Chapter 23
Human Health

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23. HUMAN HEALTH

23.1 Introduction

This chapter addresses the potential human health impacts relating to the construction and operational of the DART+ West project referred to hereafter as "the proposed development". The proposed development aims to upgrade, modernise and improve the existing Dublin City Centre to Maynooth and M3 Parkway railway lines by providing a sustainable, electrified, reliable and more frequent rail service, improving the services and capacity serving the communities along these corridors.

Health, is defined, as '*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*[1]', World Health Organization (WHO). Actual and perceived impacts of the proposed development on the human health may arise from various aspects of the proposed development. The European Commission (EC, 2017) state that human health should be considered in the context of the other factors in Article 3(1) of the EIA Directive. These impacts are dealt with throughout this Environmental Impact Assessment Report (EIAR) and this chapter is supported by and should be read in conjunction with these chapters. In particular, interactions with human health may occur with effects described in a number of specialist chapters as follows:

- Chapter 4 Description of the Proposed Development.
- Chapter 5 Construction Strategy.
- Chapter 6 Traffic and Transportation.
- Chapter 7 Population.
- Chapter 8 Biodiversity.
- Chapter 9 Land and Soils.
- Chapter 10 Water (including Hydrology & Flood Risk).
- Chapter 11 Hydrogeology.
- Chapter 12 Air Quality.
- Chapter 13 Climate.
- Chapter 14 Noise and Vibration.
- Chapter 15 Landscape and Visual Amenity.
- Chapter 16 Material Assets & Land: Agricultural Properties.
- Chapter 17 Material Assets & Land: Non-Agricultural Properties.
- Chapter 18 Material Assets: Utilities.
- Chapter 19 Material Assets: Resource and Waste Management.
- Chapter 22 Electromagnetic Compatibility and Stray Current.
- Chapter 25 Interactions.
- Chapter 26 Cumulative Effects.

This chapter sets out the relevant legislation, policy and guidance followed (Section 23.2), the methodology used for the human health assessment (Section 23.3), the receiving environment (Section 23.4) and the potential impacts of the proposed development on the human health (Section 23.5). Section 23.6 sets out mitigation measures to avoid / minimise impacts identified, and details of any residual impacts are described in Section 23.7. A list of reference material used to compile this chapter is contained in Section 23.10.

[1] Word Health Organisation (2021) ONLINE Available at: https://www.who.int/about/governance/constitution [Accessed 06 June 2020]

23.2 Legislation, policy, and guidance

23.2.1 Legislation

The human health assessment has been undertaken in accordance inter alia with EU Directive 2011/92/EU as amended by Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment ("the EIA Directive"), the Transport (Railway Infrastructure) Act 2001 (as amended and substituted), the European Union (Railway Orders) (Environmental Impact Assessment) (Amendment) Regulations 2021 (S.I. No. 743/2021) which give further effect to transposition of the EIA Directive by amending the Transport (Railway Infrastructure) Act 2001 for conditions relevant to human health.

23.2.2 Policy

Relevant policy documents that have informed this chapter include:

- *"Project Ireland 2040"* – National Planning Framework; and National Development Plan 2021-2030.
- Transport Strategy for the GDA 2016-2035 and the Draft GDA Transport Strategy 2022-2024.
- Eastern and Midland Region's Regional Spatial and Economic Strategy 2019-2031.
- Transport Strategy for the Greater Dublin Area 2016-2035.
- Draft Greater Dublin Area Transport Strategy 2022-2042.
- GDA Cycle Network Plan.
- Dublin City Development Plan 2016–2022 & draft Dublin City Development Plan 2022-2028;
  - North Lotts and Grand Canal Dock SDZ Planning Scheme 2014.
  - Ashtown-Pelletstown Local Area Plan 2014.
- Fingal Development Plan 2017 – 2023; and Draft Fingal Development Plan 2023 - 2029
  - Hansfield Strategic Development Zone Planning Scheme 2006.
  - Barnhill Local Area Plan 2018.
  - Kellystown Local Area Plan 2021.
- Kildare County Development Plan 2017 – 2023; and Draft County Development Plan 2023-2029
  - Maynooth Local Area Plan 2013-2019.
  - Kilcock Local Area Plan 2015-2021.
  - Leixlip Local Area Plan 2020-2023.
- Meath County Development Plan 2021-2027
  - Dunboyne, Clonee & Pace Local Area Plan 2009-2015.
- The Healthy Ireland Strategic Action Plan 2021-2025.
- Healthy Ireland Framework 2019-2025.
- National Physical Activity Plan 2016.
- A Healthy Weight for Ireland: Obesity Policy and Action Plan 2016-2025.
- Healthy Ireland Implementation Plan 2018-2022.

23.2.3 Guidance

This assessment is prepared based on established best practice with cognisance given to relevant guidelines to include those listed in Chapter 1 of this EIAR, and also:

- *Guidelines on information to be contained in the Environmental Impact Assessment Report*, Environmental Protection Agency, May 2022.
- *Draft Advice Notes for preparing environmental impact statements,* Environmental Protection Agency September, 2015.
- *Environmental Impact Assessment of Projects Guidance on the Preparation of the Environmental Impact Assessment Report*, European Commission 2017.
- *Health Impact Assessment Guidance A Manual*, Institute of Public Health Ireland, 2021.
- *Health Impact Assessment Resource and Tool Compilation*, US EPA 2016.
- *Environmental Impact Assessment of Projects Guidance on the Preparation of the Environmental Impact Assessment Report (European Commission 2017).*

- *Framework for Human Health Risk Assessment to Inform Decision Making*, United States Environmental Protection Agency (US EPA) 2014.
- *Human Health: Ensuring a High Level of Protection. A reference paper on addressing Human Health in Environmental Impact Assessment* International Association for Impact Assessment (IAIA) and European Public Health Association (EUPHA) *(hereafter referred to as the IAIA and EUPHA Guidance) (IAIA and EUPHA 2020).*
- *Health Impact Assessment in Planning (IEMA 2020).*
- Environmental Noise Guidelines for the European Region (hereafter referred to as the WHO Noise Guidelines) WHO 2018.

23.3 Methodology

23.3.1 Study area

The methodology devised for this human health assessment is based on established best practice with cognisance given to all relevant guidance. There is no national guidance available on an appropriate study area to focus the human health assessment. The study area has been defined with reference to the potential for impact from the proposed development and based on the availability of relevant health information. There are two study areas to inform the human health assessment:

- 100 m from the proposed development.
- County level - Dublin, Fingal, Meath and Kildare.

Generally, the closer to the works, the greater the potential for impacts. The most significant human health impacts are likely to be confined within 50 or 100 m (e.g., noise, air quality) of the proposed project, or as defined by the specialists in the respective chapters of this EIAR. These study areas are considered appropriate for this assessment. Furthermore, due to the nature of the proposed public transport infrastructure project, there is potential for wider community health effects which may influence health outcomes of the wider community such as: access to public transport services, accessibility to health facilities, greater access to employment opportunities and opportunities for social connections all of which are determinants of health.

Health statistics are generally reported by county or Health Service Executive (HSE) region. The health statistics for the counties Dublin, Fingal, Meath and Kildare are used to inform the health profile of the study area. Census information relating to health is also available at the Electoral Divisions (EDs) level and is consulted for those EDs that are wholly or partially located within 100 m of the permanent works 'study areas' - refer to Table 23-1.

Table 23-1 Electoral Divisions (EDs) wholly and / or partially contained within 100m of the permanent works 'Study Areas'

Study Areas	Electoral Division	County / Local Authority administrative area
Ashtown Level Crossing	Ashtown A	Dublin City
	Castleknock - Park	Fingal
Coolmine Level Crossing	Castleknock - Knockmaroon	Fingal
	Blanchardstown - Delwood	
Porterstown Level Crossing	Castleknock - Knockmaroon	Fingal
	Blanchardstown - Delwood	
	Blanchardstown - Blakestown	
	Lucan North	
Clonsilla & Barberstown Level Crossings	Blanchardstown - Blakestown	Fingal

Study Areas	Electoral Division	County / Local Authority administrative area
	Lucan North	
Blakestown Level Crossing	Leixlip	Kildare
	Maynooth	
Proposed Spencer Dock Station	North Dock B	Dublin City
Connolly Station	North Dock C	Dublin City
	Mountjoy A	
Proposed depot	Maynooth	Kildare
	Kilcock	
Bridge reconstruction works:		
OBG5 Broombridge	Cabra East A	Dublin City
	Cabra West A	
	Cabra West B	
OBG9 Old Navan Road Bridge	Blanchardstown-Abbotstown	Fingal
	Castleknock-Park	
OBG11 Castleknock Bridge	Blanchardstown – Abbotstown	Fingal
	Castleknock-Park	
	Castleknock-Knockmaroon	
	Blanchardstown-Roselawn	
OBG14 Cope Bridge	Leixlip	Kildare
OBG16 Louisa Bridge	Leixlip	Kildare

23.3.2 Assessment methodology

23.3.2.1 Desktop study

The human health assessment requires that an understanding of the health profile of the area is built up, as far as practicable. Sources of desktop information that has informed the baseline environment and this assessment include:

- DART+ West land use survey mapping information and google maps.
- Central Statistics Office - Census 2016.
- Statistical information from HSE, Pobal, to include: Lenus Health Profiles 2015 for Dublin, Fingal, Meath and Kildare, HSE.
- EPA maps: Consideration of issues/ concerns raised during public consultations.
- Literature review related to transport projects, rail projects and electrification of rail lines.
- Interactions with other specialists' EIAR chapters.

23.3.2.2 Site visit

A site visit of the key infrastructural works locations proposed as part of the DART+ West project was undertaken in June 2021. The site visit allows for a greater appreciation of the local environment, travel patterns, health facilities and health promotion including relevant health facilities. The site visit also informed the location of land uses and sensitive receptors including residential, medical facilities, educational and amenity within the 100m study area. The land use survey completed for the proposed development was also consulted and is illustrated in Drawing no. MAY-MDC-ENV-ROUT-DR-V-70000-D to 70011-D contained in Volume 3A of this EIAR.

23.3.3 Consultation

Relevant feedback received from statutory, non-statutory groups, the public, community groups, and private individuals during the Options Selection Processes has helped informed this assessment. The key consultation phases include:

- Non-statutory EIA Scoping Report.
- Options Selection Process
  - PC1 Public Consultation.
  - PC2 Public Consultation and local Ashtown public consultation.

The feedback received during public consultation as part of the options selection process is summarised in the public consultation findings reports which has informed this chapter. Furthermore, close collaboration with the design team and the other EIA specialists has informed the human health assessment, as appropriate.

23.3.4 Categorisation of impacts

The purpose of the human health assessment is to identify the likely significant effects of the proposed development. It usually follows that impacts of human health nature are a function of:

- The location and character of the local environment.
- The sensitivity of the local population and its capacity to absorb change.
- The nature of the environmental effect.
- The scale or extent of the effect in terms of area or population affected.
- The duration and frequency of an effect.
- The probability of an impact occurrence and possibility of effectively reducing the effects (mitigation).

Impacts result from direct, indirect, secondary and cumulative effects on existing environmental conditions. Effects can be *positive, neutral* or *negative*. Significance of an effect depends on, among other considerations, the nature of the environmental effect, the timing and duration of an effect and the probability of the occurrence of an effect. The significance of an effect can be described as *imperceptible, slight, moderate, significant*, *very significant* or *profound* (refer to Table 23-4). The impacts may be short-term, medium-term or long-term. The duration of an effect may be *momentary, brief, temporary, short-term, medium-term, long-term, permanent or reversible* in accordance with the timescales detailed in Table 23-2. The frequency of that effect can also influence significance i.e. if the effect will occur once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually. For example, disruption to road for a few hours could be described as having an *imperceptible, negative, brief* impact versus the complete closure of a road for a number of months which could be described as a *very significant, negative*, *temporary* impact.

This human health assessment addresses effects at a community level rather than for individuals or identifiable properties, although impacts for individual properties are discussed where these are significant or located within close proximity to the proposed development.

The criteria used to describe the potential effects is outlined in Table 23-2 which is adapted from the EPA Guidelines, 2022.

Table 23-2 Criteria used to describe human health effects (adapted from the EPA, 2022)

Quality of Effects:	
Positive	A change which improves human health.
Neutral	No effects, or effects that are imperceptible on human health, within normal bounds of variation or within the margin of forecasting error.
Negative	A change which reduces human health.

Describing the Extent and Context of Effects:	
Extent	Describe the size of the area, the number of sites, and the proportion of populations' human health affected by an effect.
Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Describing the Probability of the Effects:	
Likely effects	The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
Unlikely effects	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measure are properly implemented.
Describing the Duration and Frequency of Effects:	
Momentary effects	Effects lasting from seconds to minutes
Brief effects	Effects last less than a day
Temporary effects	Effects lasting less than a year
Short-term effects	Effects lasting one to seven years
Medium-term effects	Effects lasting seven to fifteen years
Long-term effects	Effects lasting fifteen to sixty years.
Permanent effects	Effects lasting over sixty years
Reversible effects	Effects that can be undone, for example through remediation or restoration.
Frequency of effects	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hour, daily, weekly, monthly, annually).
Note 1:	*for the purposes of planning consent procedures*

23.3.4.1 Significance of health effects

The assessment of significance relates to the identification and assessment of potential human health effects on the community. It is recognised that some individuals may have a different response to effects than others. Examples might include vulnerable groups, such as the elderly, very young, people with disabilities or the sick however this assessment does not attempt to assess impacts on an individual basis.

The EPA Guidelines on the information to be contained in Environmental Impact Assessment Report (May 2022) states, "*The evaluation of effects on these pathways is carried out by reference to accepted standards (usually international) of safety in dose, exposure or risk. These standards are in turn based upon medical and scientific investigation of the direct effects on health of the individual substance, effect or risk. This practice of reliance upon limits, doses and thresholds for environmental pathways, such as air, water or soil, provides robust and reliable health protectors [protection criteria] for analysis relating to the environment.*"

Therefore, this assessment has taken account of the relevant guidelines and limit values or thresholds which are listed in the other specialists' environmental assessments contained in this EIAR, specifically: Chapter 9 (Land & Soils as it relates to contaminated land), Chapter 10 (Water), Chapter 12 (Air Quality), Chapter 14 (Noise & Vibration), Chapter 22 (Electromagnetic effects and stray current). This human health assessment relies on the findings of the specialist assessments contained within this EIAR.

The significance criteria to assess human health effects is defined in Table 23-3. The quality of impact (positive, negative or neutral), the probability, duration and timing of effects that are used to qualify the type of human health impact is defined in Table 23-3.

Table 23-3 Significance criteria in the assessment of human health impacts (adapted from EPA)

Impact Level	Significance Criteria
Imperceptible	An effect capable of measurement but without significant human health consequences.

Impact Level	Significance Criteria
Not significant	An effect which causes noticeable changes in the character of the environment without affecting the community human health sensitivities.
Slight	A slight/ small effect which causes noticeable changes in the reported symptoms of the population without affecting the community human health sensitivities (morbidity or mortality).
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging community's human health baseline trends.
Significant	An effect which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the environment affecting human health (morbidity or mortality).
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters **most o**f a sensitive aspect of the environment affecting the community's human health (morbidity or mortality which can be).
Profound	An effect which changes a sensitive characteristic of the environment that profoundly affects the human health status of the community.

23.3.4.2 Framework for assessment

This section describes the framework for considering potential human health risks/ impacts. The United States Environmental Protection Agency (USEPA) Human Health Risk Assessment is a useful framework for considering potential human health impacts. It includes four basic steps to inform decision making detailed in the Table 23-4 below.

Table 23-4 Framework for considering potential human health risk/impacts (informed by USEPA)

Step 1 – Hazard Identification	Examines whether a stressor has the potential to cause harm to humans and/or ecological systems, and if so, under what circumstances. For example, in the case of transport infrastructure project one might consider an emission such as noise or air pollutants and examine its potential for harm.
Step 2 – Dose Response Assessment	Examines the numerical relationship (emission standards) between exposure and likely human health response/effects. For example, typically when the dose/ emission increases the response/health effect increases. Some individuals may have a different dose response/ health effect than others e.g. vulnerable groups such as the old, very young or sick.
Step 3 – Exposure Assessment	Examines what is known about the frequency, timing, and levels of contact with a stressor (e.g. emission). For example, estimating human exposure to an emission/agent in the environment or estimating future exposure of an agent that has not yet been released/ present in the environment.
Step 4 – Risk Characterisation	Examines how well the data support conclusions about the nature and extent of the risk from exposure to environmental stressors. A risk characterisation conveys the risk assessor's judgment as to the nature and presence or absence of risks, along with information about how the risk was assessed, and where assumptions and uncertainties still exist. (This includes cross-referencing with the other environmental chapters of this EIAR).
Note: Informed by USEPA	

23.3.4.2.1 Health based standards

Health based standards are set by bodies such as the World Health Organisation (WHO) and the European Union (EU). The standards are environmental health thresholds set for a range of environmental parameters to ensure no adverse health effects on the most vulnerable in society. For example, air quality and noise levels are set at levels to protect the vulnerable, not the robust. These standards are set to ensure scientific analysis (i.e. modelling) is undertaken on the baseline environment which includes an analysis of the likely changes in the receiving/baseline environment as a result of the proposed development to predict potential human health effects. This results in a level of certainty in relation to the potential effects (positive or negative) before a project is developed. This scientific analysis provides decision makers with a clear methodology outlining what information was used, data gaps and any assumptions that were made in order to provide a comprehensive assessment of impacts on human health.

Regardless of the methodology, psychological effects or well-being effects are difficult to measure as these effects are more subjective in nature. It must also be recognised that there are uncertainties in relation to assessing impacts on individuals due to availability of health data about individuals and the difficulty in predicting effects on individuals, which could be based on a variety of assumptions. Subsequently, the existing receiving environment and relevant health-based standards assessment are relied upon to arrive at conclusions relating to likely human health effects on the community.

23.3.4.2.2 Hazard identification

Human health impacts related to transport infrastructure such as rail and electrification projects can arise as a result of a variety of factors and interactions across environmental receptors. For example, collisions, traffic accidents or safety issues, emissions to air, noise pollution, impacts on water quality, flooding, electrocution, etc. which have the potential to cause a threat to the health of populations and the wider environment. It can be said that all aspects of the environment can influence human health to some degree or another.

A literature review was performed and identified recognised health effects of road and bridge infrastructure and the effects on human health during both the construction and operation stages. Transport can affect health outcomes both directly and indirectly. For example, negative direct effects could be through traffic accidents and indirectly, as a result of supporting an increase in car based transport system which in turn increases the fossil fueled vehicles on roads, thereby increasing noise and air pollution, and carbon emissions into the atmosphere, contributing to climate change while also supporting sedentary lifestyles.

Although somewhat outdated, the information contained in the Institute of Public Health (IPH) published Health Impacts of Transport (2005) is still relevant today where it analysed the pathways from transport to health, as presented in Figure 23-1. The main impacts can be summarised as: road traffic injuries, air pollution, noise pollution, effects on physical activity, effects on community (social networks, social capital on health) and social inclusion (effect on access and social inclusion). As the development relates to the electrification of an existing railway corridor those effects resulting from the electrification upgrades and the associated infrastructure works and capacity enhancements are considered in this assessment.

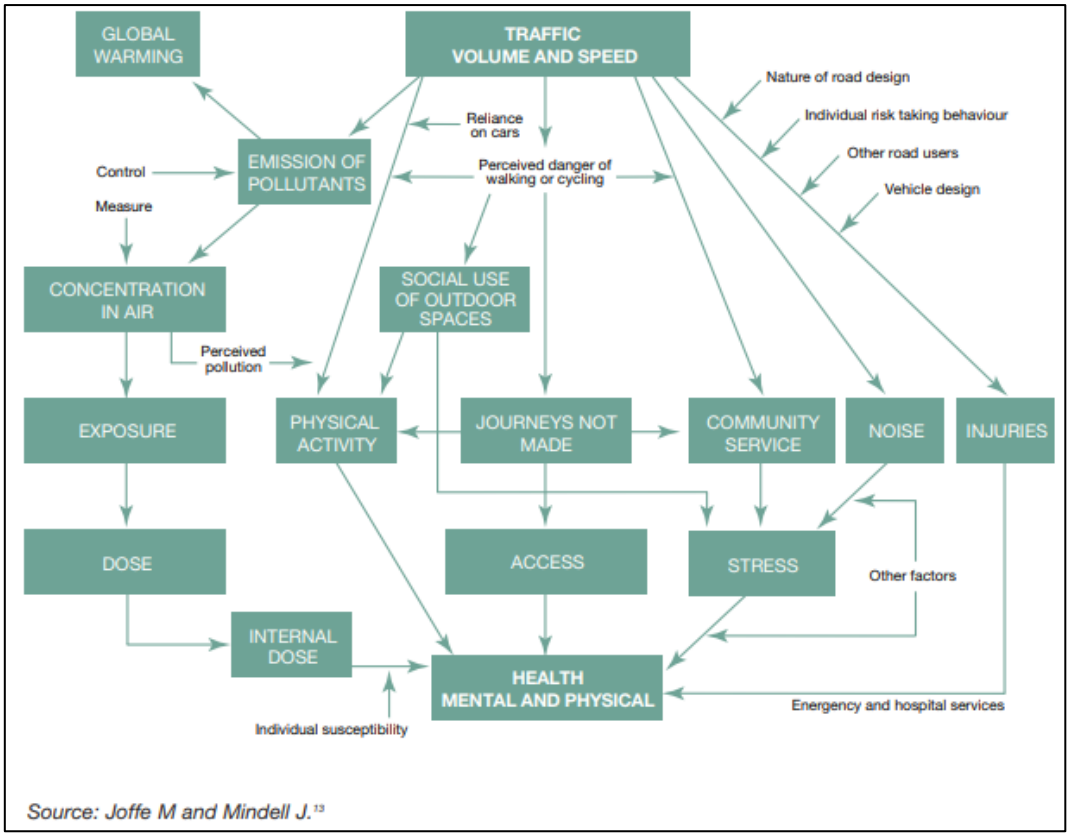


Figure 23-1 Pathways from transport and health outcomes (IPH, 2005)

A literature review from similar projects identifies that there are four main hazards to human health that can be classified under: physical, psychosocial, chemical and biological hazards and are summarised in Table 23-5.

Table 23-5 Four main hazards to human health

Types of Hazards	Description
Physical	The main physical hazards identified are: • Noise (including nuisance/ disturbance, noise induced hearing impairment, interference with speech communication, sleep disturbance, hypertension and cardiovascular disease), • Vibration (including nuisance) • Air quality (including construction dust, carbon monoxide, fine particles, etc.), • Water quality (including effects due to flood risk); • Soils (effects due to contamination of land); • Traffic – including collisions, injuries or worst-case fatalities); and • Other physical hazards e.g. radon, Electromagnetic fields and stray current.
Psychosocial	The main hazards identified include: • Nuisance • Anti-social behaviour • Suicide
Chemical	The main hazards identified include: • Heavy metals, • Contaminants
Biological	The main biological hazards identified are: • Surface water and ground water (including water contamination) • Aspergillus (A fungi with potential for human health impacts) • Rodent-borne diseases e.g. Leptospirosis

23.3.4.2.3 Hazards of emissions to air

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. The applicable legal standards in Ireland are outlined in the Air Quality Regulations, which incorporate the Cleaner Air for Europe (CAFE) Directive. The Air Quality Regulations set limit values for the pollutants nitrogen dioxide (NO_2) and nitrogen oxides (NO_X), particulate matter (PM) with an aerodynamic diameter of less than 10 microns (PM_{10}), PM with an aerodynamic diameter of less than 2.5 microns ($PM_{2.5}$), lead (Pb), sulphur dioxide (SO_2), benzene and carbon monoxide (CO). These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Chapter 12, Ambient Air Quality Standards of this EIAR). The Institute of Air Quality Management (IAQM) guidelines (IAQM, 2014) for assessing the impact of dust emissions from construction and demolition activities based on the scale and nature of the works and the sensitivity of the area to dust impacts have also informed the air quality assessment. The TII guidance document Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (TII 2011) details the methodology for determining air quality impact significance criteria for road schemes in Ireland. The degree of impact is determined based on both the absolute and relative impact of the proposed development. The significance criteria are based on particulate matter (PM_{10}) and Nitrogen Oxoide (NO_2) as these pollutants are most likely to exceed the annual mean limit values (40 µg/m^3)[2] The criteria have also been applied to the predicted annual particulate matter ($PM_{2.5}$) concentrations for the purpose of this assessment.

The WHO Air Quality Guidelines (WHO 2006) limit values relating to NO_2, PM_{10} and $PM_{2.5}$ are presented in Chapter 12 Volume 2 of this EIAR. The WHO Air Quality Guideline values are more stringent than the European Union (EU) statutory limit values for PM_{10} and $PM_{2.5}$. In relation to NO_2, the compliance limit values

[2] Micrograms (One-millionth of a gram) per cubic meter air

are equivalent. However, the WHO one-hour guideline value is an absolute value while the EU standards allows this limit to be exceeded for 18 hours / annum without breaching the statutory limit value.

With regards to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development in Ireland. Dublin City Council (DCC) has published a guidance document entitled *Air Quality Monitoring and Noise Control Unit's Good Practice Guide for Construction and Demolition*. However, this guidance does not specify a guideline value. The appropriate limits for the assessment of air quality impacts of the proposed development are detailed in Air Quality Regulations, which incorporate the CAFE Directive, and are detailed in Chapter 12, Volume 2 of this EIAR.

23.3.4.2.4 Hazards of noise and vibration emissions

Noise is measured using the standard decibel scale (dBA). The "A" represents a weighting that mimics human hearing. It is important to note that because the decibel is a logarithmic scale i.e. non-linear scale, therefore the figure can be somewhat confusing. An increase in 3 bdB means a doubling of the sound intensity in energy terms. However, the human ear does not normally perceive this degree of increase in volume. Normally, a 10dB increase in noise levels equates to a subjective doubling in audible sound.

Dublin City Council's 'Air Quality Monitoring and Noise Control Unit's Good Practice Guide (DCC GPG) for Construction and Demolition' outlines a risk assessment methodology directly applicable to the specific construction activities on the proposed site, refer to Chapter 14, Volume 2 of this EIAR for further information. The proposed development has been classed as a high-risk category site based on the DCC GPG risk assessment factors as detailed below: -

- Duration of the works.
- Distance to noise sensitive locations (NSLs).
- Ambient noise levels.
- Site operating hours.
- Location of works.
- Duration of demolition.
- Intrusive noise activities, including vibration generating activities.

Whilst Fingal County Council (FCC), Meath County Council (MCC) or Kildare County Council (KCC) do not use an equivalent noise risk assessment procedure, the approach used by DCC has been applied in Chapter 14 Noise and Vibration of this EIAR across the full extent of the proposed development to ensure a uniform approach for construction noise assessment.

Table 23-6 BS 5228-1 Example of Thresholds of Potential Significant Effect

Assessment Category & Threshold Value Period (L_{Aeq})	Construction Noise Threshold (CNT) (dB)		
	Category A [A]	Category B [B]	Category C [C]
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75
Evenings & Weekends (19:00 – 23:00hrs weekdays) (13:00 - 23:00hrs Saturdays) (07:00 – 23:00hrs Sundays)	55	60	65
Night-time (23:00 to 07:00hrs)	45	50	55
Notes	Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values	Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.	Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

These thresholds have been applied to residential buildings.

For commercial buildings (offices, industrial facilities, sport clubs etc.) which are less noise sensitive, the following fixed noise limits have been applied:

- Commercial, offices and industrial facilities: Category C values from Table 23.6.

In order to assist with interpretation of significance, Table 23.7 includes guidance as to the lik ely magnitude of noise impact associated with construction activities, relative to the construction noise level. This guidance is derived from Table 3.16 of DMRB Noise and Vibration (UKHA 2020) and adapted to include the relevant significance effects from the EPA Guidelines (EPA 2022).

In accordance with the DMRB Noise and Vibration (UKHA 2020), construction noise and construction traffic noise impacts shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- Ten or more days or nights in any 15 consecutive days or nights.
- A total number of days exceeding 40 in any six consecutive months.

Table 23-7 Construction Noise Significance Ratings

Range of Construction Noise level	Guidelines for Noise Impact Assessment Significance (DMRB)	EPA EIAR Significance Effects	Determination
Below or equal to baseline noise level	Negligible	Not Significant	Depending on CNT, duration & baseline noise level
Above baseline noise level and below or equal to CNT	Minor	Slight to Moderate	
Above CNT and below or equal to CNT +5 dB	Moderate	Moderate to Significant	
Above CNT +5 to +15 dB	Major	Significant, to Very Significant	
Above +15 dB		Very Significant to Profound	

The adapted DMRB Noise and Vibration (UKHA 2020) guidance outlined is used to assess the predicted construction noise levels at NSLs and comment on the likely impacts during the construction stages.

According to the WHO, noise is the second greatest environmental cause of health problems, after air quality. Excessive noise can seriously harm human health, affect mental health and people's daily activities including in sensitive receptors such as residential properties, schools, workplace etc. The EPA State of the Environment Report (2020a) state that "*noise can disturb sleep, cause cardiovascular and psychophysiological effects, reduce performance and provoke annoyance responses and changes in social behaviour.*" The EPA also state that "*a study commissioned by the European Commission on the health implications of road, railway and aircraft noise in the European Union (RIVM, 2014) found that exposure to noise in Europe contributes to:*

- *about 910,000 additional prevalent cases of hypertension;*
- *43,000 hospital admissions per year;*
- *at least 10,000 premature deaths per year related to coronary heart disease and stroke."*

The assessment and management of noise from the infrastructural transport sources (roads, rail, and airports) are governed by the Environmental Noise Directive and associated 2006 Environmental Noise Regulations (S.I. 140 of 2006). Chapter 14 Noise and Vibration identifies the detailed criteria for assessing noise and vibration impacts relating to the proposed development including human health impacts which is relied upon for this assessment.

Vibration

Humans are sensitive to vibration stimuli, and perception of vibration at high magnitudes may cause concern to building occupants. BS 5228 – 2 notes that vibration typically becomes perceptible at around 0.15 mm/s to 0.3 mm/s and may become disturbing or annoying at higher magnitudes. During construction works associated with breaking of ground, piling and excavation, depending on the methodologies involved the vibration limits set (Refer to Table 14.24 Human Response vibration significant ratings in Chapter 14) would be clearly perceptible to building occupants and would have the potential to cause subjective effects.

Table 23-8 Human Response Vibration Significance Ratings

Criteria	Impact Magnitude	Significance Rating
≥10 mm/s PPV	Very High	Very Significant
≥1 mm/s PPV	High	Moderate to Significant
≥0.3 mm/s PPV	Medium	Slight to Moderate
≥0.14 mm/s PPV	Low	Not significant to Slight
Less than 0.14 mm/s PPV	Very Low	Imperceptible to Not significant

Higher levels of vibration are however typically tolerated for single events or events of short-term duration, particularly during construction projects and when the origin of vibration is known. For example, piling can typically be tolerated at vibration levels up to 2.5 mm/s during the daytime and the evening if those affected are aware of the time-frame and origin of the vibration, and if they have been informed about the limit values relating to the structural integrity of neighbouring properties. Table 23.8 presents the significance ratings relating to potential impacts to building occupants during construction based on guidance from BS 5228 – 2. (Refer to Chapter 14 for more detailed information).

23.3.4.2.5 Hazards of emissions on hydrology (flood risk)

Emissions standards and pathways that affect human health relating to hydrology include water quality and flood risk. These hazards would be considered biological hazards. Hydraulic structures such as bridges, culverts, channel diversions, outfalls and flood defences can, if not appropriately designed, impact negatively on upstream water levels and downstream flows. If the conveyance area of a river is significantly reduced, it may impede flow during times of floods thus causing water levels within the vicinity of the structure to be raised above what would occur in the absence of the structure and potentially increase flooding of undefended lands. Chapter 10 of this EIAR details the criteria for assessing these hydrological impacts.

23.3.4.2.6 Hazards of emissions on hydrogeology

Construction and operational (fuel spillages, etc.) activities pose a risk to surface water particularly contaminated surface water runoff from construction activities entering the watercourse. Impacts to sources of drinking water are sensitive and are considered in Chapter 11 of this EIAR which details the criteria for assessing hydrogeological impacts.

23.3.4.2.7 Hazards of emissions on soils and geology (contaminated land)

Consideration of likely emissions to and from a project relating to contamination of soil or the potential to uncover contaminated materials/land based on previous land uses (e.g., landfill, industrial, manufacturing uses) have the potential to affect human health. During construction activities there is potential to unearth or uncover previously buried materials or contaminants and depending on the nature of the contamination may have the potential to affect human health if not appropriately addressed. Chapter 9 (Land & Soils) of this EIAR details the criteria for assessing contaminated land which is in accordance *Guidelines on Procedures for Assessment & Treatment of Geology, Hydrology & Hydrogeology for National Roads* (TII, 2008).

Radon is a naturally occurring radioactive gas that originates from the decay of uranium in rocks and soils. It is colourless, odourless and tasteless and can only be measured using special equipment. Radon rises up

through the ground to disperse in the air and only becomes a health hazard when it is trapped in buildings and is considered in this context.

23.3.4.2.8 Hazards of electromagnetic fields

Consideration of likely impacts arising from Electromagnetic Fields (EMF) and Electromagnetic Interference (EMI) as a result of the proposed development are modelled and assessed in Chapter 22 of this EIAR. Electromagnetic Fields (EMF) comprise an electric field and a magnetic field and are emitted from both natural and manmade sources in the environment. Examples of manmade sources of EMF include mobile phones, televisions, and electrical power lines. All sources of EMF below 300 GHz in the electromagnetic spectrum are considered Non-Ionising Radiation, which means the EMF does not carry enough energy to remove an electron from its atomic structure unlike what is classed as ionising radiation such as Gamma rays or X-rays.

Conclusion from Scientific research, the WHO states (2002)[3]: scientific knowledge about the health effects of EMF is substantial and is based on a large number of epidemiological, animal and invitro studies. Many health outcomes ranging from reproductive defects to cardiovascular and neurodegenerative diseases have been examined, but the most consistent evidence to date concerns childhood leukemia. In 2001, an expert scientific working group of WHO's International Agency for Research on Cancer (IARC) reviewed studies related to the carcinogenicity of static and extremely low frequency (ELF) electric and magnetic fields. Using the standard IARC classification that weighs human, animal and laboratory evidence, ELF magnetic fields were classified as possibly carcinogenic to humans based on epidemiological studies of childhood leukemia. An example of a well-known agent classified in the same category is coffee, which may increase risk of kidney cancer, while at the same time be protective against bowel cancer. "*Possibly carcinogenic to humans"* is a classification used to denote an agent for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence for carcinogenicity in experimental animals.

Chapter 22 (Electromagnetic Effects and Stray Current) has modelled and assessed the potential effects including those on human health and is relied upon for this assessment.

Evidence for all other cancers in children and adults, as well as other types of exposures (i.e., static fields and ELF electric fields) was considered inadequate to classify either due to insufficient or inconsistent scientific information. While the classification of ELF magnetic fields as possibly carcinogenic to humans has been made by IARC, it remains possible that there are other explanations for the observed association between exposure to ELF magnetic fields and childhood leukemia.' ibid

23.3.4.2.9 Hazards influencing psychosocial impacts

Consideration of likely negative psychosocial hazards relating to the improvements to existing development and new infrastructure developments include issues such as nuisance and anti-social behaviour. On the contrary, there could also be positive psychosocial impacts on the community due to improved connectivity particularly for public transport users, pedestrians, and cyclists and also as a result of regeneration associated with land use changes and associated increased economic prosperity. Due to the subjectivity relating to psychosocial effects it is not possible to use a standard based approach in this assessment.

Demolition and property acquisition can also have an impact on the occupants and communities depending on the impact caused due to the compulsory acquisition of the family home and subsequent break from family, neighbours, community ties and the general amenity of residents that are affected. It is not possible to assess the individual human health effects of such impacts as part of this community-based assessment. However, Chapter 16 and 17 assesses the land-take requirements and impacts on property (agricultural and non-agricultural) as a result of the proposed development.

[3] WHO. 2002. Establishing a dialogue on risk from electromagnetic fields ONLINE Available at: https://www.who.int/peh-emf/publications/en/EMF_Risk_ALL.pdf [Accessed 06 June 2021]

23.3.5 Difficulties encountered/ limitations

This assessment was undertaken during the Covid 19 pandemic. Due to certain government restrictions travel, community events, gatherings and 'normal' in person community activities associated with the EIA process were affected.

Furthermore, population health considerations relating to the use of public transport and potential long-term changes due to the effects of the pandemic has been considered as part of this assessment, as far as is possible, in an evolving global pandemic including what it might mean for the future of settlements, travel and communities. No particular difficulties were encountered in preparing the human health assessment.

23.4 Relevant characteristics of the receiving environment

23.4.1 Introduction

This chapter will assess the likely construction and operational impacts of the proposed development on human health. The characteristics of the project that will potentially impact human health include all relevant elements of the construction and operation of the proposed development. The 'Description of the Proposed Development' and 'Construction Strategy' are detailed in Chapters 4 and 5 respectively, and are relied upon for this assessment, and is not repeated beyond where is it relevant to this assessment.

The proposed development aims to increase train frequency from the current ten-minute frequency to a five-minute all-day frequency. This will be achieved by increasing services from the current 6 trains per hour per direction to 12 trains per hour per direction by 2027, increasing passenger capacity from 5,000 to 13,200 subject to passenger demand. To achieve the required increased train frequencies, the proposed DART+ West will electrify c.40 km of the railway line from Connolly/Docklands area in Dublin City Centre eastwards to a proposed depot facility located west of Maynooth, and to the M3 Parkway Station. It also includes upgrade and reconfiguration of existing railway infrastructure in the city centre, the closure of the six level crossings along the line and construction of replacement infrastructure works (where appropriate) at Ashtown, Coolmine, Porterstown, Clonsilla, Barberstown and Blakestown level crossings. The project also involves the construction of a new 'Spencer Dock' station in the Docklands area of the City.

The construction of the proposed development will take place in a phased basis over a 47-month period. The key relevant characteristics of the proposed development considered in this assessment include the construction and operational effects of the proposed development. In particular, the assessment is required to report on likely and significant potential effects. Therefore, impacts associated with permanent land use changes associated with the proposed development include the following:

- Construction and operation of the electrified rail line and ancillary works.
- Construction of Spencer Dock Station.
- Capacity improvements at Connolly Station.
- Level crossing closures and construction and operation of replacement infrastructure (where appropriate) at Ashtown, Coolmine, Porterstown, Clonsilla, Barberstown and Blakestown.
- Construction and operation of the proposed depot.
- Temporary construction compounds effects.
- Operation of permanent maintenance compounds.
- Construction and operation of substations and ancillary works.

Human health is also considered with reference to, and interactions with other environmental receptors during the construction and operation phases and the corresponding chapters in this EIAR to include impacts of:

- emissions to the air environment.
- emissions to the noise and vibration environment.
- emissions on hydrology (surface water quality and flood risk).

- emissions on hydrogeology environment (drinking water).
- emissions on soil (contaminated land).
- emissions on electromagnetic fields.
- traffic and safety effects.
- psychosocial effects.
- physical activity effects.

Potential human health impacts during the operational phase of the EIAR are likely to include:

- Likely improvements to rail passenger and road safety particularly due to the elimination of the rail – road interaction.
- Potential positive impacts on the noise and vibration environment due to quieter electrified fleet.
- Potential reduction of impacts on air quality environment and associated greenhouse gas emissions (influencing climate change) associated with reduction in use of diesel-powered trains to an electrified fleet.

An accurate assessment of the receiving environment is necessary to predict the likely significance of the impacts of the proposed development. The following section presents an overview human health profile of the study area and existing receiving environmental influencing human health in the study area.

23.4.2 Health profile

Census 2016 collates the self-reported health status of the population age 15 years and over. In the State, 85% of the population perceive their health as 'good/very good' similar percentages of the populations of each of the counties in the study area report their health as good or very good also. Dublin City 83%, Fingal 88%, with 90% of Kildare and Meath's populations reporting their health as good/very good.

Health in Ireland Key Trends 2021 prepared by the Department of Health includes summary statistics on health and health care in Ireland and the EU 27 countries over the past ten years. Demographic data shows rapidly changing population structures in Ireland and the EU. For example, over the past decade we have added, on average, 3 months per year to our life expectancy. Understanding the trends in demographics, fertility and mortality is vital for the planning and delivery of health care services, as well as public infrastructure now and into the future.

Population health at the national level presents a picture of decreasing mortality rates and high self-perceived health over the past ten years. Indeed, Ireland is reported as having the highest self-perceived health status in the EU. Health status can reflect income inequality, with fewer low-income earners reporting good health both in Ireland and across the EU. The overall trends indicate that age-standardised mortality rates have declined by 16% for all causes over the past decade[4] highlighting the advances in health care services and health promotion across Europe.

'Lenus' Irish Health Repository has health profiles created for all counties including Dublin, Fingal, Meath and Kildare. While the data is somewhat dated it can be used to compare the key mortality rates in these counties with the national average from the four principal causes of death namely: cancer, heart disease and stroke, respiratory disease, and injury & poisoning, over the 2007 – 2012 period. These include the following statistics:

- Mortality rates in Dublin City are above national average for heart disease and stroke in those aged under 65 years.[5]
- In Fingal, cancer incidence rates are higher than average for female malignant melanoma, male colorectal cancer and male and female lung cancers.[6]

[4] Department of Health. (2021) Health Trends in Ireland: Key Trends 2021 Available at: https://www.gov.ie/en/publication/350b7-health-in-ireland-key-trends-2021/ [Accessed 22 December 2021]
[5] Lenus Health Profile 2015 Dublin City. Available at: https://www.lenus.ie/handle/10147/584037 [Accessed 08 June 2021]
[6] Lenus Health Profile 2015 Fingal. Available at: https://www.lenus.ie/handle/10147/584023[Accessed 08 June 2021]

- In Kildare, male incidence rate of malignant colorectal cancer is the highest nationally, and male and female incidence rates of malignant melanoma are above the national rate.[7]
- In Meath, cancer incidence rate for the main causes of cancer are average except for female malignant colorectal cancer which is the second highest nationally.[8]

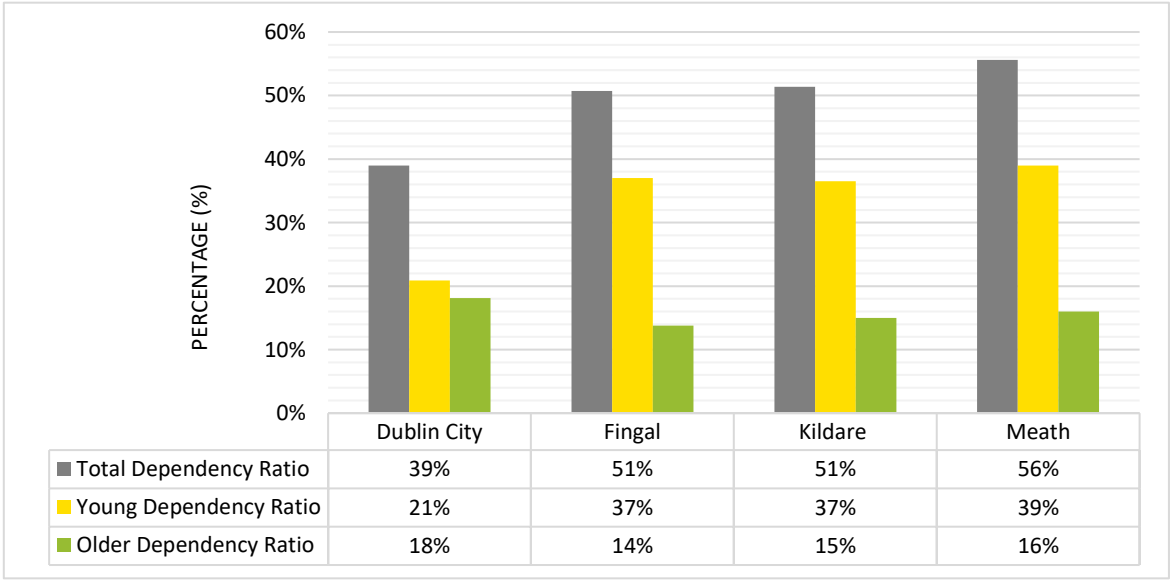
In terms of life expectancy, Ireland is reported to have a higher life expectancy at birth than the EU28 average[9]. Since 2007, the life expectancy in males increased by 3 years, and almost 3 years for females. From 2009 – 2018 period, the most significant population growth across all regions of Ireland is the population aged 65 and over which increased by 35.2% since 2009, which is considerably higher than the EU average increase of 16.5%.[10] The increased life expectancy can be linked to the decrease of mortality rates from major diseases. On the other hand, the fertility rate in Ireland has been gradually decreasing. However, Ireland still has the third highest fertility rate in the EU, this is largely due to the reduction of women in the main child- bearing age groups in recent period.

23.4.2.1 Vulnerable Groups

23.4.2.1.1 Age Dependency

Age dependency ratio is the population ratio of those typically not in the labour force, aged 0-14 and 65+ that are shown as a percentage of those typically in the labour force (aged 15-64). Age dependency indicates the pressure on the productive population to support services for younger and older age cohorts of the population. The age dependency ratios for counties Dublin City, Fingal, Kildare and Meath are presented in Figure 23-1 below.

The total age dependency ratio is the sum of young and old age dependency ratios. County Meath had the highest young dependency ratio (39&) in the 2016 Census period in the Country, reflecting its young and growing population. Meath has the highest dependency ratio of all the counties with a total age dependency ratio at 56%. Kildare and Fingal have both 51% of the population classified as dependents dominated again by the younger cohort. Dublin City is at 39% with a slightly older dependency ratio (21%) than the others indicating an ageing population cohort and less young dependents living in Dublin.



	Dublin City	Fingal	Kildare	Meath
Total Dependency Ratio	39%	51%	51%	56%
Young Dependency Ratio	21%	37%	37%	39%
Older Dependency Ratio	18%	14%	15%	16%

Figure 23-4 Age dependency ratio for Dublin City, Fingal, Kildare, and Meath (Source: Census, 2016)

[7] Lenus Health Profile 2015 Kildare. Available at: https://www.lenus.ie/handle/10147/584022 [Accessed 08 June 2021]
[8] Lenus Health Profile 2015 Meath. [Accessed 08 June 2021] Available at: https://www.lenus.ie/handle/10147/584018
[9] Department of Health. (2021) Health Trends in Ireland: Key Trends 2021 Available at: https://www.gov.ie/en/publication/350b7-health-in-ireland-key-trends-2021// [Accessed 22 December 2021]
[10] Department of Health. (2021) Health Trends in Ireland: Key Trends 2021 Available at: https://www.gov.ie/en/publication/350b7-health-in-ireland-key-trends-2021// [Accessed 22 December 2021]

23.4.2.1.2 Disability

In Ireland, there were a total of 643,131 people who stated they had a disability in April 2016, accounting for 13.5% of the population. This represented an increase of 47,796 persons (8%) on the 2011 figure of 595,335. Types of disabilities can vary to include physical disabilities, vision impairment, deaf or hard of hearing, mental health conditions and intellectual disability, etc. Census 2016 reports the percentage of population with disabilities. Dublin City has the highest percentage of people with disabilities in the study area at approximately 15%, followed by Kildare 12.5% and Meath at 11.6%, and Fingal at 10.8%.

The percentage of the population with disabilities and carers was reviewed at EDs level located partially or within 100m of key infrastructure works and is detailed in Figure 23-5 below.

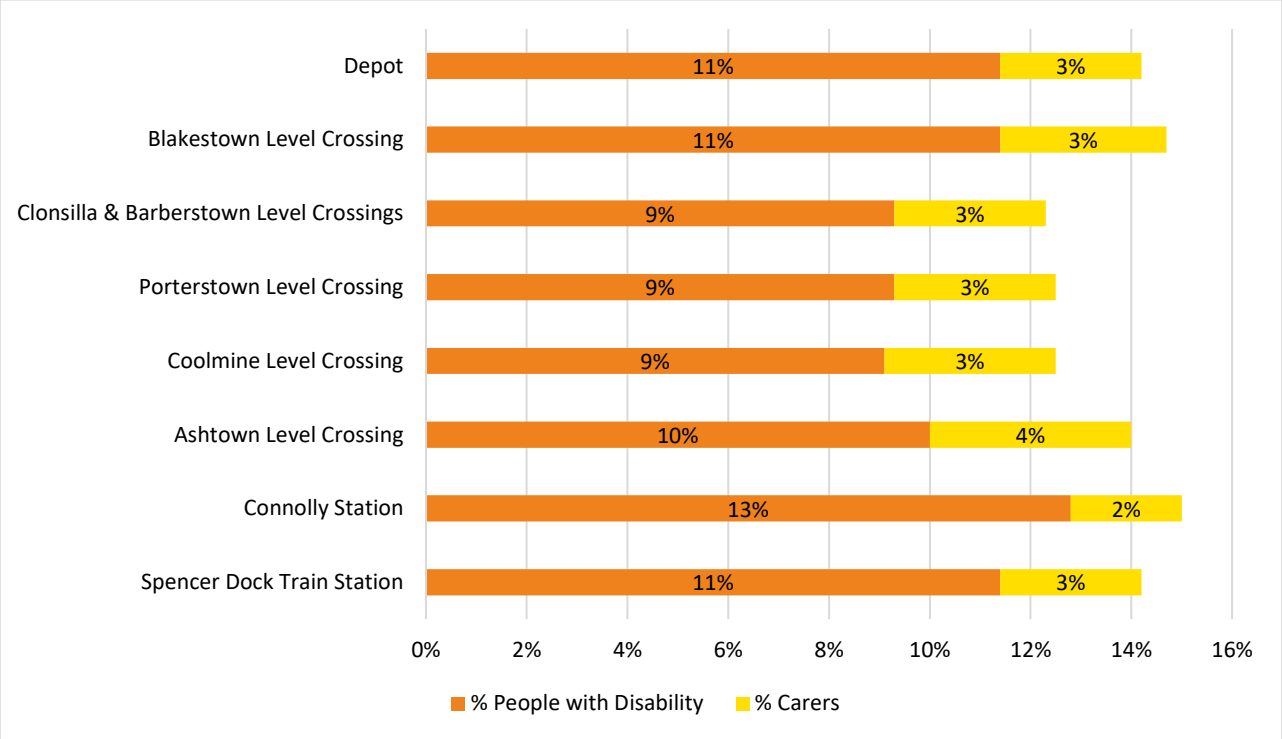


Figure 23-5 Average percentage of people with disability and or are carers within ED study areas[11] (Source: Census 2016)

23.4.2.2 Levels of deprivation

The Haase and Pratschke (HP) deprivation index looks at geographical areas in order to measure the relative affluence or disadvantage of a particular geographical area. These are compiled from various census under 10 key indicators including: the proportion of skilled professionals, education levels, employment levels, and single-parent households found in an area. The HP deprivation relative index scores range from approximately -40 (most disadvantaged) to + 40 (most affluent) as shown in Table 23-9 below. This data is particularly useful in assessing predicted health outcomes.

Table 23-9 The Haase and Pratschke (HP) deprivation Index[12]

Relative Index Score	Description
Over 30	Extremely Affluent
20 to 30	Very Affluent

[11] Average for EDs located wholly or partially within 100m of the key infrastructure works - proposed train station and the six level crossing closures and associated replacement works

[12] Haase and Pratschke, 2017. [Accessed 08 June 2021] The 2016 Pobal HP Deprivation Index for Small Areas (SA). Available at: https://www.pobal.ie/app/uploads/2018/06/The-2016-Pobal-HP-Deprivation-Index-Introduction-07.pdf

Relative Index Score	Description
10 to 20	Affluent
0 to 10	Marginally Above Average
0 to -10	Marginally Below Average
-10 to -20	Disadvantaged
-20 to -30	Very Disadvantaged
Below -30	Extremely Disadvantaged

The deprivation index scores for the study areas at proposed train stations and level crossing replacement works and the wider county study areas is detailed in Table 23-10 below. All study areas range from 'Marginally Above Average' to 'Affluent'. There are areas City centre and suburbs area outside of the 100m study area that are classified as 'marginally below average' or disadvantaged'. Improvement in public transport can benefit all of society and particularly those who are located in disadvantaged areas and supports positive health outcomes.

Table 23-10 Deprivation Index Scores within Study Areas

Study Area	Average Deprivation Score 2016	Deprivation Description
Proposed Spencer Dock Station	11.1	Affluent
Connolly Station	2.31	Marginally Above Average
Ashtown Level Crossing	11.8	Affluent
Coolmine Level Crossing	8.5	Marginally Above Average
Porterstown Level Crossing	8.4	Marginally Above Average
Clonsilla & Barberstown Level Crossings	8.3	Marginally Above Average
Blakestown Level Crossing	9	Marginally Above Average
Depot	9.5	Marginally Above Average
County / Local Authority administrative area		
Dublin City	3.1	Marginally Above Average
Fingal	5.3	Marginally Above Average
County Kildare	3.18	Affluent
County Meath	1.83	Marginally Above Average
Source: Pobal		
Note: Study Area - refer to Table 23.1 for the Electoral Divisions contained within 100m of proposed trains stations and level crossing replacement works		

23.4.3 Collision statistics

The Road Safety Authority (RSA) report on collisions in the Republic of Ireland with statistics available online from 2005 to 2016. Four collisions are reported in vicinity of the Coolmine level crossing. One minor collision occurred at the Coolmine level crossing between a car and pedestrian. One fatal collision occurred between a motorcycle and a pedestrian approximately 90m north of the level crossing. Two minor collisions also occurred in this location, one of which involved a car and a pedestrian at the level crossing. There were also a number of minor collisions on approach to the Ashtown, Porterstown, Clonsilla and Porterstown level crossings. No collisions were recorded in vicinity of the Barberstown level crossing.

Iarnród Éireann (IAMS) also records incidents at level crossings. Table 23-11 summarises the incident records at the six level crossings for the 2015-2020. The reports demonstrate there are continued issues at all level crossings particularly with regards to road vehicle strikes of the level crossing barriers, cyclists/pedestrians incidents involving collisions, trespassing on the live railway and also people interfering with barriers while in

operation. The complete closure of the level crossings and provision of replacement infrastructure is expected to improve safety and reduce these incidents and safety issues occurring.

Table 23-11 Incident records at level crossings between 2015 and 2020

Location (Level Crossing no.)	Incident Description	Total incidents
Ashtown level crossing (XG004)	Road traffic accident, near miss cyclist, vehicles strike the level crossing	3
Coolmine level crossing (XG006)	Road vehicles strikes the level crossing	9
	Trespass	5
	Person(s) interfere with level crossing	2
Porterstown level crossing (XG008)	Road vehicles strikes the level crossing	5
	Other road users strike the level crossing	2
	Trespass	20
	Person(s) interfere with level crossing	15
Clonsilla level crossing (XG010)	Trespass	1
Barberstown level crossing (XG012)	Road vehicles strikes the level crossing	5
Blakestown level crossing (XG014)	Road vehicles strikes the level crossing	1
	Other road users strike the level crossing	1
	Trespass	1

23.4.4 Seveso sites

Major industrial accidents involving dangerous substances pose a significant threat to humans and the environment; such accidents can give rise to serious injury to people or serious damage to the environment, both on and off the site of the accident. In 2012 the Seveso-III (Directive 2012/18/EU) was adopted in Ireland. The Chemicals Act (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2015 (S.I. No. 209 of 2015) (the "COMAH Regulations"), implement the Seveso III Directive (2012/18/EU). The purpose of the COMAH Regulations is to lay down rules for the prevention of major accidents involving dangerous substances, and to seek to limit as far as possible the consequences for human health and the environment of such accidents, with the overall objective of providing a high level of protection in a consistent and effective manner.

All planning applications within 700m of Seveso sites require referral to the Health & Safety Authority (HSA) for technical advice to reduce the risk and limit the consequences of major industrial accidents.

A review of the listed Upper and Lower Tier establishments published by the Health and Safety Authority (HSA) was undertaken. At the time of writing, there is 1 Upper Tier establishment located within 700m of the proposed infrastructure works namely Intel, in Leixlip County Kildare, located approximately 100m at from the proposed development.

23.4.5 Air quality environment

Under the Clean Air for Europe Directive, EU member states must designate "Zones" for the purpose of managing air quality. For Ireland, four zones were defined in the Air Quality Standards Regulations (2011). The main areas defined in each zone are:

- Zone A: Dublin.
- Zone B: Cork.
- Zone C: Other cities and large towns comprising Limerick, Galway, Waterford, Drogheda, Dundalk, Bray, Navan, Ennis, Tralee, Kilkenny, Carlow, Naas, Sligo, Newbridge, Mullingar, Wexford, Letterkenny, Athlone, Celbridge, Clonmel, Balbriggan, Greystones, Leixlip and Portlaoise.

- Zone D: Rural Ireland, i.e. the remainder of the State excluding Zones A, B and C.

Dublin is included in Zone A. Dublin and Leixlip are Zone C, the remainder of the study area west of these areas are located in Zone D, which include Maynooth and Dunboyne and the rural areas in between.

EPA Air Quality Zone A monitoring stations have the most potential to exceed air quality limit values due to the heavily developed and urban nature of the baseline environment. The baseline assessment reported in roadside monitoring locations in proximity to Connolly Station (Amiens Street) were found to exceed the annual mean NO_2 concentration in 2017, 2018 and 2019, while the average PM_{10} levels at the urban traffic monitoring location of Blanchardstown station reported between 2 and 11 exceedances between the 2015 to 2019 year period of the 24-hour limit value of 50 µg/m^3. No exceedances were reported in EPA Air Quality Zones C and D.

Traffic is recognised as a key pressure on air quality indicators and is the main cause of air quality issues in our larger towns and cities (EPA, 2020a). Vehicles emit a range of air pollutants including nitrogen oxides (NOx), particulate matter (PM_{10} and $PM_{2.5}$), black carbon and volatile organic compounds (VOCs) particularly present in urban areas and areas with high congestion levels. There are significant human health impacts from particulate matter (PM) and nitrogen oxides (NOx) emissions, which include cardiovascular disease and lung disease such as asthma (EPA, 2020a). The EPA (2021) report on *Ireland's Air Pollutant Emissions 1990 – 2030* discusses the outlook for future compliance with 2030 targets. It notes that nitrogen oxides targets may be met with the full implementation of the measures in the Climate Action Plan however no measures have yet been set to ensure compliance with nonmethane volatile organic compounds emission ceiling for 2030. Full Implementation at farm level of ammonia abatement measures contained in the AgClimatise (National 'Climate & Air Roadmap' for the Agriculture Sector, 2020) should achieve compliance for NH_3 targets while $PM_{2.5}$ are likely to stay in compliance with the National Emissions Ceiling (NEC) Directive ceiling.

For more detail on the baseline air quality environment and monitoring results these are contained in Chapter 12 of this EIAR along with the impact assessment and is relied upon to inform this assessment.

23.4.6 Noise and vibration environment

Baseline noise and vibration surveys have been conducted at locations representative of the nearest noise sensitive locations (NSLs) which have the potential to be impacted during construction phase and/or those likely to be impacted during the operational phase and are detailed in Chapter 14 (Noise and Vibration) contained in Volume 2 of this EIAR.

In general, the noise survey for the proposed development determined that the study area is influenced by noise from the existing adjacent railway, road traffic and the local residential activities set back from road traffic. Construction noise located in proximity to the proposed Spencer Dock Station in the Docklands is also recorded as being a dominant noise source in this area.

The vibration monitoring results indicates a low vibration environment. Analysis of the data indicates the typical Peak Particle Velocity (PPV) value associated with passing rail is ranges between 0.01 and 0.29 mm/s (millimetres per second) across the various zones (it is higher in the more urban locations where there are more train carriages and other external forces present such as road traffic, etc). Chapter 14 of this EIAR contains the detailed noise and vibration survey monitoring results.

23.4.7 Hydrological environment (flood risk)

A site-specific flood risk assessment for the proposed development has been prepared to support the proposed development (contained as a supporting document of this EIAR). Chapter 10 (Water) reports on the results of the assessment and potential water quality impacts.

Areas that have been identified with potentially elevated level of flood risk include:

- Docklands / Newcomen area.

- Leixlip.
- Confey Station, flooding emanates from minor tributaries of the Rye Water River as they cross under the canal and railway.
- Barberstown (XG012) Level Crossing.
- Between Maynooth and Kilcock – River Lyreen flooding.
- Dunboyne Tolka River Valley – South of M3 Parkway.

There are no identified bathing waters in Dublin Bay. The Royal Canal and River Liffey are amenity resources used by the people for a variety of amenity and recreational purposes including boating and swimming activities. Chapter 10 (Water) Volume 2 of this EIAR contains detailed information relating to the receiving environment.

23.4.8 Hydrogeology (including drinking water)

The study area of the proposed development is serviced by private and public water supply schemes, which are surface water and groundwater fed. Leixlip Water Treatment Plant is located ~1.4 km from the proposed development and is fed by the river Liffey and its tributaries. One such tributary drains the area of land between the proposed development and the M4. This plant provides a significant percentage of the potable water supply to the population of Dublin City and environs.

Whilst the majority of the study area is serviced by public water schemes. There is a public group scheme situated at Dunboyne immediately south of the M3 Parkway Station. The scheme is groundwater fed. The Source Protection Area (SPA) for the supply is adjacent to the existing railway line. The Dunboyne Public Supply is the main water supply for Dunboyne, Clonee, and other small communities in the area.

The area is serviced by a total of four public well sources (PWS) three of which are located along the southern bank of the Tolka River while the fourth is located by the Dunboyne Industrial Estate. Information on private water supplies identified there are two wells in the centre of the Dunboyne, circa 500 m east of the railway and 300 m north of the railway close to the M3 Parkway. Further information on the hydrogeology of the study area is contained in Chapter 11 (Hydrogeology) Volume 2 of this EIAR.

23.4.9 Soils and geology (including contaminated land)

The ground investigation results confirm the presence of contaminated land in Zones A and B below the railway and its vicinity, consistent with the existing diesel operated trains and industrial uses in these areas. These contaminated materials will require disposal as hazardous waste in accordance Waste Acceptance Criteria (WAC) with the classification of waste and disposal to a suitably licenced waste facility.

Radon is a naturally occurring radioactive gas that originates from the decay of uranium in rocks and soils. It is colourless, odourless and tasteless and can only be measured using special equipment. The proposed development is located in radon area where >1%, 1% to 5% and 5% to 10% of homes are predicted to have radon levels in excess of the reference level of 200 Bq/m^3. Radon rises up through the ground to disperse in the air and only becomes a health hazard when it is trapped in buildings. The Building Regulations require the installation of radon preventive measures to minimise the level of radon in buildings and will be applied as standard design as part of the proposed development buildings.

23.4.10 Electromagnetic effects and stray current

Electromagnetic Fields (EMF) occur in nature and therefore have always been present on earth. However, during the 20th Century exposure to man-made sources of EMF has steadily increased due to electricity demand, advancing wireless technologies, changes in work practices and social behaviours. Everyone is exposed to complete mix of electric and magnetic field at many different frequencies at home and at work.

Public concern over possible human health effects from EMF has led to significant guidance being developed by the WHO. Concerns expressed are reported as including childhood leukaemia and other cancers and normally relate to high tension electricity transmission cables[13].

Countries set their own national standards for exposure to electromagnetic fields. However, the majority of national standards are based on the guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). This non-governmental organization, formally recognized by WHO, evaluates scientific results from all over the world. ICNIRP produces guidelines recommending limits of exposure, which are reviewed periodically and updated as necessary. EMF from DC electrified rail is relatively low risk.

23.4.11 Psychosocial Impacts

Due to the subjectivity relating to psychosocial effects it is not possible to use a standard based approach in this assessment. The proposed development is primarily confined to the existing Dublin to Maynooth and M3 Parkway rail corridors and has been designed to avoid and/or reduce impacts to as many properties as possible. However, the project will require acquisition and / or demolition of a number of private properties. Demolition and property acquisition can have impact on both the occupants themselves but also at community level due to impact on community ties and amenity of residents, local economy, etc. The impacts associated with demolition and/or acquisition of private property, such as private residential and commercial properties is assessed in Chapters 16 (Material Assets: Agricultural property) and Chapter 17 (Material Assets Non-Agricultural property) of Volume 2 of this EIAR. It is recognised that the design development and the subsequent approval and compulsory acquisition process can cause anxiety and/or stress to property owners and their families as well as potentially impact social networks/community ties which cannot be mitigated against in this EIAR. If the project is successful compensation for these impacts will be assessed as part of a separate process, following appropriate liaison with the property owners affected and is not assessed further as part of this human health assessment.

Consideration of negative psychosocial hazards relating to the proposed development include potential for nuisance, anti-social behaviour and potentially locations for suicide events to occur. There are already incidents of anti-social behaviour and suicide events occurring on the existing rail network. Design measures such as barriers to climbing/falling are implemented as far as is practicable to deter such incidents from occurring on the existing network and will continue to be monitored.

According to the Iarnród Eireann's 2020 Annual Report, from 2019 to 2020 there was a significant increase (18%) of anti-social behaviour report on the rail network. To combat the increase in anti-social behaviour, Iarnród Éireann have devised a security strategy "which incorporates the proactive support of our security contractor and *An Garda Síochána"*[14]. This security strategy will be implemented across the DART network, including the DART+ West project once operational. The Iarnród Éireann's Text SMS Service[15] which is currently operational on the DART network will be maintained to allow all customers to discreetly report incidents of anti-social behaviour at any time including while on board a train while the incident is occurring therefore helping combat the negative effects associated with such incidents on all passengers.

23.4.12 Physical activity

It is well documented that walking and cycling significantly reduces the risk of all-cause mortality particularly where physical activity is consistent and can result in mortality risk reduction[16]. This is due to a strong continuous dose – response relationship between physical activity and human health, whereby each increase in physical activity induces additional health benefits. From a human health perspective this can translate into improved 'fitness' and reduced risk of cardiovascular and chronic diseases and premature death, as well as

[13] WHO. 2021. Available At: Establishing a dialogue on risks from electromagnetic fields (who.int) [Accessed 06 June 2021]
[14] Iarnród Eireann's 2020 Annual Report Available At: https://www.irishrail.ie/Admin/getmedia/df8a02dd-a5ad-411d-8591-c3cb485c9c42/Iarnrod-Eireann-Annual-Report-2020.pdf
[15] Irish Rail ONLINE Available at https://www.irishrail.ie/en-ie/faqs/how-do-i-use-the-anti-social-behaviour-text-servic
[16] Kelly et al., 2018 PubMed Available at https://pubmed.ncbi.nlm.nih.gov/25344355/

cognitive and mental health benefits[17] and from an economic perspective, reduced public health costs, workplace absenteeism, and increased productivity[18].

Land use planning and transport patterns can influence physical activity and / or inactivity of populations which in turn can influence lifestyle factors and human health outcomes. Transport patterns that promote walking, cycling and sustainable modes of travel can reduce sedentary lifestyles, increasing activity and improve health outcomes. Research has demonstrated that the availability of dedicated, segregated cycleways, short cycle trip distance and proximity of cycleways to public transport interchanges and green space are positively associated with increased rates of cycling in cities; while perceived and real traffic danger, long cycle trip distance, and distance from cycleways are negatively associated[19].

The proposed development is located adjacent to the Royal Canal greenway, which includes an area for walking, cycling and is also an amenity (blue/green way) which is shown to have health benefits. Existing and planned walking and cycling routes and public transport networks included in the Greater Dublin Cycle Strategy, Development Plans and promotion of active modes of travel across all local authorities has been considered as part of the proposed development.

23.5 Description of Potential Impacts

This section of the chapter evaluates the potential impacts for the 'Do Nothing' scenario followed by an assessment of impacts for the 'Do Something' scenario, 'the proposed development' during the construction phase and the operational phase under the heading of human health.

Chapter 4 presents the detailed project description. In summary, the proposed DART+ West will electrify c.40km of the railway track from Connolly/Docklands in the city centre eastwards to a new maintenance depot facility located west of Maynooth, and to M3 Parkway. It also includes upgrade and reconfiguration of existing railway infrastructure in the city centre, closure of the six level crossings and associated infrastructure replacement works at Ashtown, Coolmine, Porterstown, Clonsilla, and Barberstown level crossings, construction of a new Spencer Dock train station in the Docklands area and all ancillary works.

The proposed development will increase train frequency from the current 10-minute frequency to a 5-minute all-day frequency and to increase trains from four to eight carriages. This will be achieved by increasing services from the current 6 trains per hour per direction to 12 trains per hour per direction by 2027, increasing passenger capacity from 5,000 to 13,200 subject to passenger demand.

The proposed development will be a predominantly online project with electrification of the line and a significant portion of the works will be undertaken within existing Iarnród Éireann lands. Development works outside of Iarnród Éireann lands will be required at a number of locations for some of the project such as the level crossing replacements, the construction of the depot area, the provision of power to the line and private lands adjoining the Irish Rail corridor associated with modifications to the main permanent way (railway corridor).

The construction of the proposed development will take place in a phased basis over a 47- month period as detailed in Chapter 5 Construction Strategy. Some construction sites will be in place for 6 months (construction of substations) while others will be longer 2 years (Spencer Dock Station).

23.5.1 Do Nothing Scenario

The 'Do Nothing' scenario of the proposed development assumes the proposed development is not built and that the existing factors affecting human health continue. Population growth and demand for transport is projected to continue and in turn will continue to put pressure on the existing rail and road network . The do-

[17] McKinney et al., 2016; Sothern et al., 1999; Vogel et al., 2009; Warburton et al., 2006
[18] Cadilhac et al., 2011; Hafner et al., 2020; Katzmarzyk et al., 2000; Shephard, 1986
[19] Buehler & Dill, 2016; Dill & Carr, 2003; Fraser & Lock, 2011; Nelson & Allen, 1997; Pucher et al., 2010; Winters et al., 2012

nothing scenario will also result in a continuation of the use of diesel-powered trains and associated noise, vibration and air quality emissions associated with the existing fleet which will continue to impact on the environment. The continued pressure on the existing transport network is likely to result in worsening traffic congestion on roads for all modes and an increase in safety incidents and/or collision particularly at the six level crossings.

The worsening conditions will be experienced particularly by passengers on trains due to capacity issues, and at train stations. Commuters in the GDA will have limited options due to the congested rail network and in turn this may increase the use of the private car for journeys with journey times likely to increase and become more extended across the day particularly at the morning and evening peak times, which could also have negative psychosocial effects (stress factors) on the wider population.

The Do Nothing Scenario is likely to affect all communities but particularly those who are passengers that rely on public transport for travel, those living at level crossings, and vulnerable groups in the study area including the young, old, the sick, and people with disabilities.

23.5.2 Potential Construction Impacts

This section assesses the 'Do Something' scenario of the proposed development during the construction phase on human health. As already stated, environmental health standards are set to protect the vulnerable and not the robust, who are generally more resilient to changes in their environment. In accordance with the methodology outlined in Section 23.3, a summary of likely significant human health impacts / hazards relating to the construction of the proposed development have been identified to include:

- Impacts of emissions to air (dust emissions).
- Impacts of noise and vibration emissions (construction noise).
- Impact of emissions to hydrology (flood risk).
- Impact of emissions to hydrogeology (drinking water quality).
- Impact of emissions to soils and geology (contaminated land).
- Impacts of collisions/risks of accidents (traffic impacts).
- Psychosocial hazards (nuisance/ stress).
- Effects on physical activity.

Chemical and biological hazards will remain a possibility in certain limited circumstances during the construction and operation phases from potential traffic, spillages or accidents. These will be managed at detailed design and in accordance with best practice construction methods relating to good housekeeping and implementation of environmental, health and safety standards throughout the lifetime of the project as required by EU Directives, statutory legal requirements and national construction and employment law as appropriate and for this reason are not considered further as part of this environmental assessment.

Prior to any demolition, excavation or construction, a Construction Environmental Management Plan (CEMP) will be produced by the successful contractor. The CEMP will set out the Contractor's overall management and administration of the construction project. The CEMP will be prepared by the Contractor during the pre-construction phase to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the CEMP, Environmental Operating Plan (EOP) and the Construction and Demolition Waste Management Plan (CDWMP).

23.5.2.1 Emissions to Air

The greatest potential impact on human health due to air quality impacts during the construction phase is from construction traffic emissions from vehicles including particulate matter (PM_{10} and $PM_{2.5}$) and Nitrogen Oxide (NO_x) emissions and the potential for nuisance dust emissions. Chapter 12 (Air Quality) Volume 2 of this EIAR details the air quality baseline and the assessment relating to the proposed construction works.

The Spencer Dock area during the construction phase was deemed to require a detailed modelling assessment due to high background concentrations. The air quality assessment found that, the impact of the proposed

development in terms of NO_2, PM_{10} and $PM_{2.5}$ is considered negligible. Therefore, the overall impact of NO_2, PM_{10} and $PM_{2.5}$ concentrations as a result of the proposed development is *short-term, negative and imperceptible*.

In accordance with TII guidance (TII 2011), the impact of the proposed development on ambient air quality in the construction phase is considered *short-term, localised, negative and imperceptible*. In accordance with the EPA Guidelines (EPA, 2022) the impacts/effects associated with the construction phase traffic emissions pre-mitigation are *not significant and short-term*.

The mitigation requirement levels take into account the sensitivity of the location established and the proposed activities that will be conducted on site which may generate air quality and dust emissions, the assessment finds that a high level of dust mitigation is required for the majority of sites. When the dust mitigation measures detailed in Section 12.6.1 in Chapter 12 in Volume 2 of this EIAR are implemented, fugitive emissions of dust from the site are not predicted to be significant and pose no significant human health risk to nearby receptors. The air dispersion modelling assessment of construction phase traffic emissions has found negligible results at all 'worst-case' modelled locations. Consistent implementation of good dust minimisation practices will ensure that the impact from construction dust is *localised, reversible and not significant*.

The construction phase of the assessment identifies *a negligible* impact on air quality in the vicinity of the proposed development and no residual construction phase dust impacts.

23.5.2.2 Noise and Vibration Emissions

Chapter 14 Noise and Vibration in Volume 2 of this EIAR details the methodology and detailed assessment results of potential noise and vibration effects including those on human health. This section provides a summary of the noise and vibration assessment that is of relevance to this chapter.

To reduce disruption to railway services, a significant portion of the construction works on the railway line is required to take place at night. Unfortunately, as a consequence of this requirement there will be significant construction noise during the night, weekends and/or during public holidays which will impact residential amenity and communities adjoining or in proximity to the works locations. The works are also likely to cause nuisance and disturbance to those close to the construction sites, compounds and along haulage routes many of which are adjacent to sensitive residential receptors. The extensive night-time construction works programme is likely to cause sleep disturbance and nuisance factor. Significant noise effects will be experienced by those located along the full extent of the railway line during the piling activities associated with construction of the foundations for the poles to support the overhead electricity lines which will take place during night (to facilitate the continued operation of railway services). Additionally, disturbance is likely to occur during the installation of the all piling works for level crossing replacements and at the proposed Spencer Dock Station. The magnitude and duration of the potential impacts on sensitive receptors depends on the nature and location of these works along the extent of the proposed development.

The Noise and Vibration assessment in Chapter 14, Volume 2 of this EIAR has concluded that as the construction phase is short-term, any elevated levels of noise will be of limited duration and, as a result, are not expected to pose significant risk to human health.

In terms of the noise exposure of construction workers and potential hearing damage that may be caused due to exposure to high levels of noise, the Safety, Health and Welfare at Work (General Application) Regulations 2007 (Statutory Instrument No. 299 of 2007) provides guidance in terms of allowable workplace noise exposure levels for employees. The Regulations specify two noise Action Levels at which the employer is legally obliged to reduce the risk of exposure to noise. The appointed contractor will be required to comply with the Regulations and provide appropriate noise exposure mitigation measures where necessary.

With the application of the mitigation measures proposed in Chapter 14 Noise and Vibration of this EIAR, the potential impacts on the noise environment and residential amenity of communities is *negative, moderate to profound, brief to temporary to short-term impacts.*

Vibration

The range of activities with the greatest potential to generate vibration will be at level crossing closures, track lowering and linear work areas during piling for OHLE installation. The assessment in Chapter 14, Noise and Vibration assessed the impact and requires that any activities undertaken at the construction sites will be required to operate below the vibration limits set. Vibration impact will be experienced by humans during certain works which will result in *significant, negative, brief to temporary* vibration impacts. With the implementation of vibration mitigation and monitoring measures outlined in Chapter 14 the residual impact of vibration during construction will be *negative, slight to moderate and brief to temporary* depending on location. All construction activity will be carried out within the human response vibration thresholds specified in Table 14-24 in Chapter 14 in Volume 2 of this EIAR.

23.5.2.3 Emissions to Hydrology

Flood Risk

There is the potential for flood events to occur during the construction phase. The construction works will increase the number of people near known sources of flooding, thus increasing the potential for flood risk related impacts on human health. The risk is reduced due to the relatively predictable nature of the flooding within the study area e.g., systems are in place to monitor and warn against extreme tidal events. No significant impacts are likely on human health from flood risk during the construction stage after the implementation of the flood risk management measures inherent in the design and as detailed in Chapter 10 of this EIAR.

Water Quality

Potential impacts on water quality during the construction phase arise from elevated silt/sediment loading within watercourses from construction site runoff, spillage of concrete, grout and other cement-based products and accidental spillage of hydrocarbons from construction plant and refuelling operations. There are no drinking water supplies likely to be affected during construction works. Therefore, no significant impacts are likely on human health as a result of potential water quality impacts during the construction stage.

The Royal Canal and River Liffey are used for recreational purposes. While not officially bathing waters, people do swim and/or recreate in these water bodies. During construction works there is potential for elevated levels of siltation etc., affecting water quality. Access to the Canal/ River will be restricted to the public during these construction periods and therefore there is no source pathway to impact human health.

23.5.2.4 Emissions to Hydrogeology

Chapter 11 Hydrogeology assessment assessed the potential impacts of the proposed development on particularly important groundwater receptors including the water supply boreholes. The assessment determined that it is not likely for a potential impact mechanism between the proposed works and the groundwater supply boreholes during the construction stage. Therefore, there will be no human health effects.

23.5.2.5 Emissions to Soil/ Contaminated land

At Connolly Station, the removal of contamination from bricks and joints is required in the vaults area leading to the new Preston Street entrance. This will require specialist conservation knowledge and training as well as measures to work in a confined space.

The Land Quality Management / Chartered Institute of Environmental Health Suitable 4 Use Limits (S4Uls) Human Health Risk Assessment provides a framework for assessing the suitability of materials to be reused within a project site despite exceedances in soil geochemical constituents but dependent on the setting and associated source-pathway-receptors. Implementation of assessments in accordance with these criteria will be used to identify uses elsewhere within the site boundary that can be achieved with materials that would otherwise have to be sent to landfill if removed from the site.

There is a potential of localised contamination from construction materials leaching into the underlying soils due to exposure, dewatering or construction related spillages resulting in a permanent negative impact on the soils. There is also the potential for hydrocarbon release during construction works and the use of vehicle and construction plants, which may contaminate the soils. In the case of soils, the impact is *negative and slight* as the requirement of good construction practices will necessitate the immediate excavation/remediation of any such spillage resulting in a very low risk of pollution to the soils and consequently the underlying aquifers and any potential effects to human health.

No significant impacts are likely on human health during the construction stage after the implementation of the mitigation measures inherent in the design and as detailed in Chapter 9 (Land and Soils) of this EIAR.

23.5.2.6 Emissions due to Electromagnetic effects and Stray Current

Electromagnetic emissions from the construction phase of the project will not differ from a typical large-scale construction project. The largest sources of elevated baseline levels in the AC range will be in the immediate vicinity (within 5 m) of onsite generators used to power electronic tools and lighting. Levels will not exceed public exposure guideline limits outside of the construction works. No likely significant effects on human health have been identified during the construction phase of the proposed development.

23.5.2.7 Collisions / Risks of accidents

Construction activities may increase the risk of collisions due to an increase in the number of movements of HGVs entering and exiting from the construction compound and on haulage routes, especially those located in a heavily trafficked urban environment. Vulnerable groups e.g., the very young, elderly, sick and people with disabilities are likely to be more at risk in this respect.

The successful contractor will be required to prepare a Construction Traffic Management Plan (CTMP) in advance of the commencement of works, to ensure the safety of site personnel and members of the public and minimise construction phase-related traffic delays and disruptions. The proposed development is not likely to significantly increase the risk of accidents and collisions.

Construction workers will be exposed to a risk of potential accidents occurring while working at heights, and at or near water. The EOP will be required to address these risks and detail measures to address health and safety risks as appropriate. Overall, *negative, not significant, temporary to short-term* effects during the construction phase are predicted.

23.5.2.8 Psychosocial effects

Assessment of the psychosocial effects includes consideration of the potential for nuisance effects and anti-social behaviour. There is likely to be short-term nuisance during all stages of construction particularly along the railway corridor during the daytime and night-time construction programme which will impact the community particularly residential properties and commercial properties, and road/ rail users located in proximity the respective construction works, construction compounds and along haulage routes.

Construction works outside of the existing railway corridor, namely at locations of the proposed Spencer Dock Station, the proposed depot and the six-level crossing closures and infrastructure replacements will likely generate the significant nuisance due to the scale of the significant infrastructure works required during the associated construction durations as detailed in Chapter 5.

The night-time construction works within the existing railway corridor will cause significant nuisance to neighbouring properties, the impacts of which have been assessed in Chapter 14 Noise and Vibration in Volume 2 of this EIAR. The potential ranges from moderate to profound in magnitude across the six zones, where profound impacts are likely in Zone F due to the rural nature of the baseline environment. However as these will be temporary to short-term in nature, they effect with be *negative, and reversible*.

The community and rail users will also experience annoyance from the temporary impacts of traffic management and other effects during the construction phase. Whilst individual annoyance cannot be discounted, annoyance in itself is not a health effect. There is no evidence that there are any significant effects on human health from transient levels of annoyance. In these circumstances the negative impacts are assessed at *slight*. In addition, while there may be positive impacts of reduced annoyance for those not stuck in traffic there is little evidence of positive impacts on human health and the positive impact is assessed also as *slight*. Overall, it is considered that the construction phase of the proposed development will not result in any significant psychosocial effects as a result of the proposed development.

There is potential for anti-social behaviour in the form of trespass and theft to arise on construction sites. All areas will be provided with suitable fencing/hoarding and appropriate security which will be monitored by the contractors. No significant effects are likely to arise.

23.5.2.9 Physical activity

During the construction stage there will be modifications to the existing road and rail network including temporary or short-term modifications to existing walking and cycling routes, access to train station platforms, public spaces and along the Royal Canal towpath which will result in inconvenience to pedestrians and cyclists resulting in *slight to moderate, negative temporary to short-term* impacts.

23.5.3 Potential Operational Impacts

This section assesses the 'Do-Something' scenario of the proposed development during the operational phase on human health. There is little evidence in the general body of medical literature regarding human health impacts associated with the electrification of railways or railways in general. This is likely to be a result of absence of significant negative effects and the recognition of the overall societal benefits of having an effective, clean and modern public transport system.

Bridge Parapet Heightening

The inclusion of the parapet heightening works at road bridges and footbridges will likely impact on the journey amenity of road users and ensures safety of the users over the new overhead lines. The effect on journey amenity for road users including pedestrians is positive*, slight, and permanent.*

Overhead Lines

The inclusion of the overhead lines will likely impact on the rail safety considerations and journey amenity of all road and rail users. The operations of overhead lines are governed by strict regulations and maintenance requirements and will ensure they are operated safely and protected against from contact with the public. Therefore, no significant effects are likely.

23.5.3.1 Emissions to Air

Air quality will be impacted by both the changes to the road and rail transport network. The proposed development will see the electrification of the rail network in this area which will result in a reduction of the emissions to air associated with diesel-powered fleet and there will be a net benefit to air quality including climate change criteria. The proposed development is beneficial, with reductions in emissions of all pollutants modelled. The majority of these reductions result from the shift from diesel units to electric rail units.

A reduction in mass NO_x emissions will contribute to a reduction in NO_2 concentrations at key locations such as Glasnevin where baseline monitoring recorded exceedances in NO_2 concentrations. As well as the direct impact of change of fuel, the provision of a more frequent and reliable rail service is expected to reduce the reliance on the private car which is one of the most significant emitters of NO_2 in urban areas. Chapter 12 of this EIAR details the air quality assessment and demonstrates that the proposed development will be in compliance with the limit values set for ambient air quality standards.

The project also supports pedestrians and cyclists with the construction of segregated replacement infrastructure at five of the six level crossings, therefore supporting sustainable mobility.

To support the existing maintenance compounds along the route, three new operational maintenance compounds are required:

- An additional facility is proposed at the Navan Road Parkway station.
- The proposed depot will also host a maintenance facility.
- The existing maintenance facility at Docklands will be relocated within the area of the Docklands lands within the ownership of CIÉ.

Should any of the maintenance compounds require storage of materials or other activities that have the potential to generate dust, the dust mitigation measures set out in Chapter 12 and Appendix A12.4 Dust Mitigation in Volume 4 of this EIAR will be utilised. These will ensure operational phase impacts with respect to dust nuisance, health impacts are not significant in the long term. In addition, any maintenance activities on the rail line will also implement the dust mitigation measures set out in Chapter 12.

23.5.3.2 Noise and Vibration Emissions

The proposed development will facilitate the operation of an enhanced rail service between Dublin and Maynooth and M3 Parkway. An increase in operational services has the potential to pose impacts to noise and vibration at the closest properties along the length of the proposed development.

An assessment of the likely increase in operational noise levels has been undertaken at the unattended baseline survey locations detailed in Chapter 14 (Noise and Vibration) Volume 2 of this EIAR. The majority of locations show a slight change in rail noise levels as a result of DART+ West, with some areas experiencing a neutral or positive change. However, there are Noise Sensitive Location (NSLs) where the impact rating is determined as *negative and moderate to significant* within sections of Zone B on the MGWR line between Spencer Dock and Glasnevin and in Zone F which is between Maynooth and the proposed depot. Both of these Zones will experience a negative impact as there will be an increase in rail activity on these sections of the track when compared to the Do-Nothing scenario. Mitigation measures to reduce this impact are presented in Section 14.6 of Chapter 14.

WHO published Environmental Noise Guidelines for the European Region in 2018. The objective of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources. The guidelines present recommendations for each noise source type in terms of L_{den} and L_{night} levels above which there is risk of adverse health risks. However, it should be noted that the WHO guideline values referred to here are recommended to serve as the basis for a policy-making process to allow evidence based public health orientated recommendations. They are not intended to be noise limits and the WHO document states the following regarding the implementation of the guidelines:

> *"The WHO guideline values are evidence-based public health-oriented recommendations. As such, they are recommended to serve as the basis for a policy-making process in which policy options are considered. In the policy decisions on reference values, such as noise limits for a possible standard or legislation, additional considerations – such as feasibility, costs, preferences and so on – feature in and can influence the ultimate value chosen as a noise limit. WHO acknowledges that implementing the guideline recommendations will require coordinated effort from ministries, public and private sectors and nongovernmental organizations, as well as possible input from international development and finance organizations. WHO will work with Member States and support the implementation process through its regional and country offices."*

It is therefore not intended to refer to the WHO guidelines in an absolute sense as part of this assessment and it will be a decision for national and local policy makers to adopt the WHO guidelines and propose noise limits for use. Notwithstanding this the following recommendations are noted from the WHO guidelines:

- For average noise exposure, the WHO strongly recommends reducing noise levels produced by railway traffic below 54 dB L_{den}, as railway noise above this level is associated with adverse health effects.
- For night noise exposure, the WHO strongly recommends reducing noise levels produced by railway traffic during night time below 44 dB L_{night}, as night-time railway noise above this level is associated with adverse effects on sleep.

The recommended noise exposure levels are similar to the absolute levels identified in Chapter 14, however as the proposed development is an existing track already exposed to rail noise it is not practical to achieve these absolute levels in many areas.

As the WHO guidelines are intended to allow policy makers make health-orientated recommendations Chapter 14 has undertaken an assessment of the health effects of the calculated noise levels in terms of prevalence of highly annoyed population using the percentage highly annoyed (%HA) metric and sleep disturbance using the percentage highly sleep disturbed (%HSD) metric based on the community response studies for rail noise on which the WHO datasets are based.

The analysis indicates that depending on the zone the risk of health impact varies. It compares the health impact metrics of the Do-Nothing scenario to the Do Something scenario. This presents the change in potential health impacts as a result of the proposed development. The comparison finds that there are small changes to the health impacts in all zones and changes in noise level are *slight negative and positive depending on the zone*. The potential operational noise impacts identified in Chapter 14 are summarised by EIAR Zone as follows:

- Zone A – Negative, neutral and positive, slight, long-term impact.
- Zone B – Negative, slight, long-term impact.
- Zone C – Negative, neutral and positive, slight, long-term impact.
- Zone D – Positive, slight to moderate, long-term impact.
- Zone E – Negative, neutral and positive, slight, long-term impact.
- Zone F – Neutral to negative, slight, long-term impact.

In summary, the negative noise effect in some locations is due to the overall increase in night-time rail movements, and corresponding noise levels at night, in Zones A and F. In Zone E the negative impact is slight and linked to minor changes in the rail noise levels during the day. Overall, these changes are not likely to impact significantly on human health.

Vibration Effects on Human Health

The proposed development will facilitate the operation of an enhanced rail service between Dublin and Maynooth and M3 Parkway. An increase in operational services has the potential to pose vibration impacts to at the closest properties along the length of the proposed development.

Vibration caused by the dynamic forces between the train wheels and track is a potential source of impact during the operational phase. The vibration assessment in Chapter 14 of this EIAR has found that a similar level of vibration will be generated by both diesel multiple units (DMU's) and electrical multiple units (EMU's). The range of operational vibration levels have been found to be not significant. Therefore, the potential human health impacts from vibration effects are likely to be *not significant*.

23.5.3.3 Emissions to Hydrology

Flood Risk

The separate Site-Specific Flood Risk Assessment carried out for the proposed development identified flood risk areas throughout the development lands. Where development is proposed within areas of flood risk, appropriate flood risk management measures have been adopted. The findings of this SSFRA indicate that flood risk to the proposed development can be managed with negligible effect on flood risk elsewhere.

Water Quality

New surface water drainage networks and Sustainable urban Drainage System (SuDS) are incorporated into the design of the proposed development. There is no significant risk of contamination of surface water quality during the operational stage.

23.5.3.4 Emissions to Hydrogeology

There is no significant risk of contamination of drinking water supplies during the operational stage. Additional data collection and analysis will be undertaken at detailed design stage to assess the impact of the piling and slab work on groundwater flow patterns and will inform potential groundwater flooding impacts at Spencer Dock Station.

23.5.3.5 Emissions to Soils and Geology

The deployment of electrified trains and the consequent reduction of pollution from diesel trains (due to fuel and oil leaks on the tracks) there will no longer be a pathway for this type of contamination to enter the soil (railway line ballast) to a sensitive receptor (i.e., the canal) during periods of flooding. These contaminates do not currently affect human health however the change is likely to result in a *minor beneficial, indirect, slight to moderate, and permanen*t effect to soils and geology of the area.

23.5.3.6 Electromagnetic effects

The proposed development will be an electrified 1,500 voltage Direct Current (DC) rail system. Potential hazards/sources of EMF during the operational phase include the railway itself, substations and associated feeder powerlines. The operation of the system poses the potential for EMI on sensitive receptors including human beings. The following potentially sensitive receptors within 100m study area are considered as part of Chapter 22 of this EIAR and include:

- Local residents and the community.
- Domestic and industrial electrical equipment.
- Telecommunications infrastructure (including wireless radio services).
- Sensitive medical and research equipment.
- Utilities.
- Mainline rail, suburban rail, and light rail system.

The proposed project is required to comply with the requirements of the European Directive on Electromagnetic Compatibility (2014/30/EU), and European Standards EN 50121 (Parts 1-5), which address railway Electromagnetic Compatibility (EMC). In addition, all electrical and electronic products placed on the market or taken into service in the European Union must comply with all applicable directives which include the above EMC Directive, the Low Voltage Directive (2014/35/EU) and the Radio Equipment Directive (2014/53/EU). These directives have been transposed inter alia by S.I. No. 145/2016 - European Communities (Electromagnetic Compatibility) Regulations 2016; S.I. No. 248/2017 - European Union (Radio Equipment) Regulations 2017; S.I. No. 345/2016 - European Union (Low Voltage Electrical Equipment) Regulations 2016.

Further, the proposed development is assessed by reference to the guidelines on limiting exposures to electromagnetic fields as published by the International Commission on Non-Ionising Radiation Protection (ICNIRP) and the EU EMF Recommendation (1999/519/EC) when addressing human health effects.

The EMF Directive specifies limits for human exposure to electromagnetic fields. This level is set from 4,000 µT at DC to 800 µT at 5 Hz. Chapter 22 of this EIAR details the criteria for assessing EMI and Stray current effects on human health. Modelling was undertaken to examine these potential effects and found that the public will not be exposed to levels that exceed the limit values and therefore the significance of the effects arising from DC and near DC magnetic fields for human beings is classed as *imperceptible* with the quality of effect classed as *neutral.* Low level DC and near DC fields well below the limits set out in the EC Recommendation (i.e.<< 40,000 µT) will persist permanently once the traction supply remains energised.

23.5.3.7 Impacts of Collisions / Risks of accidents

The proposed development will permanently close the six existing level crossings at Ashtown, Coolmine, Porterstown, Clonsilla, Barberstown and Blakestown. The removal of the rail-road interface at these locations will eliminate collision risk for vehicular, cyclist and pedestrians at the level crossings barriers, which are shown to be locations where collisions and incidents have occurred. The proposed development will have a *significant positive, permanent* effect on human health due to improvements in road and rail safety.

23.5.3.8 Psychosocial effects

Consideration of the negative psychosocial hazards relating to the proposed development include potential for nuisance, anti-social behaviour and potentially new locations for suicide events to occur.

Suicide events have the potential to create a profound human health impact to those individuals, and to their family and network of friends and unfortunately despite design and measures to deter individuals, these incidents continue to occur on railways. While suicide and attempted suicide is an issue for railways there is no evidence to suggest the presence of a railway increases the risk of suicide in any way. This project is primarily an electrification project on an existing rail network it has been designed to include: anti-climbing, barriers to prevent falling from all bridges including parapet heightening so that the potential of such incidents occurring are reduced as far as is practicable, however not withstanding these measures it is recognises that there is potential for negative effects to occur.

New public infrastructure such as transport corridors, public plazas and rail stations can also provide locations for anti-social behaviour and/ or loitering to occur. While it is recognised that isolated incidents can occur, the proposed development is a generally located on an existing CIÉ land located in Dublin City and suburban locations, as a result it is unlikely that the proposed development would promote significant additional anti-social behaviour. CCTV is included as part of the design at the proposed Ashtown underpass and at existing Stations, the new Spencer Dock Station and plaza, these measures will help monitor and deter anti-social behaviour and potential anti-social loitering in these areas. The project is likely to result in a *slight, negative momentary to brief* effects where these incidents occur.

The proposed DART+ West development will significantly increase rail capacity and frequency along the existing Maynooth and M3 Parkway lines that is currently constrained on the network. It will transport passengers in modernised trains and will cater for the needs of growing communities by providing increased capacity, and particularly during the peak AM and PM commuter periods. The frequency of trains along the rail line will increase from 6 to 12 trains per hour (subject to passenger demand) allowing for more flexible use of the rail service. The combination of increases in frequency and capacity of the rail network will contribute to safer and more comfortable journeys and reduce stress for all passengers.

Commute time unpredictability are found to be significant contributors to elevated stress levels among commuters. Stress has been found to have implications in relation health outcomes as well as mental issues and reducing sources of stress on the transport network is likely to result in *indirect long-term positive* health outcomes.

Overall, there is likely to be positive psychosocial effects on human health and the community due to improved connectivity, particularly communities either side of the railway corridor and for pedestrians, cyclists including tourists as a result of the removal of the road rail interface and associated congestion, capacity improvements and overall sustainable rail modernisation. The modernisation of the railway will also support continued population growth and development, support long-term economic prosperity and associated health outcomes.

There is also likely to be indirect secondary psychosocial effects by facilitating greater social connections and physical activity at stations, on trains and the upgrades to station facilities that include amenity/ public realm areas around stations at the level crossings. The proposed development will have a *significant positive long-term effect* on commuters on the rail and road network within the GDA.

23.5.3.9 Physical activity

The provision of segregated walking and cycling facilities as part of the proposed development, namely at the Ashtown, Coolmine, Porterstown, Clonsilla and Barberstown level crossing will continue to facilitate active travel modes in the area resulting in a *positive, long-term* effect on human health and allow for continued land use and transport integration with the rail network and sustainable modes of travel.

The bridge structures have been designed to be accessible for walkers and cyclists therefore, supporting continued physical activity. However, it is recognised that some of these structures will increase journeys time particularly for vulnerable groups however they will provide a safer route for all road users which will have a significant positive long-term effect on the community.

Blakestown level crossing will be permanently closed and does not include any replacement walking or cycling infrastructure. Chapter 6 Traffic and Transportation assessment found that this level crossing does not indicate sufficient demand for replacement infrastructure. However, the loss of the access will result in severance and loss of access to those who walk or cycle and particularly those who access the Royal Canal towpath at this location, these effects are likely to result in a *negative, moderate*, *long-term* impact for those users.

23.6 Mitigation and Monitoring Measures

This EIA has evolved together with the design process, site visits and public consultation which has allowed for the inclusion of mitigation measures as part of the Design and the Construction Strategy detailed in Chapter 4 and Chapter 5 respectively. A number of the construction and operation stage mitigation measures relating to human health are already defined in the specialist's EIAR chapters, to avoid unnecessary repetition, the applicable mitigation measures relating to effects on human health are summarised below and are required to be cross-referenced in the respective Chapter as appropriate. Chapter 27 of this EIAR collates all mitigation measures contained in this EIAR.

23.6.1 Construction Stage Mitigation

The following mitigation measures will be implemented to mitigate potential impacts on human health during the construction phase:

1. To address potential air quality impacts during the construction phase, the mitigation measures detailed in Chapter 12 Section 12.6.1 of this EIAR shall be implemented in full including the development of air quality management plan (AQMP) before commencing construction works which shall be submitted for approval to the relevant planning authorities.
2. To address noise and vibration effects the mitigation and monitoring measures detailed in Chapter 14 (Noise and Vibration) Section 14.6.1 of this EIAR shall be implemented in full. Some of the key mitigation measures relevant for human health are listed below:
    a. The implementation of the noise monitoring programme proposed in Chapter 14 Noise and Vibration of this EIAR in relation to demolition and construction activities shall be implemented in full.
    b. Piling programmes will be planned so as to control the amount of disturbance in noise and vibration sensitive areas at times that are considered of greatest sensitivity. Noise reduction shall be achieved by implementing the mitigation measures detailed in Section 14.6.1 in Chapter 14 of this EIAR.
    c. The Contractor will be required to be proactive in engaging with the occupants of neighbouring properties and is required to notify occupiers of any works forecast to generate appreciable levels of noise, explaining the nature and duration of the works. Night-works and piling works have the potential to generate the most significant noise impacts. All affected sensitive locations should be notified of planned works in advance of the works progressing. The notification will be required to include a description of the works, the expected duration and details of how to contact the contractor to log complaints.

   d. Hours of Work: consideration should be given to the scheduling of activities in a manner that reflects the location of the site and the nature of neighbouring properties. Each potentially noisy event/activity should be considered on its individual merits and scheduled according to its noise level, proximity to sensitive locations and possible options for noise control.
   e. Undertake noise control audits including reports on monitoring at regular intervals throughout the construction programme particularly close to sensitive residential properties.
3. To address potential flood risk and water quality impacts to human health the mitigation and monitoring measures detailed in Chapter 10 of this EIAR shall be implemented in full.
4. Appropriate signage and safety barriers shall be erected along the Royal Canal in advance and during the canal dewatering works.
5. Hydrogeology mitigation and monitoring measures detailed in Chapter 11 of this EIAR shall be implemented in full including the mitigation measures for protecting the groundwater quality resource.
6. To address potential impacts from contaminated land or materials, the land and soils mitigation and monitoring measures detailed in Chapter 9 of this EIAR shall be implemented in full. Furthermore, the contractor(s) will ensure appropriate education, training and licences are in place to handle all waste materials including all hazardous waste materials to ensure the safety of workforce and the surrounding population.
7. Traffic/collisions/ safety:
   a. Construction Environmental Management Plan: Prior to any demolition, excavation or construction, a Construction Environmental Management Plan (CEMP) will be produced by the successful contractor. The CEMP will set out the Contractor's overall management and administration of the construction project. The CEMP will be prepared by the Contractor during the pre-construction phase to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the CEMP, Environmental Operating Plan (EOP) and the Construction and Demolition Waste Management Plan (CDWMP). These shall include measures to address working on an active railway, working in water, working from heights and working with electricity.
   b. Construction Traffic Management Plan (CTMP): The successful contractor will be required to prepare a Construction Traffic Management Plan (CTMP) in advance of the commencement of works, to ensure the safety of site personnel and members of the public and minimise construction phase-related traffic delays and disruptions.
   c. Implement all mitigation measures specified in Chapter 6 Traffic and Transportation
8. Stakeholder Communication Plan**:** CIÉ will develop and maintain a stakeholders list and agree on the communication strategy with residents/landowners/occupiers in advance of construction works commencing.

With the application of the mitigation measures identified in this section along with those specific mitigation measures in this EIAR that interact with human health, impacts will be avoided, reduced and/ or mitigated so as to limit the likely significant effects on human health during the construction stage.

23.6.2 Operation Stage Mitigation

The following mitigation measures will be implemented to mitigate potential impacts on human health during the operation stage:

1. To address potential air quality impacts, should any of the maintenance compounds require storage of materials or other activities that have the potential to generate dust, the dust mitigation measures set out in Chapter 12 and Appendix A12.4 Dust Mitigation in Volume 4 of this EIAR will be utilised. These will ensure operational phase impacts with respect to dust nuisance, health impacts are not significant in the long term. In addition, any maintenance activities on the rail line will also implement the dust mitigation measures set out in Chapter 12.
2. To address operational noise impacts the mitigation and monitoring measures shall be implemented in full as detailed in Chapter 14 (Noise and Vibration) Section 14.6.2 of this EIAR.

3. To address potential hydrogeological impacts the design and operational stage mitigation proposed in Chapter 11 will be implemented in full at detailed design stage.
4. Detailed design will integrate public safety design measures to reduce opportunities of anti-social behaviour and loitering at Spencer Dock Station, Connolly/ Preston Street, existing stations, Ashtown underpass and will utilise attractive design measures, lighting and public realm enhancements particularly as part the level crossing replacements works. As far as practicable these measures shall include:
   a. The use of active and passive surveillance measures.
   b. CIÉ/the design team shall consult with An Garda Síochana and the respective local authority at the detailed design stage.
   c. Appropriate safety lighting on bridges and cul-de-sac at closed level crossings to ensure safety of all road users.
5. Stakeholder Management Plan: Notification of routine maintenance works to properties in vicinity of the railway corridor that are likely to be affected by the works.
6. Ongoing monitoring of noise and vibration levels along the corridor to fully understand effects and take corrective action to reduce effects and ameliorate exceedances of limits impacting neighbouring properties.
7. Preparation and implementation of the Spencer Dock Station flood emergency response plan.

With the application of the mitigation measures identified in this section along with those specific mitigation measures in this EIAR that interact with human health there are no likely significant impacts during the operation stage.

23.7 Residual Effects

Residual effects are those unintended effects after mitigation is applied. Overall, from a health protection and promotion perspective, the project will result in *positive long-term* residual effects to the community due to the development of a modern, electrified railway line resulting in less air, noise, and greenhouse gas emissions to the environment and improved access to services including health related facilities. The sections below discuss residual effects under each of the environmental topics considered in this chapter.

23.7.1 Air quality

There are no residual construction phase dust impacts.

During the operation stage, residual air quality effects are considered to be *positive, significant and long-term*.

23.7.2 Noise and vibration emissions

Construction Stage: Due to the nature of the works, much of which will occur during both the day and night-time there will be construction noise residual impacts which will be *negative, moderate to profound, temporary to short-term (*Refer to Chapter 14, Section 14.7.1 for more details). However, the construction phase is short-term and therefore any elevated levels of noise will be of limited duration and, as a result, are not expected to pose any significant risk to human health.

In terms of the noise exposure of construction workers and potential hearing damage that may be caused due to exposure to high levels of noise, the Safety, Health and Welfare at Work (General Application) Regulations 2007 (Statutory Instrument No. 299 of 2007) provides guidance in terms of allowable workplace noise exposure levels for employees. The Regulations specify two noise Action Levels at which the employer is legally obliged to reduce the risk of exposure to noise. The appointed contractor will be required to comply with the Regulations and provide appropriate noise exposure mitigation measures where necessary.

The residual impact of vibration during construction is will likely to be *negative, slight to moderate and brief to temporary* depending on the location.

Operation stage: With the mitigation measures applied as recommended in Chapter 14 of this EIAR, the residual rail noise impact during the operation of the proposed development was recalculated and compared over the day and night noise levels in the affected NSL in Zones B and F to determine the degree of significance of the impact. The assessment determined that the Do Something rail noise levels (DART+ West) with mitigation are equivalent to or less than the prevailing ambient baseline in Zone B which measures all noise sources in the environment however, the residual impact is likely to be *negative, slight and long-term*.

In Zone F, after the mitigation is applied it results in reductions of up to 11dB at locations adjacent to the noise barrier. It is therefore concluded that the residual impact in Zone F is likely to be *negative, slight and long term*.

23.7.3 Hydrology

Water quality

Following the implementation of the measures outlined in the Environmental Operating Plan in Appendix D of Appendix A5.1 in Volume 4 of this EIAR, there is will likely to be a *negative, slight, temporary* residual effect on water quality during the construction phase of the proposed development.

Flood Risk

Following the implementation of the mitigation measures during the construction phase it will limit impacts of flood risk events, with weather warnings and other mitigation the potential impacts to human health are not likely to be significant.

Recreational and amenity waters

The use of the canal upstream and downstream of Ashtown will be prohibited during the works. The impact is short-term and not significant.

23.7.4 Hydrogeology

There will be imperceptible residual effects to the hydrogeological environment which is not likely to impact human health.

23.7.5 Soil/Contaminated land

After mitigation is applied there will be imperceptible residual effects to human health.

23.7.6 Electromagnetic effects and stray current

As stated in Chapter 22 of this EIAR, after the construction and commissioning of the proposed development locations within 100 m of the line may not be suitable for the installation of equipment sensitive to DC and quasi-DC magnetic fields without the implementation of some of the mitigation measures discussed in Chapter 22. There will be no likely significant effects to human health.

Despite applied mitigation measures to minimise the magnitude of stray current, it is an inevitable phenomenon associated with DC rail systems. Continued monitoring of the performance of the traction circuit with respect to current returns to the substation will be required. There will be no significant impacts to human health.

23.7.7 Psychosocial effects

There is potential for the proposed development to have wider positive societal health promotion effects that may be associated with public transport infrastructure. Namely due to the increased frequency and reliability

of public transport services in turn, providing improved access to employment centres and educational and social facilities along these corridors. The effects would be particularly positive for students, the elderly, and lower socio-economic groups. There is a potential for greater access to health prevention and promotion facilities including hospitals, health care facilities, amenities areas, as well as supporting economic development across a wider area which could also have positive psychosocial effects and improve social cohesion.

23.7.8 Physical activity

The proposed development will also remove potential sources of conflict and congestion at the level crossings and provide safer walking and cycling infrastructure at these locations. Reduced congestion at level crossings will decrease road traffic in these areas and promote walking and cycling that is integrated with public transport, the overall residual effect will be *positive and long-term* on physical activity.

23.8 Cumulative Effects

The cumulative assessment resulting from the many minor or significant effects resulting from the entirety of the project is assessed in each of the specialists' chapters as appropriate. Overall, the cumulative effects as a result of the proposed development is likely to be *positive, slight and long-term* cumulative effects on the human health due to improvements in the public transport infrastructure including a safer, more frequent, reliable, cleaner and energy efficient transport system. (The cumulative assessment of relevant plans and projects is undertaken separately in Chapter 26 of this EIAR.

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