the degree to which a receptor can avoid, adapt to or recover from an effect; ▪ Tolerance – the ability of a receptor to accommodate temporary or permanent change; and ▪ Recoverability – the temporal scale over, and extent to, which a receptor will recover following an effect.
Significance	Effects resulting from MANDS are significant if they meet the criteria for 'Significant', 'Very Significant' or 'Profound'.
Significant Environmental Effect (In Relation to MANDS Assessment)	Could include the loss of life, permanent injury and temporary or permanent destruction of an environmental receptor which cannot be remediated through minor clean-up and restoration.
Source-Pathway-Receptor Linkage	For a risk to arise there must be a hazard that consists of a 'source' (e.g., high rainfall); a 'receptor' (e.g., people, property, environment); and a pathway between the source and the receptor (e.g., flood routes).
Vulnerability	Describes the potential for harm as a result of an event, for example due to sensitivity or value of receptors. In the context of the EIA Directive, the term refers to the 'exposure and resilience' of the development to the risk of a major accident and/or disaster. Vulnerability is influenced by sensitivity, adaptive capacity and magnitude of impact.

28.9 References

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Directives and Legislation

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Chemicals Act (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2015 (S.I. No. 209 of 2015)

Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union interoperability [2016].

Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety [2016].

Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC [2012].

Directive 2012/34/EU of the European Parliament and of the Council of 21 November 2012 establishing a single European railway area [2012] (as amended).

Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 on the assessment of the effects of certain public and private projects on the environment [2014].

European Union (Railway Safety) Regulations 2013 (S.I. No. 444 of 2013)

European Union (Regulation of Railways) Regulations 2015 (S.I. No. 249 of 2015)

Railway Safety Act 2005 (No. 31 of 2005)

Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013)

Safety, Health and Welfare at Work (General Application) Regulations 2007 (S.I. No 299 of 2007)

Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005)

Transport Infrastructure Ireland's (TII's) strategies and procedures:

- Business Continuity Management – Process, Plans and Teams;
- Business Continuity Plans;
- Incident Management Plans;
- Design of Earthworks Drainage, Network Drainage, Attenuation & Pollution Control, TII, March 2015; and
- Road Drainage and the Water Environment (TII, 2015).