BALLINA FLOOD RELIEF SCHEME EIAR

Chapter 8: Human Health

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8.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) assesses the potential population health impacts relating to the construction and operation of the proposed Ballina Flood Relief Scheme (the 'Proposed Scheme').

The assessment of human health in Environmental Impact Assessment (EIA) takes a public health approach, meaning it reaches conclusions on the health outcomes of defined populations, rather than the health outcomes of individuals. Guidance explaining this approach is set out is **Section 8.2.1**.

This chapter has been prepared by RPS and meets the EIA requirements in relation to assessing the likely significant, beneficial and adverse effects of the Proposed Scheme on human health. Details and competencies of the lead specialist who prepared this chapter can be found in **Chapter 1: Introduction**.

The potential for the Proposed Scheme to affect population health outcomes may arise from various health pathways. Potential effects on physical and mental health link to impacts discussed throughout this EIAR. In particular, the health assessment draws inputs from the following chapters:

- Chapter 5: Project Description
- Chapter 6: Traffic and Transportation
- Chapter 7: Population
- Chapter 14: Climate
- Chapter 15: Noise and Vibration
- Chapter 21: Risk of Major Accidents or Disasters

The health assessment takes as its input the residual effect conclusions of the EIAR technical chapters listed above. In this regard the health assessment relies on the mitigation measures set out in those chapters and does not repeat them. This avoids duplication and keeps the assessment proportionate.

Furthermore, the scope of this Human Health chapter has been kept proportionate, considering only those determinants of health with the potential for likely and significant population health effects. The issues covered by this assessment are listed in **Section 8.2.6**.

8.2 Methodology

8.2.1 Legislation and Guidance

The following legislation in **Table 8-1** is relevant to the assessment of the effects on human health.

Table 8-1: Health Legislation

Legislation	Description
The EIA Regulations 2018 (Government of Ireland 2018)	Sets the requirement to consider the likely significant effects on human health
• The Safety, Health and Welfare at Work etc Act 2005 (as amended) (Government of Ireland, 2005) • Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2016 (S.I. No. 36 of 2016); • Safety, Health and Welfare at Work (Construction) (Amendment) Regulations 2021 (S.I. No. 528/2021). • The Safety, Health and Welfare at Work (Diving) Regulations 2018	Sets out general duties on employers, including ensuring, so far as is reasonably practicable, that employees and individuals at the place of work who are not employees are not exposed to risks to their safety, health or welfare.

Legislation	Description
The Environmental Protection Agency Act 1992 (as amended) (Government of Ireland, 1992)	Governs environmental exposures, including provisions in relation to nuisance.
The Air Quality Standards Regulations 2011 (Government of Ireland, 2011)	Sets the regulatory thresholds for air quality. These are the standards considered acceptable in terms of public health protection in the Republic of Ireland.
Environmental Noise Regulations 2018 (as amended) (Government of Ireland, 2018b)	Sets a common approach to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise.

The following guidance in **Table 8-2** has informed the assessment.

Table 8-2: Health Guidance

Guidance	Description
Institute of Environmental Management and Assessment (IEMA) 2022 guidance on health in EIA series, effective scoping (Pyper et al., 2022a) and determining significance (Pyper et al., 2022b).	EIA practitioner guidance on assessing human health, applicable to Republic of Ireland and Northern Ireland. Guidance sets out principles and methods of assessment.
Institute of Public Health (IPH), Guidance, Standalone Health Impact Assessment and health in environmental assessment, 2021 (Institute of Public Health, 2021).	Sets current good practice for the assessment of human health in EIA, including assessment methods. This updates the 2009 guidance from the IPH.
International Association for Impact Assessment (IAIA) and European Public Health Association. A reference paper on addressing Human Health in EIA (International for Impact Assessment & European Public Health Association, 2020) and academic discussion of the same (Cave et al., 2021).	This international consensus piece informed the IPH 2021 guidance. The publication explains EIA for public health stakeholders and sets out transparent assessment approaches adopted by the IPH.
International Association for Impact Assessment. Health Impact Assessment International Best Practice Principles, 2021 (Winkler et al., 2021).	Confirms the relationship between HIA and EIA. Confirms the application of HIA principles when undertaking health in EIA.
Environmental Protection Agency. Guidelines on the information to be contained in Environmental Impact Assessment Reports (Environmental Protection Agency, 2022).	The EPA present a health protection position statement on the coverage of health in EIA. The wider public health remit is covered by the IPH 2021 guidance.

In addition, due regard was given, as appropriate, to World Health Organization advisory guidelines, e.g. World Health Organization, (2021) and World Health Organization, (2018). The application of such guidelines for health in EIA is described by IEMA (Pyper et al., 2022b), IPH (Pyper et al., 2021) and Cave et al. (2021).

8.2.2 Policy Context

The following policies are associated with the Human Health Assessment:

- National Planning Framework (NPF) (Government of Ireland, 2018c)
- National Development Plan 2021 - 2030 (Department of Public Expenditure, NDP Delivery and Reform, 2021)
- Healthy Ireland Framework (HIF) (2019-2025) (Department of Health, 2019)
- Health Services Healthy Ireland Implementation Plan 2023-2027 (HSE, 2023)
- Roadmap for Social Inclusion (2020-2025) (Government of Ireland, 2023)
- Mayo County Development Plan 2022-2028 (Mayo County Council, 2022)
- Ballina Town & Environs LAP 2021-2027 (MCC, 2021)

- Ballina Local Area Plan 2024-2030 (MCC, 2024)
- Healthy Mayo Strategic Plan 2020-2023 (Mayo County Council, 2021)

8.2.2.1 National Planning Framework

The NPF states that "*Good access to a range of quality education and health services, relative to the scale of a region, city, town, neighbourhood or community is a defining characteristic of attractive, successful and competitive places. Compact, smart growth in urban areas and strong and stable rural communities will enable the enhanced and effective provision of a range of accessible services*" (p.15).

An overarching aim of the NPF is "*Creating a clean environment for a healthy society*" through three main objectives:

- *"Water Quality Recognising the links and addressing on-going challenges between development activity, water quality and our health.*
- *Promoting Cleaner Air - Addressing air quality problems in urban and rural areas through better planning and design.*
- *Noise Management - Incorporating consistent measures to avoid, mitigate and minimise or promote the pro-active management of noise"* (p.117)

Chapter 6, Healthy Communities states that "*decisions made regarding land use and the built environment, including transportation, affect these health risks in a variety of ways, for example through influencing air and water quality, traffic safety, opportunities for physical activity and social interactions as well as access to workplace, education, healthcare and other facilities and services such as food and alcohol outlets*" (p.82).

8.2.2.2 National Development Plan 2021-2030

The National Development Plan (NDP) recognises the importance of both climate adaptation and access to good quality education and healthcare as part of its areas of investment, stating also that infrastructure improvements such as flood relief measures can retain and attract people to the area and help diversify rural economies.

8.2.2.3 Healthy Ireland Framework (HIF) 2018-2023

HIF states that "*many health and wellbeing indicators are affected by individuals' personal lifestyle choices. … The effects of these risk factors can be minimised if individuals can be motivated and supported to make healthier choices. To be effective, action to control the determinants of health must include developing understanding and skills, and promoting informed health choices*" (p.14) (Department of Health, 2019).

"*Those working in non-health sector disciplines and settings such as educationalists, city planners, housing and transport officials, probation officers and welfare officers, also have a critical role to play in improving health and wellbeing*." (p. 26)

This recognises that some of the burden of poor health is due to factors beyond the control of the Proposed Scheme. It also recognises that access to opportunities to be physically active and being able to afford and access health food is paramount to public health. These factors are influenced by the development.

The four goals of Healthy Ireland are relevant and have informed the assessment:

Goal 1: Increase the proportion of people who are healthy at all stages of life

Goal 2: Reduce health inequalities

Goal 3: Protect the public from threats to health and wellbeing

Goal 4: Create an environment where every individual and sector of society can play their part in achieving a healthy Ireland.

8.2.2.4 Health Services Healthy Ireland Implementation Plan 2023-2027

The Health Services Healthy Ireland Implementation Plan 2023–2027 sets out the direction for the Health Service Executive (HSE) in delivering on its role for the implementation of the Healthy Ireland Strategic Action Plan 2021–2025 Action Plan. Reducing health inequalities is highlighted as a priority theme in the in the Plan, in recognition of a pressing need to address health inequalities and place a greater emphasis on promoting healthy living among communities most in need.

The aim of the Plan is to promote and support healthy living and healthy behaviours for all age groups of the population of Ireland. The Plan includes a suite of strategic priorities and actions to support the delivery of the Healthy Ireland Framework vision of enabling the population to enjoy physical and mental health and wellbeing to their full potential. These include embedding health and wellbeing in health service delivery, strengthening partnership and community working, supporting healthy behaviours from childhood through to healthy ageing, and supporting staff personal health and wellbeing.

8.2.2.5 Road for Social Inclusion 2020-2025

The introduction states that *"Education, health, housing, employment and social integration (i.e., a person's sense of "connectedness" with their community) are all factors that contribute to a person's overall sense of wellbeing or welfare"* (p. 10).

8.2.2.6 Mayo County Development Plan 2022-2028

"*The Mayo County Development Plan (2022-2028) sets out the roadmap for the overall proper planning and sustainable development of County Mayo over the plan period*" (p.3). The plan supports and manages the physical, economic and social development of the County, "*in the interest of the overall common good, and in compliance with environmental legislation*" (p.3). The plan advances strategic aims under the cross-cutting themes of sustainable communities, placemaking, social inclusion, regeneration, green infrastructure and climate action; to ensure the needs of citizens, communities, built and natural environments, infrastructure and economic/employment development are met, while also combatting and adapting to climate change.

This assessment has been informed by the strategic aims of the Plan, specifically:

Infrastructural development – "To protect, improve and provide water, wastewater, surface water and flood alleviation services throughout the country" (p.23).

Sustainable Communities – "To develop and support vibrant sustainable communities in Mayo where people can live, work and enjoy access to a wide range of community, health, educational facilities and amenities […] thereby supporting a high quality of life for all to enjoy" (p. 23).

8.2.3 Local Health and Wellbeing Plans

8.2.3.1 Healthy Mayo Strategic Plan 2020 – 2023

The aim of the Healthy Mayo Strategic Plan 2020 – 2023 is to ensure *"A Healthy Mayo, where everyone can enjoy physical and mental health and wellbeing to their full potential, where wellbeing is valued and supported at every level of society and is everyone's responsibility"* (p.6).

8.2.4 Human Health Study Area

The River Moy flows through Ballina and is the main source of flooding in the town. Ballina is located just upstream of the Moy Estuary and the reach of the Moy downstream of the Salmon Weir in Ballina is tidal. The Proposed Scheme includes flood relief measures in Ballina for the River Moy and the following tributaries: Quignamanger Stream, Bunree Stream, Brusna River and the Tullyegan Stream.

The human health study area has regard to localised health effects and wider health effects. Bio-physical health determinants (such as changes to noise exposure) are likely to have a localised impact as potential changes in hazard exposures are limited by physical dispersion characteristics. Social and behavioural determinants (such as changes to community factors) are likely to have both localised and wider impacts.

The study area for baseline statistics relating to health effects focuses on electoral divisions (EDs), with Mayo County and Ireland averages as comparators. Regard is also given to the study areas of other EIAR chapters.

The following geographically defined human health populations are used in the assessment:

- The 'site specific' area of Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED. This is also referred to as the Site Specific Study Area.
- The 'local' area is the local authority of Mayo County.
- The 'regional' area is the province of Connaught in the west of Ireland.
- The 'national' area is Republic of Ireland (and beyond for transboundary effects).

As study areas do not necessarily define the boundaries of potential health effects, particularly mental health effects, the health chapter uses study areas to broadly define representative population groups, including in relation to sensitivity rather than to set boundaries on the extent of potential effects.

The health assessment has regard to the zones of influence defined by other EIAR chapters that are interrelated technical disciplines for the health assessment. Those chapters provide data inputs to the health assessment. Those zones of influence are relevant and inform the health chapter's consideration of effect magnitude.

8.2.5 Data Sources

Data from inter-related technical disciplines have been used to inform the assessment (e.g., **Chapter 15: Noise and Vibration** references to the GeoDirectory). Data informs the health assessment by identifying potential receptors and community assets for these disciplines, such as schools, residential properties, walking and cycling routes, as well as tourism and recreational amenities. No separate health field surveys have been undertaken. The health analysis is informed by scheme-wise consultation.

The following data sources have informed the health baseline assessment:

- Central Statistics Office 2022 Census (Central Statistics Office, 2022a)
- Pobal HP Deprivation Indices 2022 (Pobal, 2023)
- Google Earth Pro 2021 aerial and street level photography

8.2.6 Key Parameters for Assessment

Following guidance on Human Health in EIA (see **Table 8-2**) the following determinants of health are scoped into the health assessment:

- Housing.
- Open space, leisure and play.
- Transport modes, access and connections.
- Employment and income.
- Noise and vibration.
- Wider societal infrastructure and resources.

Justification for the impacts scoped in and out of the assessment can be found in EIA Scoping Report for the Proposed Scheme. Other EIAR technical assessments with the potential to impact human health have been reviewed and it is concluded that they do not require further discussion from a public health perspective.

8.2.7 Assessment Criteria and Significance

8.2.7.1 General Approach

This section sets out the methods for assessment of any likely significant population health effects of the Proposed Scheme.

The generic scheme-wide approach to the assessment methodology is set out in **Chapter 1: Introduction** of the EIAR. This section sets how the generic approach is refined to address the specific needs of the EIA health assessment. Namely criteria for sensitivity, magnitude and significance that inform a professional judgment and reasoned conclusion as to the public health implications of the Proposed Scheme.

Regard has been had to the EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (Environmental Protection Agency, 2022). The guidelines provide generic definitions for significance, but also note that when more specific definitions exist within a specialised factor or topic, these should be used in preference to the generalised definitions. In the case of Human Health, specific definitions are set out by IPH (Pyper et al., 2021) and IEMA (Pyper et al., 2022b).

The methodology outlined in this section primarily follows the IEMA 2022 guidance, which sets out best practice for the consideration of health in EIA. The IEMA guidance was informed by the international consensus publication between impact assessment and public health practitioners: the IAIA/EUPHA Reference Paper (Cave et al., 2020).

Where significant adverse population health effects are identified, including for vulnerable groups, then mitigation has been proposed to avoid or reduce these effects. Mitigation is secured as part of the Proposed Scheme design or development consent. In line with good practice the Proposed Scheme takes a proportionate approach to identifying opportunities to enhance beneficial population health effects, including for vulnerable groups.

Cumulative effects are considered, including inter-related effects of the Proposed Scheme. This analysis considers how the same geographic or vulnerable group populations may be affected by more than one change in relevant health determinants, for example the combined effects of changes in air quality and noise on population health outcomes.

Where proportionate, the need for monitoring has been considered, including relevant governance.

8.2.7.2 Determinants of Health, Risk Factors and Health Outcomes

The chapter uses the World Health Organization (WHO) definition of health, which states that health is a *"state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity"* (WHO, 1948).

The chapter also uses the WHO definition for mental health, which is a *"state in which every individual realises his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community"* (WHO, 2022).

Health and wellbeing are influenced by a range of factors, termed the 'wider determinants of health'. Determinants of health span environmental, social, behavioural, economic and institutional factors. Determinants therefore reflect a mix of influences from society and environment on population and individual health.

Impacts of the Proposed Scheme that result in a change in determinants have the potential to cause beneficial or adverse effects on health, either directly or indirectly. The degree to which these determinants influence health varies, given the degree of personal choice, location, mobility and exposure.

A change in a determinant of health does not equate directly to a change in population health. Rather the change in a determinant alters risk factors for certain health outcomes. The assessment considers the degree and distribution of change in these pathways. The analysis of health pathways focuses on the risk factors and health outcomes that are most relevant to the determinants of health affected by the Proposed Scheme. As there are both complex and wide-ranging links between determinants of health, risk factors and health outcomes, it would not be proportionate or informative for an assessment to consider every interaction.

Typically, the change in a risk factor may need to be large, sustained and widespread within a population for there to be a significant influence on public health outcomes.

8.2.7.3 Population Health Approach and Vulnerable Groups

In line with IEMA and IPH guidance, a population health approach has been taken, informed by discussion of receptors within the other technical chapters of the EIAR. Population health refers to "*the health outcomes of a group of individuals, including the distribution of such outcomes within the group"* (Kindig and Stoddart, 2003).

For each determinant of health, the human health chapter identifies relevant inequalities through consideration of the differential effect to the 'general population' of the relevant study area and effects to the 'vulnerable population group' of that study area. The vulnerable population group is comprised of relevant sensitivities for that determinant of health. The following population groups have been considered:

- The 'general population' including residents, visitors, workers, service providers, and service users.
- The 'vulnerable group population'.

The methods draw on the list of vulnerable population groups set out in the IEMA guide to effective scoping, Table 9.2 (Pyper et al., 2022a). The following six broad population groups are used to inform a consistent narrative on potential health inequalities across the assessment. People falling into more than one group may be especially sensitive:

- **Young age:** Children and young people (including pregnant women and unborn children).
- **Old age:** Older people (particularly frail elderly).
- **Low income:** People on low income, who are economically inactive or unemployed/workless.
- **Poor health:** People with existing poor health; those with existing long-term physical or mental health conditions or disability that substantially affects their ability to carry out normal day-to-day activities.
- **Social disadvantage:** People who suffer discrimination or other social disadvantage, including relevant protected characteristics under the Irish Human Rights and Equality Commission Act 2014 or groups who may experience low social status or social isolation for other reasons.
- **Access and geographical factors:** People experiencing barriers in access to services, amenities and facilities and people living in areas known to exhibit high deprivation or poor economic and/or health indicators.

The assessment covers these populations within two groups: The general population for the geographic area, notably residents of the site-specific area defined in **Section 8.2.4**, and the vulnerable sub-population for this area. The latter is comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The following general characterisations of how the 'general population' may differ from 'vulnerable group populations' were considered when scoring sensitivity. These statements are not duplicated in each assessment and apply (as relevant) to the issues discussed for both construction and operation.

- In terms of life stage, the general population can be characterised as including a high proportion of people who are independent, as well as those who are providing some care. By contrast, the vulnerable group population can be characterised as including a high proportion of people who are providing a lot of care, as well as those who are dependant.
- The general population can be characterised as experiencing low deprivation. However, the professional judgment is that the vulnerable group population experiences high deprivation (including where this is due to pockets of higher deprivation within low deprivation areas).
- The general population can be characterised as broadly comprised of people with good health status. Vulnerable groups, however, tend to include those parts of the population reporting bad or very bad health status.

- The general population tends to include a large majority of people who characterise their day-to-day activities as not limited. The vulnerable group population tends to represent those who rate their day-to-day activities as limited a little or limited a lot.
- Based on a professional judgement the general population's resilience (capacity to adapt to change) can be characterised as high whilst the vulnerable group population can be characterised as having limited resilience.
- Regarding the usage of affected infrastructure or facilities, the professional judgement is that the general population are more likely to have many alternatives to resources shared with the Proposed Scheme (e.g., shared routes or community assets). For the vulnerable group population, the professional judgement is that they are more likely to have a reliance on shared resources.
- The general population includes the proportion of the community whose outlook on the Proposed Scheme includes support and ambivalence. The vulnerable group population includes the proportion of the community who are uncertain or concerned about the Proposed Scheme.

8.2.7.4 Temporal Scope

The temporal scope of the assessment is consistent with the period over which the Proposed Scheme will be carried out and therefore covers the construction and operational periods. It is anticipated that construction will take place over an approximate 36-month period, followed by a 15-month handover period. The design life of the Proposed Scheme is 50 years.

With respect to the duration of impacts, the IEMA (Pyper et al., 2022b) terminology has been used as a guide within this assessment. The terms have been defined by this assessment as follows:

- 'Very short term' relates to effects measured in hours, days or weeks.
- 'Short term' relates to effects measured in months.
- 'Medium term' related to effects measured in years.
- 'Long term' relates to effects measured in decades (e.g., the long-term effects on health from long-term employment).

8.2.7.5 Determining Effect Significance

The assessment of EIA health significance is an informed expert judgement about what is important, desirable or acceptable for public health with regards to changes triggered by the Proposed Scheme. These judgements are value-dependant (underpinned by scientific data, but also informed by professional perspectives); and are context-dependent (judgements reflect relevant social, economic and political factors for the population).

The determination of significance has two stages:

- Firstly, the sensitivity of the receptor affected, and the magnitude of the effect upon it are characterised. This establishes whether there is a relevant population and a relevant change to consider.
- Secondly, a professional judgement is made as to whether the expected change in a population's health outcomes would be significant in public health terms. This judgement is explained using an evidence-based narrative setting out reasoned conclusions.

Table 8-3, **Table 8-4**, **Table 8-5** and **Table 8-6** together summarise the assessment methodology that has been adopted. This approach shows how the general EIA methods of using sensitivity and magnitude to inform a judgement of significance, are applied for human health. The approach uses professional judgement, drawing on consistent and transparent criteria for sensitivity and magnitude. It also references relevant contextual evidence to explain what significance means for human health in public health terms.

The EIA human health assessment uses qualitative analysis following the 2022 IEMA guidance approach (Pyper et al., 2022b). This draws on qualitative and quantitative inputs from other EIAR topic chapters. This reflects the consensus position amongst public health and impact assessment practitioners that qualitative analysis is the most appropriate methodology for assessing wider determinants of health proportionately, consistently and transparently.

The EIA health chapter conclusions are both EIA scores, such as major, moderate, minor or negligible; and a narrative explaining this score with reference to evidence, local context and any inequalities.

Terms in bold in **Table 8-3**, **Table 8-4** and **Table 8-6** indicate terms that qualitatively describe levels within criteria that are discussed across the scoring options. For example, high, moderate, low or very low levels of deprivation. These are the terms from the guidance that are used within the assessment narrative.

Table 8-3: Health Sensitivity Methodology Criteria

Category/ Score	Indicative criteria (judgment based on most relevant criteria, it is likely in any given analysis that some criteria will span score categories) *The narrative explains that the population or sub-population's sensitivity is driven by (select as appropriate):*
High	**High** levels of deprivation (including pockets of deprivation); **reliance** on resources shared (between the population and the project); existing **wide** inequalities between the most and least healthy; a community whose outlook is predominantly anxiety or **concern**; people who are **prevented** from undertaking daily activities; **dependants**; people with **very poor** health status; and/or people with a **very low** capacity to adapt.
Medium	**Moderate** levels of deprivation; **few alternatives** to shared resources; existing **widening** inequalities between the most and least healthy; a community whose outlook is predominantly **uncertainty** with some concern; people who are **highly limited** from undertaking daily activities; people providing or requiring **a lot of care**; people with **poor** health status; and/or people with a **limited** capacity to adapt.
Low	**Low** levels of deprivation; **many alternatives** to shared resources; existing **narrowing** inequalities between the most and least healthy; a community whose outlook is predominantly **ambivalence** with some concern; people who are **slightly limited** from undertaking daily activities; people providing or requiring **some care**; people with **fair** health status; and/or people with a **high** capacity to adapt.
Very low	**Very low** levels of deprivation; **no** shared resources; existing **narrow** inequalities between the most and least healthy; a community whose outlook is predominantly **support** with some concern; people who are **not limited** from undertaking daily activities; people who are independent (not a carer or dependant); people with **good** health status; and/or people with a **very high** capacity to adapt.

Table 8-4: Health Magnitude Methodology Criteria

Category/ Score	Indicative criteria (judgment based on most relevant criteria, it is likely in any given analysis that some criteria will span score categories) *The narrative explains that the change due to the project has (select as appropriate):*
High	**High** exposure or scale; **long-term** duration; **continuous** frequency; severity predominantly related to **mortality** or changes in morbidity (physical or mental health) for very severe illness/injury outcomes; **majority** of population affected; **permanent** change; **substantial** service quality implications.
Medium	**Low** exposure or **medium** scale; **medium-term** duration; **frequent** events; severity predominantly related to moderate changes in **morbidity** or major change in quality-of-life; **large minority** of population affected; **gradual** reversal; **small** service quality implications.
Low	**Very low** exposure or **small** scale; **short-term** duration; **occasional** events; severity predominantly related to minor change in **morbidity** or moderate change in quality-of-life; **small minority** of population affected; **rapid** reversal; **slight** service quality implications.
Negligible	**Negligible** exposure or scale; **very short-term** duration; **one-off** frequency; severity predominantly relates to a minor change in **quality-of-life**; very few people affected; immediate reversal once activity complete; no service quality implication.

Table 8-5: Assessment Matrix (Indicative)

Magnitude of Impact	Sensitivity			
	High	**Medium**	**Low**	**Very low**
High	Major	Moderate or major	Moderate or minor	Minor or negligible

Medium	Moderate or major	Moderate	Minor	Minor or negligible
Low	Moderate or minor	Minor	Minor	Negligible
Negligible	Minor or negligible	Minor or negligible	Negligible	Negligible

Where the matrix offers more than one significance option, professional judgement is used to decide which option is most appropriate.

Table 8-6: Health Significance Methodology Criteria

Category/ Score	Indicative criteria (judgment based on most relevant criteria, it is likely in any given analysis that some criteria will span score categories)
Major (significant)	The narrative explains that this is significant for public health because (select as appropriate): • Changes, due to the project, have a **substantial** effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by referencing relevant policy and effect size (magnitude and sensitivity scores), and as informed by consultation themes among stakeholders, particularly public health stakeholders, that show **consensus** on the importance of the effect. • Change, due to the project, could result in a regulatory threshold or statutory standard being **crossed** (if applicable). • There is likely to be a **substantial** change in the health baseline of the population, including as evidenced by the effect size and scientific literature showing there is a **causal** relationship between changes that would result from the project and changes to health outcomes. • In addition, health priorities for the relevant study area are of **specific** relevance to the determinant of health or population group affected by the project.
Moderate (significant)	The narrative explains that this is significant for public health because (select as appropriate): • Changes, due to the project, have an **influential** effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by referencing relevant policy and effect size, and as informed by consultation themes among stakeholders, which may show **mixed views**. • Change, due to the project, could result in a regulatory threshold or statutory standard being **approached** (if applicable). • There is likely to be a **small** change in the health baseline of the population, including as evidenced by the effect size and scientific literature showing there is a **clear** relationship between changes that would result from the project and changes to health outcomes. • In addition, health priorities for the relevant study area are of **general** relevance to the determinant of health or population group affected by the project.
Minor (not significant)	The narrative explains that this is not significant for public health because (select as appropriate): • Changes, due to the project, have a **marginal** effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by effect size of limited policy influence and/or that **no** relevant consultation themes emerge among stakeholders. • Change, due to the project, would be **well within** a regulatory threshold or statutory standard (if applicable); but could result in a guideline being crossed (if applicable). • There is likely to be a **slight** change in the health baseline of the population, including as evidenced by the effect size and/or scientific literature showing there is only a **suggestive** relationship between changes that would result from the project and changes to health outcomes. • In addition, health priorities for the relevant study area are of **low** relevance to the determinant of health or population group affected by the project.
Negligible (not significant)	The narrative explains that this is not significant for public health because (select as appropriate): • Changes, due to the project, are **not related** to the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by effect size or lack of relevant policy, and as informed by the project having **no responses** on this issue among stakeholders. • Change, due to the project, would **not affect** a regulatory threshold, statutory standard or guideline (if applicable). • There is likely to be a **very limited** change in the health baseline of the population, including as evidenced by the effect size and/or scientific literature showing there is an **unsupported** relationship between changes that would result from the project and changes to health outcomes.

Category/ Score	Indicative criteria (judgment based on most relevant criteria, it is likely in any given analysis that some criteria will span score categories)
	• In addition, health priorities for the relevant study area are **not** relevant to the determinant of health or population group affected by the project.

Population health effects that are scored major or moderate are considered significant.

Ultimately a likely significant health effect is one that should be brought to the attention of the determining authority, as the effect of the Proposed Scheme is judged to provide, or be contrary to providing, a high level of protection to population health. This may include reasoned conclusions in relation to health protection, health improvement and/or improving services.

Where significant adverse effects are identified, mitigation is considered to reduce the significance of such effects. Similarly, enhancements are considered where significant and proportionate opportunities to benefit population health are identified.

8.2.8 Data Limitations

This assessment is based on publicly available statistics and evidence sources. No new primary research or bespoke analysis of non-public data was undertaken for the assessment.

Baseline data includes indicators where the available public data is pre-Covid-19, or that have yet to show the full impacts of the pandemic for public health. The baseline is considered sufficient and robust in evidencing that there are vulnerable population groups with high sensitivity in the study area. New data would be unlikely to change that conclusion as a 'high' sensitivity is already assigned to vulnerable groups, and any new data would not change this.

The health assessment partially draws from and builds upon the technical outputs from other technical chapters of the EIAR. As a consequence, the assumptions and limitations of those assessments also apply to any information used in this chapter (e.g., for modelling work undertaken). It is, however, considered that the information available provides a suitable basis for assessment.

8.2.9 Consultations

Meetings and follow up consultations were arranged with stakeholders at all phases of the Proposed Scheme. There were no specific consultation comments in relation to Human Health.

8.3 Description of the Existing Environment

8.3.1 Baseline Environment

Different communities have varying susceptibilities to health impacts and benefits as a result of social and demographic structure, behaviour and relative economic circumstances. The aim of the following information is primarily to put into context the local health circumstances of the communities surrounding the Proposed Scheme site, drawing from available statistics. Where possible, data has been collected for Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED. Where ED data is not available, data for Mayo County has been used to compare with the national average.

It should be noted that the description of the whole population, and the populations within the local and wider study area, does not exclude the probability that there will be some individuals or groups of people who do not conform to the overall profile.

8.3.1.1 General Health

Based on the 2022 census statistics (Central Statistics Office, 2023a), the general health of the 5 EDs that make up the study area is very good. Consistent with the county and national averages, the majority of residents of all EDs report 'very good' and 'good' health. Less than 1% of residents in all EDs have reported

having ‘very bad’ health, which is consistent with county and national averages. Please see **Table 8-1** for statistics of the general public.

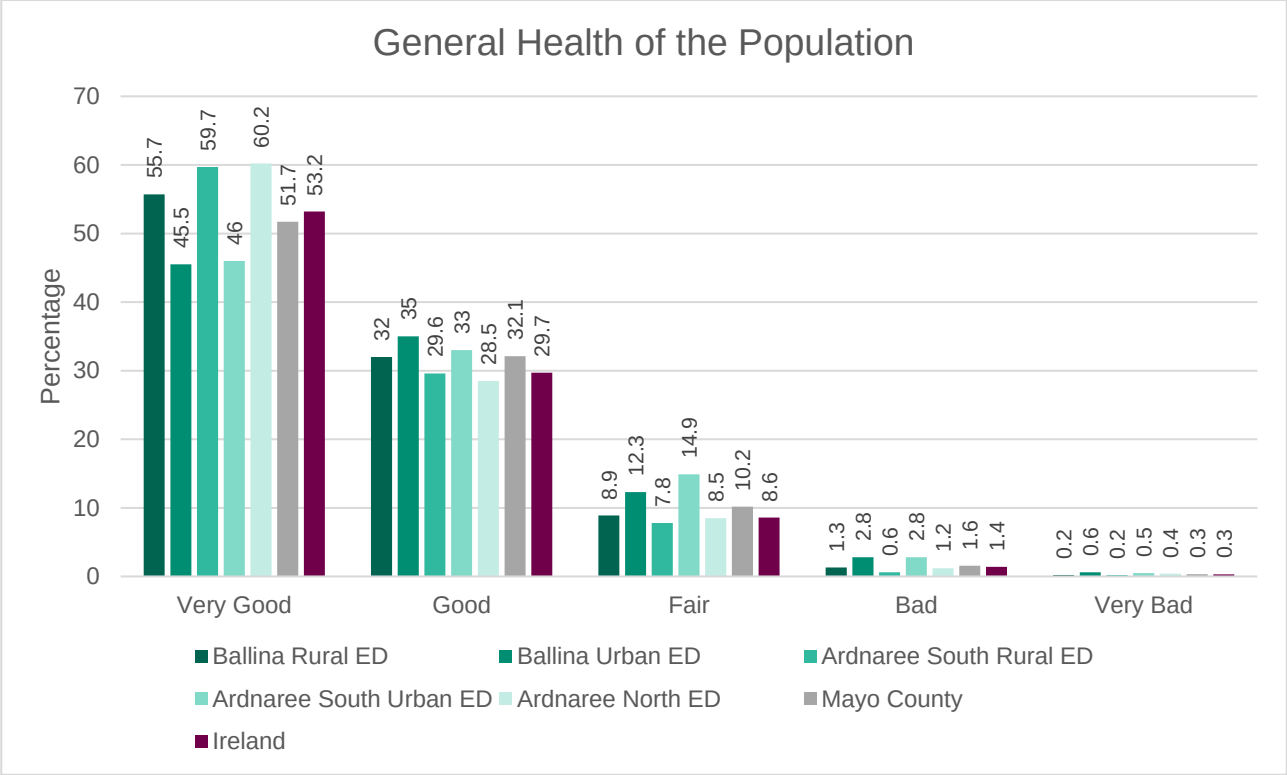

Figure 8-1: General Health of the Population at ED, County and National Level. Census 2022.

8.3.1.2 Life Expectancy

Recent (2021) life expectancy statistics are only available at the national (Ireland) level. Life expectancy in Ireland at birth in 2021 was 80.5 for males and 84.3 for females (Eurostat, 2023a). Life expectancy is increasing with male life expectancy consistently lower than female life expectancy (**Figure 8-3**).

Healthy life expectancy (HLE) statistics (i.e., the number of years a person is in good health) are only available at the national (Ireland) level. Healthy life expectancy for both males and females has been increasing over the past decade (between 2009 and 2019) (**Figure 8-2**) (Eurostat, 2023b).However, there is a decrease in healthy life expectancy for both males and females in 2020, which is likely attributable to the Covid-19 pandemic. In 2021, life expectancy in Ireland was 66.4 for males 68 for females, showing a return to the previously increasing trend.

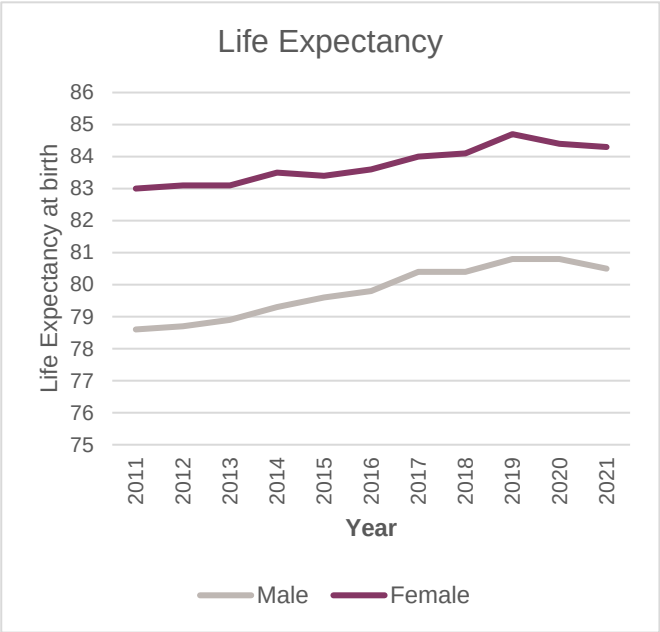

Figure 8-3: Life expectancy in Ireland (EuroStat, 2023)

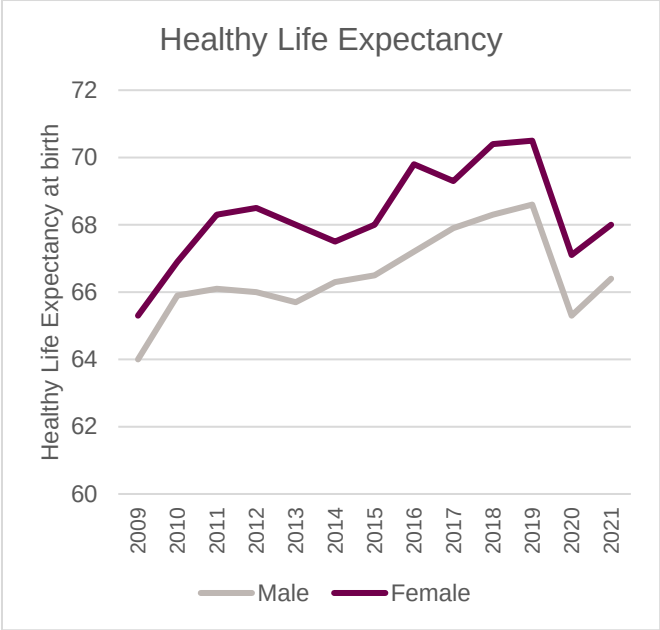

Figure 8-2: Healthy Life Expectancy in Ireland (EuroStat, 2023)

8.3.1.3 Physical Health

Overall, currently available physical health statistics for Mayo County perform similarly to national averages. There is a slightly lower percentage of the population reporting very good health (51.7%) than the national average (53.2%), and a slightly higher percentage of the population reporting good health (32.1%) in Mayo County compared to the national average (29.7%) (Central Statistics Office, 2022b). The percentage of the population reporting bad health in Mayo County (1.6%) and Ireland (1.4%) are comparable.

The rate of procedures on the cardiovascular and respiratory systems in Mayo County is illustrated in **Figure 8-4** and used as proxy for hospital admissions rates for diseases of the circulatory and cardiovascular system (data for the latter are no longer available). The rate of procedures on the cardiovascular system in Mayo County decreased from 115.26 to 114.52 between 2010 and 2021. The rate of procedures on the respiratory system has increased from 65.4 to 75.26 between 2010 and 2021 (Central Statistics Office, 2023b).

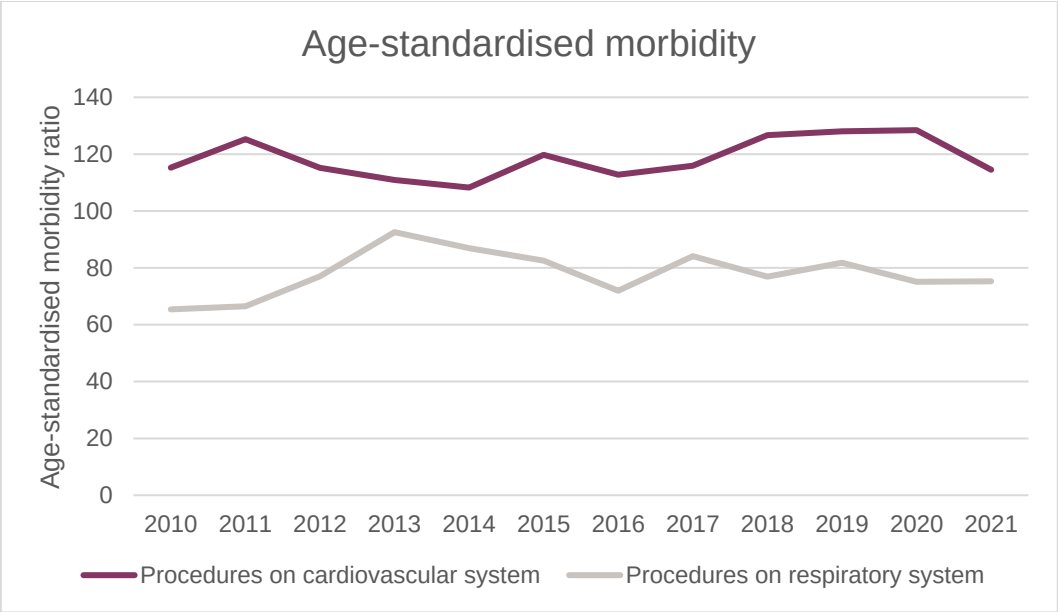

Figure 8-4: Age-Standardised Morbidity Rate for Procedures on the Cardiovascular and Respiratory Systems for Mayo County (Central Statistics Office, 2023)

Overall, the all-age all-cause mortality rate in Mayo County (814.8 per 100,000 population) is higher than the national average (659.6 per 100,000 population) in 2021, and has consistently been higher over the years (Central Statistics Office, 2023c).

Mortality from circulatory diseases is consistently higher in Mayo County than the national average, however it is decreasing (**Figure 8-6**) (Central Statistics Office, 2023c). Similarly, mortality from respiratory diseases has fluctuated and is decreasing but remains higher than the national average, though most recent figures show a decreasing trend (**Figure 8-7**). Cancer mortality has increased slightly over the years in Mayo County, with the most recent available statistics (2021) showing a higher rate in Mayo County (235.2 per 100,000 population) compared to the national average (188.3 per 100,000 population) (**Figure 8-8**).

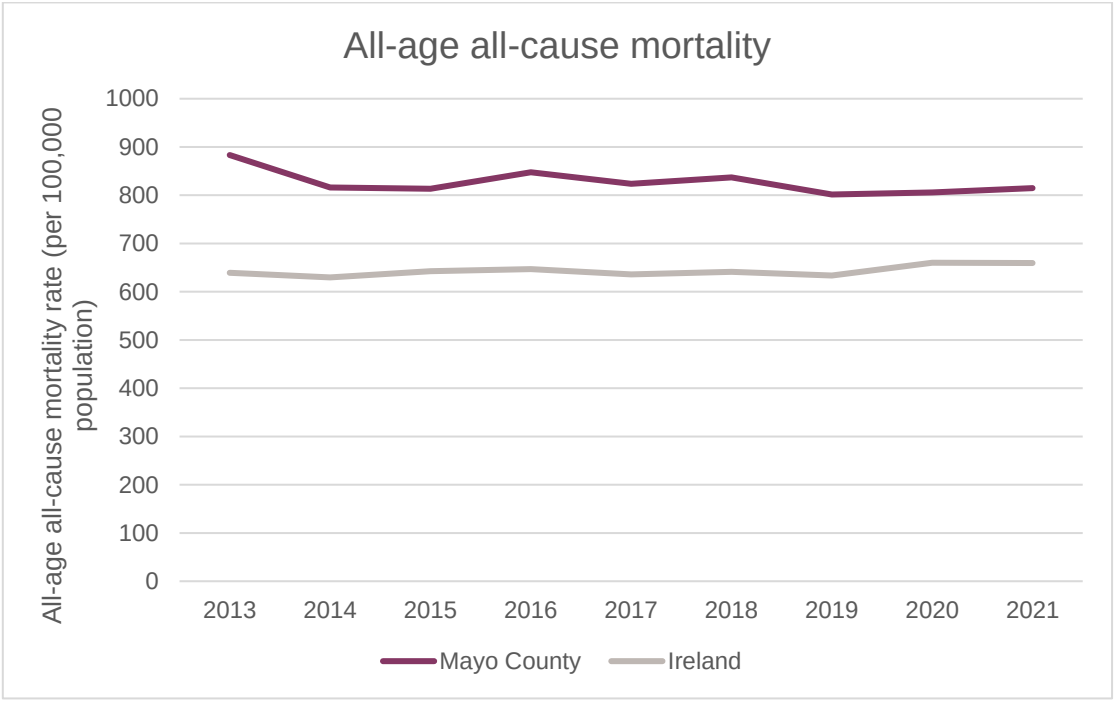

Figure 8-5: All-Age All-Cause Mortality Rate (Central Statistics Office, 2023)

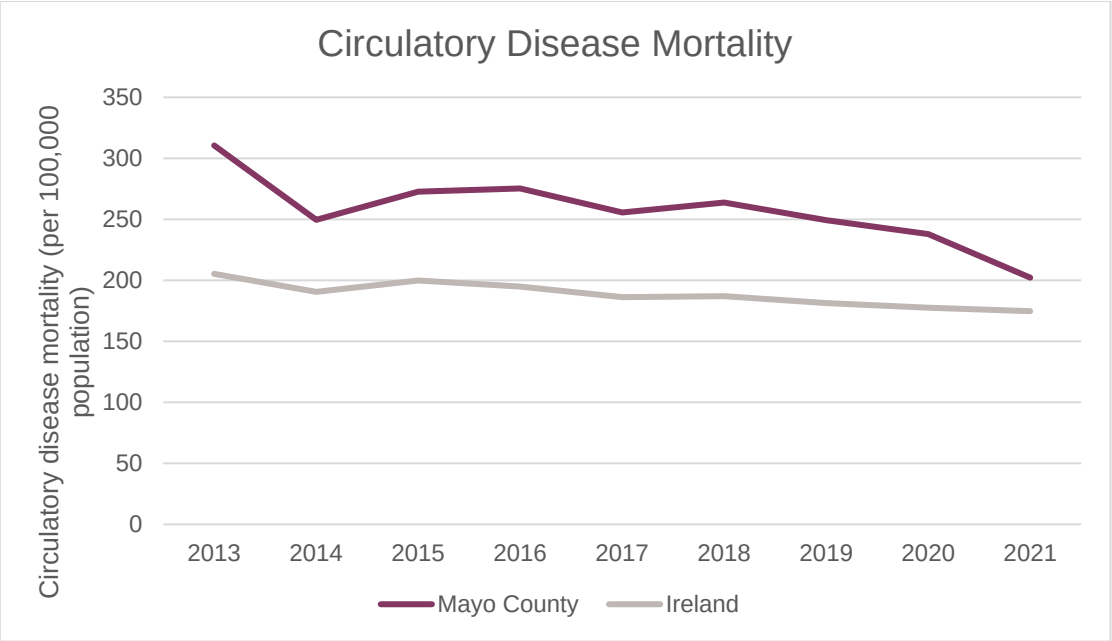

Figure 8-6: Circulatory disease mortality (Central Statistics Office, 2023)

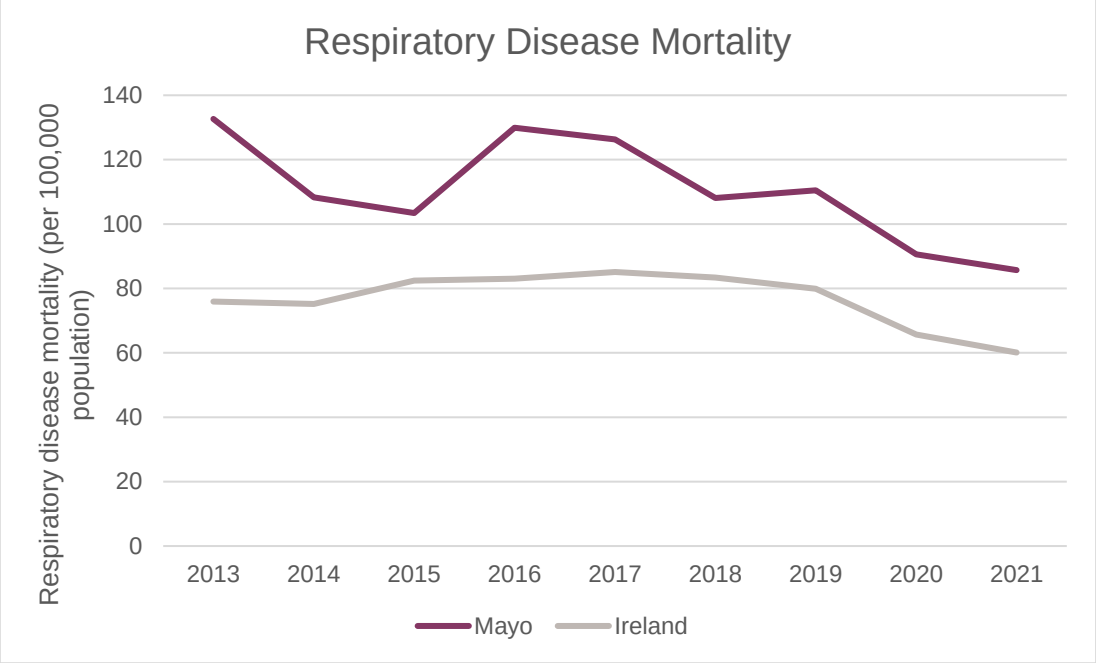

Figure 8-7: Respiratory Disease Mortality (Central Statistics Office, 2023)

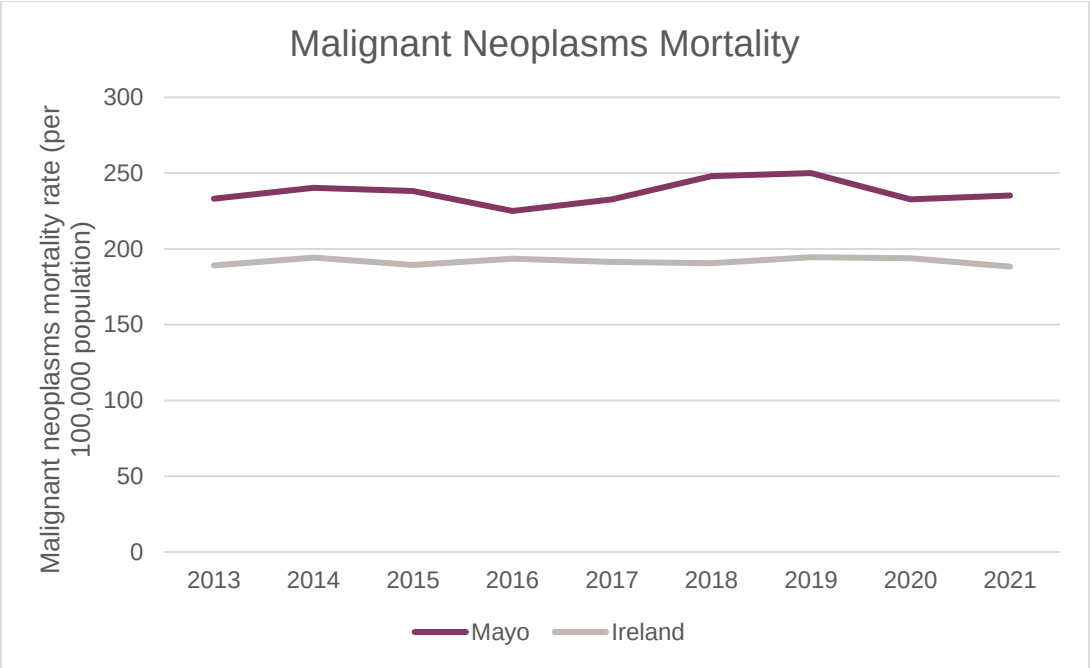

Figure 8-8: Malignant Neoplasms (Cancer) Mortality (Central Statistics Office, 2023)

8.3.1.4 Mental Health

Self-reported mental health status is only reported at the regional and national levels. Accordingly, the West region performs similar to the national comparator. In 2019, the percentage of persons aged 15 years and over that reported to have experienced moderately severe to severe depression is 1% in the West region and 2% in Ireland (Central Statistics Office, 2023d).

Death from mental and behavioural disorders is lower in Mayo County (33.0 per 100,000 population) compared to the national rate (35.1 per 100,000) (Central Statistics Office, 2023c). However, the suicide rate is slightly higher in Mayo County (11 per 100,000 population) compared to Ireland (8 per 100,000 population) (Central Statistics Office, 2023e).

8.3.1.5 Deprivation

Deprivation statistics have been reviewed and taken into account in considering population sensitivity. The Proposed Scheme site is located across five Electoral Divisions (EDs) which were classed in the 2022 Pobal Deprivation Index (Pobal, 2023) as the following: Ballina Rural ED (Marginally Below Average), Ballina Urban ED and Ardnaree South Urban ED (Disadvantaged), and Ardnaree South Rural ED and Ardnaree North ED (Marginally Above Average). There are pockets of greater deprivation at the small area geographic boundary level. Notably small areas 157016008; 157016009; 157016010; 157016011 within Ballina Urban ED to the West of the Proposed Scheme, and small areas 157154002 and 157154011 within Ardnaree South Urban ED to the East of the Proposed Scheme are classified as ‘Extremely Disadvantaged’. Higher deprivation in this community has been taken into account by the assessment in determining the level of sensitivity for vulnerable groups.

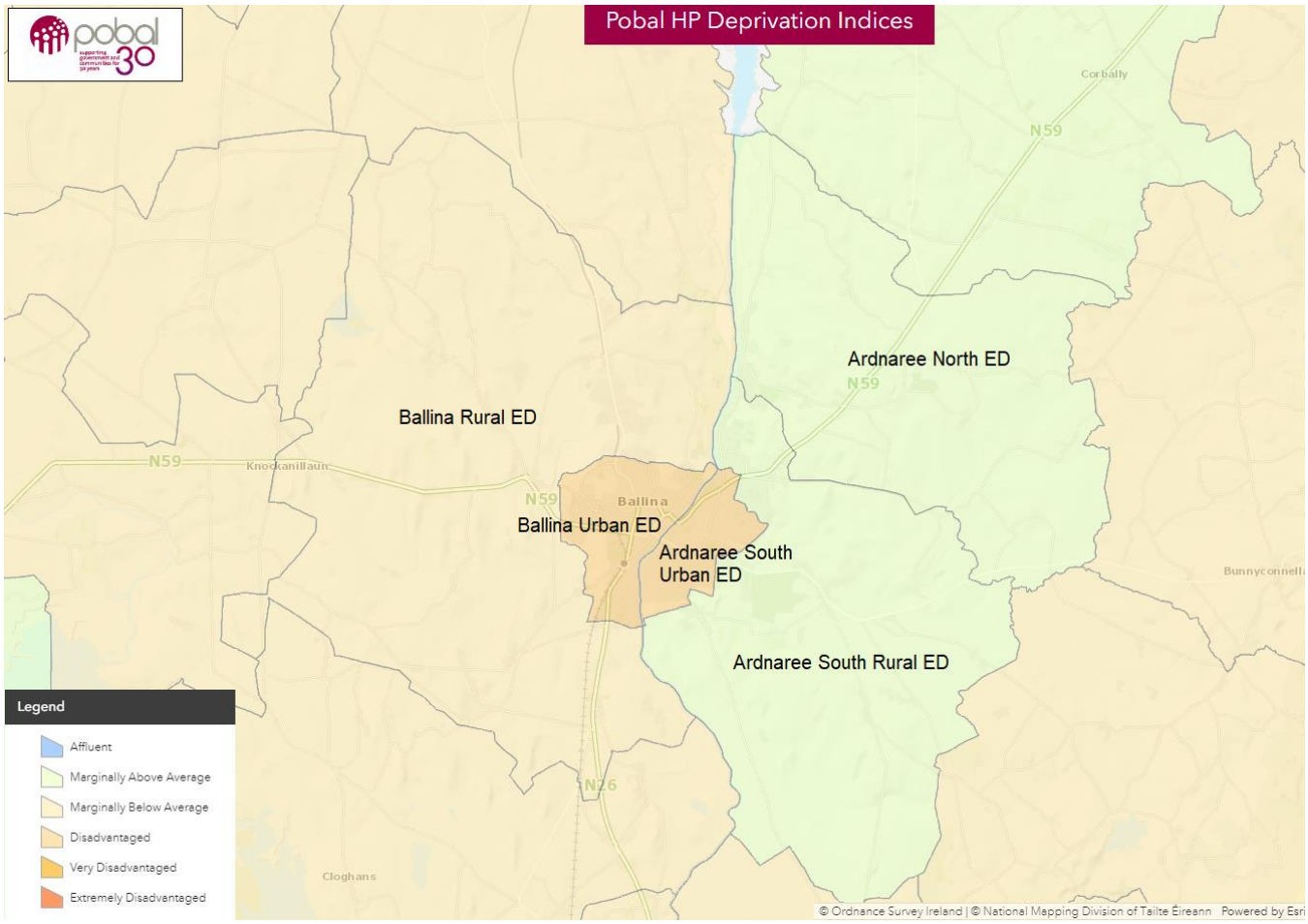

Figure 8-9: Deprivation Map for Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED Showing Overall Deprivation at ED Level (Pobal, 2022)

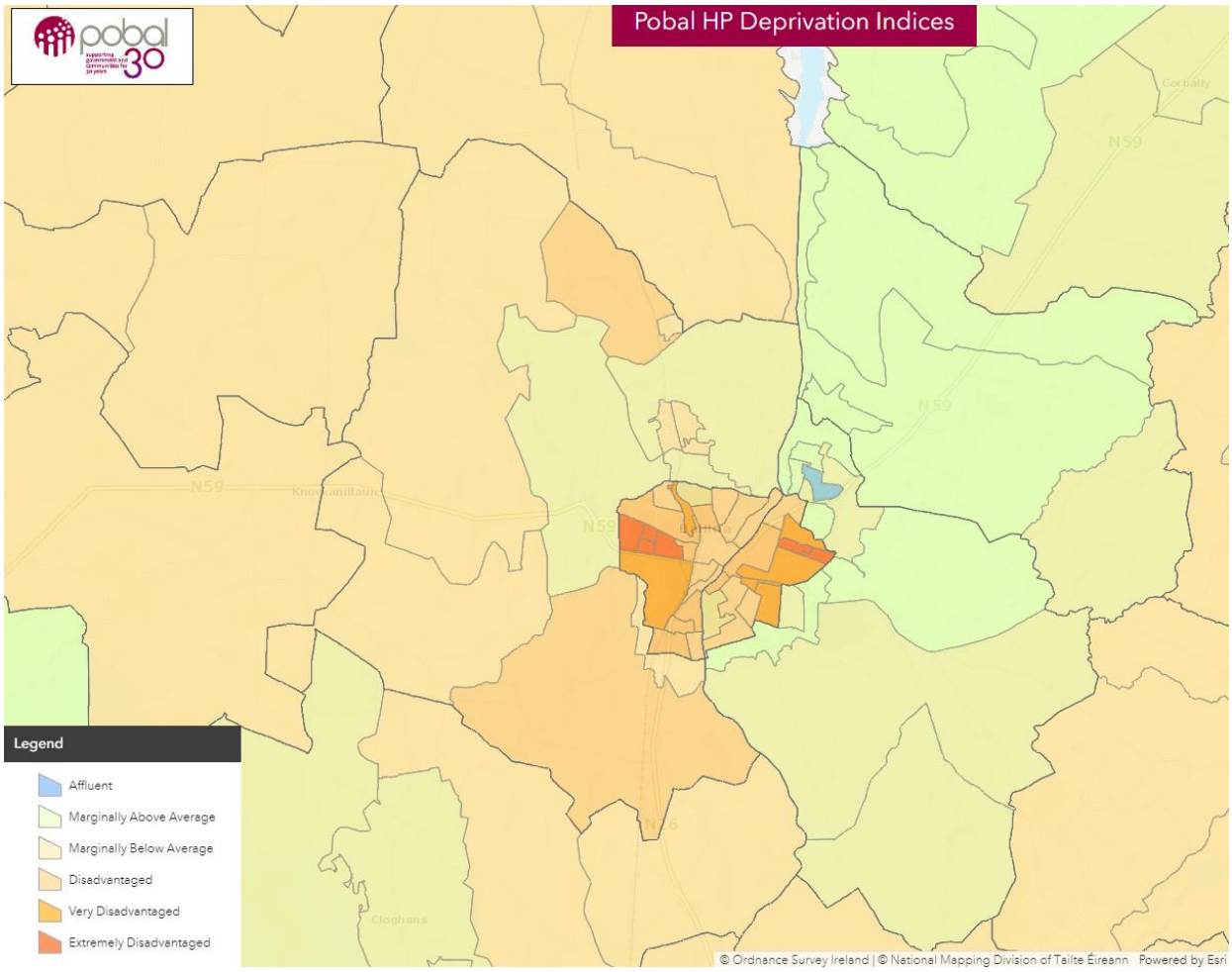

Figure 8-10: Deprivation Map at Small Area Level (Pobal, 2022)

8.3.2 Evolution of the Environment in the Absence of the Proposed Scheme

Longer term trends and interventions in population health may influence the future baseline. Health and social care, public health initiatives and government policies aim to reduce inequalities and improve quality of life. The historic success of such interventions is increasingly challenged by national trends such as an aging population, rising levels of obesity, the COVID-19 pandemic, cost-of-living crisis and climate change. The implications of these pressures for public health will take years to be reflected within statistical data releases, but it is expected that they will exacerbate public health challenges. These factors disproportionately affect vulnerable groups, including due to age and ill-health.

Climate change may exacerbate physical and mental health risk factors, particularly around flooding, extremes of temperature and uncertainty for future generations. The baseline highlights pockets of deprivation which would be most vulnerable to climate change stresses. Typically, low resource groups, e.g., in areas of high deprivation, are most sensitive to the adverse health effects of climate change.

To reflect these trends the assessment scores all vulnerable groups as having high sensitivity for all determinants of health. This appropriately captures any increase in sensitivity within the future baseline.

It would not be proportionate (or consistent with the qualitative assessment approach taken) to quantitatively model the population's future health. This reflects the complexities of interactions between the wider determinants of health, as well as the potential for macro-economic changes in the next decade that are hard to predict. Any prediction would have such wide error margins that it would greatly limit the value of the exercise.

8.4 Description of the Likely Significant Effects

8.4.1 Construction Phase

8.4.1.1 Health and Safety

Construction of the Proposed Scheme has the potential to have safety implications for the general public and workforces.

Construction of the Proposed Scheme will necessitate the presence of construction sites within the town of Ballina, and travel on the local public road network to and from these zones. Construction sites and the machinery used on them pose a potential health and safety hazard to construction workers if site rules are not properly implemented. Any short-term potential significant adverse impact on health and safety is avoided by adherence to statutory health and safety requirements.

The Proposed Scheme will be constructed in accordance with all relevant Health and Safety Legislation, including:

- Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005, S.I. No. 328/2005);
- Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2016 (S.I. No. 36 of 2016);
- Safety, Health and Welfare at Work (Construction) (Amendment) Regulations 2021 (S.I. No. 528/2021); and
- Safety, Health and Welfare at Work (Diving) Regulations 2018.

As confirmed in the IEMA 2022 guidance on health in EIA (Pyper et al., 2022a) paragraph 5.5, occupational health and safety issues are addressed by relevant regulation and this does not require further consideration within the health assessment beyond noting that it helps to mitigate community healthcare implications.

Occupational working conditions include particular risks, which are appropriately managed through health and safety policies and practices. Construction activities for the Proposed Scheme are not expected to differ from industry norms.

8.4.1.2 Open Space, Leisure and Play

This section considers the effects on *open space, leisure and play* during construction of the Proposed Scheme. Supporting people to be active is an important determinant of physical health. Time spent near green and blue space can also positively affect mental wellbeing.

This section has been informed by **Chapter 5: Project Description** and **Chapter 21: Risk of Major Accidents or Disasters** which sets out relevant assessment findings and mitigation measures which have been taken into account.

Salmon fishing is a major component of tourism in Ballina, particularly at the Ridgepool and Cathedral Beat in the centre of the town. It is noted in **Chapter 5: Project Description** that access to the River Moy for recreational activities, walking, angling and fishing is a priority. Access to the River Moy for recreational activities along the Proposed Scheme is required. Access types include vehicular, pedestrian or accessible access. There is potential for construction to affect these activities in the River of Moy. Access to and use of public open spaces, including footpaths, public parks and sport facilities located in the vicinity of the River Moy have the potential to be disrupted by the construction of the Proposed Scheme. This change would mostly affect residents in the local communities of Ballina. It is noted that there will be restrictions to the construction programme to accommodate angling activities on the River Moy, with construction activities occurring outside of the angling season in some areas, and further restrictions during fish spawning season. Further details on these restrictions are given in **Chapter 5: Project Description**.

The potential population health effect is considered plausible as there is a theoretical source-pathway-receptor linkage:

- The source is changes in access to the River Moy and surrounding green spaces due to construction.
- The pathway is disruptions to recreation generated by construction activities.

- The receptors are residents and recreational users of the River Moy.

Furthermore, the theoretical effect is considered applicable in the context of this Proposed Scheme. The population groups relevant to this assessment are:

- The 'site specific' populations of Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED.
- The sub-population vulnerable due to:
  - Young age vulnerability (specifically children who are overweight or who have low physical activity levels);
  - Old age vulnerability (specifically the elderly for whom familiar routes with appropriate mobility considerations play a part in regular exercise);
  - Low-income vulnerability (specifically people with limited access to alternative physical activity opportunities or means of transport);
  - Poor health vulnerability (people with existing poor physical or mental health);
  - Access and geographical vulnerability (people for whom close proximity to the proposed changes increases sensitivity); and
  - Social disadvantage (people who may have limited access to other forms of recreation).

The assessment covers these populations within two groups. The general population for the geographic area, notably residents of Mayo County, and the vulnerable sub-population for this area. The latter is comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The sensitivity of the general population is **low**. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in **Section 8.2.7.3** of this report. The general population comprise those members of the community in *good* physical and mental health and with resources that enable a *high* capacity to adapt to change such as selecting alternative forms of recreation or different routes to avoid any temporary disruption.

The sensitivity of the vulnerable sub-population is **high**. This reflects that the sub-population includes representation of dependants including children and people with existing poor physical or mental health. This sub-population may have fewer resources and less capacity to adapt to changes. The population may therefore be more reliant on recreation within the affected area with greater likelihood that any disruption or disturbance could affect physical activity and recreational behaviours.

As reported in **Chapter 21: Risk of Major Accidents or Disasters**, the potential effects anticipated during the construction phase relating to open space, leisure and play; such as road traffic accidents and collapse/ damage to existing structures, are considered to be not significant following mitigation.

For population health, the magnitude of change due to the Proposed Scheme is **low**. The health implication of the above effects is that there would be a change in experience of recreational river users including anglers and fishers. The literature suggests beneficial health outcomes, both physical (e.g. cardiometabolic factors, all-cause mortality, sleep quality) and mental, from access to greenspace (Yang et al., 2021). The scale of change is considered *small*. Only very *minor changes* in the quality of physical activity opportunity will be expected for a *small minority* of the population due to *temporary* disruption during construction. Any adverse effect on health behaviours and outcomes would therefore be *short to medium term* and reverse on completion of the construction work.

The significance of the population health effect for this determinant of health is **minor adverse** (not significant). The professional judgment is that there would, at most, be a very *slight* adverse change in the health baseline for the local population. This conclusion reflects that physical activity is a local public health priority and the scientific literature on the benefits of physical activity to health is well established, however the level of change due to the Proposed Scheme is appropriately mitigated by standard good practice measures that minimise disruption and disturbance through the Construction Environment Management Plan (CEMP), such as the construction restriction measures mentioned above. The change is unlikely to result in significant differential or disproportionate effects between the general population (low sensitivity) and the vulnerable sub-population (high sensitivity). Consequently, no widening of health inequalities would be expected, and no influence is expected on the ability to deliver local or national health policy.

8.4.1.3 Transport Modes, Access and Connections

This section considers population health implications of changes in construction road traffic affecting health-related travel times and accessibility (including emergency services); road safety; and active and sustainable travel for local residents (bus users, pedestrians and cyclists). Construction works and constructed-related vehicles and traffic have the potential to disrupt local vehicle traffic (private and public transport) as well as some sustainable travel (bus routes) and active travel (pedestrians and cyclists). This may include health-related journey times, community severance or road safety.

This section has been informed by **Chapter 6: Traffic and Transport**, which sets out relevant assessment findings and mitigation measures that have been considered.

With regard to health-related travel times and accessibility, health effects may be associated with emergency response times or non-emergency treatment outcomes associated with delays or non-attendance. With regard to active and sustainable travel, health effects may be associated with reductions in levels of active travel such and walking and cycling, including physical health (e.g., cardiovascular health) and mental wellbeing (e.g., increased stress and anxiety). With regard to road safety, health effects may be associated with the severity or frequency of road traffic incidents.

The potential population health effect is considered plausible as there is a theoretical source-pathway-receptor linkage:

- The source is the presence of construction vehicles and traffic restrictions on the existing network.
- The pathway is changes in health-related travel times / accessibility, changes to levels of active travel due to increased vehicle traffic, and changes to road safety.
- The receptors are local road users, including those using motor vehicles as well as pedestrians and cyclists, and emergency services using the road network.

Furthermore, the theoretical effect is considered applicable in the context of this Proposed Scheme.

The population groups relevant to this assessment are:

- The ‘site-specific’ population of Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED.
- The ‘local’ population of Mayo County.
- The sub-population vulnerable due to:
  - Young age vulnerability (children and young people as potentially more vulnerable road users);
  - Old age vulnerability (older people as potentially more vulnerable road users);
  - Poor health vulnerability (people with existing poor physical and mental health in relation to health trip journey times);
  - Low-income vulnerability (people living in deprivation, including those on low incomes for who travel costs or alternatives may be limiting); and
  - Access and geographical vulnerability (people who experience existing access barriers or who rely on the affected routes, including healthcare and other amenities).

The scientific literature indicates that there is an association between the transport changes, road safety and accessibility. The literature does not identify particular thresholds for effects. The assessment has had regard to the population groups identified in the literature that may be particularly sensitive. For example, children, pregnant women and cyclists (particularly older cyclists) are generally more vulnerable in terms of road safety. People with lower socio-economic status typically face more transportation barriers in accessing health care.

The assessment covers these populations within two groups. The general population for the geographic area, notably residents of Mayo County, and the vulnerable sub-population for this area. The latter is comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The sensitivity of the general population is **low**. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in **Section 8.2.7.3** of this report. This reflects that most people in the local area (Mayo County) would only

make occasional use of the affected section of the road network. It also includes those for whom the road network affords alternative routes. The general population comprise those members of the community with a high capacity to adapt to changes in access, including changes in healthcare access, for example due to greater resources and good physical and mental health.

The sensitivity of the vulnerable group population is **high**. Vulnerability in this case is linked to mode of travel, including pedestrians and cyclists being more sensitive to road safety changes. It also relates to age (young people and older people) being more vulnerable to accident severity, those reliant on services accessed on affected sections of the road network (e.g., traveling to schools), and those in areas of greater deprivation. Deprived populations may already face more access barriers compared to general population and therefore be more sensitive to access changes. Low incomes may compound access barriers by limiting adaptive response. Vulnerability also includes those accessing health services (emergency or non-emergency) at times and locations affected by congestion. Ambulance services (and the recipients of their care) are particularly sensitive to delays in response times (time taken to arrive and stabilise the patient). Ambulances are generally less affected by congestion due to the priority given to them travelling under blue lights. People in poor or very poor health may be more frequent users of healthcare service and therefore be more sensitive to access changes.

As reported in **Chapter 6: Traffic and Transport**, the potential effects anticipated during the construction phase relating to transport modes, access and connections, are as follows:

- The temporary effect on the road network during construction is considered to be imperceptible to slight.
- Temporary impacts due to diversions and road closures during construction is considered to be slight to moderate and will be mitigated through the Construction Traffic Management Plan (CTMP; Appendix 6-2).

The CTMP (Appendix 6-2) will set out traffic management measures to maintain access and provide early notice of any route changes. Temporary disruptions, road closures and diversions will be managed through a CTMP.

For population health, the magnitude of change for this determinant due to the Proposed Scheme is **low**.

In relation to health-related travel times and accessibility, the scale of change in delays is expected to be *small* and *medium-term*. The frequency with which health related journeys may be affected is likely to be *occasional* for most people, with the *majority* of people experiencing *no change* in health outcomes. For a very few people, severity could relate to a *very minor* change in morbidity or mortality risk factors associated with emergency time-sensitive treatment. A **low** magnitude is assigned to health-related travel times and accessibility.

In relation to road safety at the population level the scale of change in accidents would be *small*. The frequency of any incidents would be *occasional*, with severity related to a very minor change in risk of injury or mortality (though with outcome reversal gradual or permanent). The expectation is that *very few* people would be affected, with *no or slight* implications for healthcare services. Reflecting the residual effects reported in **Chapter 6: Traffic and Transport** the health chapter identifies a **low** magnitude of change on this issue.

In relation to active travel, the scale of change is considered *small* and *medium-term*, albeit of limited duration at any given location, including due to the transitory nature of construction works. Only *minor* changes in *morbidity* for *cardiovascular* and *mental health* outcomes would be expected for a *small minority* of the population due to temporary disruption during construction works. Most adverse effects on health behaviours and outcomes would be expected to *reverse* on completion of the construction works. A **low** magnitude is assigned to active travel.

The significance of the population health effect for this determinant of health is **minor adverse** (not significant).

In relation to health-related travel times and active travel, the significance of the population health effect is minor adverse (not significant). The professional judgment is that there would, at most, be a slight adverse change in the population health baseline. This conclusion reflects that road safety and access to health supporting services are specific public health priorities and there is causal association that is supported by the scientific literature. However, the change due to the Proposed Scheme is appropriately mitigated by standard good practice measures that minimise disruption and disturbance, as described in **Chapter 6:**

Traffic and Transport. The change is unlikely to result in significant differential or disproportionate effects between the general population (low sensitivity) and the vulnerable sub-population (high sensitivity). Consequently, no widening of health inequalities would be expected, and no influence is expected on the ability to deliver local or national health policy.

For road safety the significance of the population health effect is also **minor adverse** (not significant). This conclusion reflects the potential for slight change in the health baseline due to slightly increased risk of high severity road accident outcomes. The change is not expected to widen inequalities and have marginal influence on the achievement of health policy relating to road safety. Regarding wider accessibility, the temporary nature of the work and ability for people to adapt to known planned diversions or delays means there is unlikely to be a change to population health outcomes associated with access to social infrastructure such as shops, employment and educational facilities.

8.4.1.4 Employment and Income

This section considers the effects on employment and income from construction of the Proposed Scheme. In a small town context, even minor changes to employment and income can be influential to population health.

This section has been informed by **Chapter 7: Population** which sets out relevant assessment findings and mitigation measures which have been taken into account.

Employment and income are both determinants that can negatively and positively affect health and mental wellbeing (PHE, 2021; Royal College of Physicians, 2022; The Lancet Public Health, 2020). There is potential for the construction phase of the Proposed Scheme to increase economic activity in Ballina as a result of the presented of construction workers in the area. The construction phase is likely to bring indirect beneficial employment to the local population within Ballina. Additionally, it is possible that recreational and tourism activities will be adversely impacted by construction works.

The potential population health effect is considered plausible as there is a theoretical source-pathway-receptor linkage:

- The source is construction activities associated with the Proposed Scheme.
- The pathway is changes in employment and income due to construction.
- Receptors are residents and other people who rely on the River of Moy for income.

Furthermore, the theoretical effect is considered applicable in the context of this Proposed Scheme.

The population groups relevant to this assessment are:

- The ‘site-specific’ geographic population of Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED;
- The ‘local’ population of County Mayo, including other fishermen from the surrounding area who rely on access to the River of Moy.
- The sub-population vulnerable due to:
  - Young age vulnerability (children and young people who are dependants, as well as young adults early in their careers);
  - Old age vulnerability (older people who are dependant);
  - Poor health: (people with existing poor physical and mental health, including for employment opportunities and as dependants);
  - Low-income vulnerability (people on low income, who are economically inactive or unemployed/workless); and
  - Access to geographical factors (people experiencing barriers in access such as the ability to access employment and income outside the local area).

The assessment covers these populations within two groups. The general population for the geographic area, notably residents of Ballina, and the vulnerable sub-population for this area. The latter is a comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The sensitivity of the general population is **low**. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in **Section 8.2.4** of this report. The general population comprise those members of the community in employment with good socio-economic status and low levels of deprivation.

The sensitivity of the vulnerable sub-population is **high**. As stated in **Chapter 7: Population**, unemployment in Ballina is higher than the national average. Vulnerability in this case relates to people and their dependants who are on low incomes, have poor job security, poor working conditions or who are unemployed.

As reported in **Chapter 7: Population**:

- The construction phase of this project will increase economic activity in the area primarily as a result of the presence of construction workers in the area. The demand for local businesses, leisure centres and accommodation services will likely increase, thus creating local economic growth. In addition to this, it is considered that the construction phase will bring indirect employment to the local services within Ballina.
- Local businesses within the population study area will continue to operate normally. The construction works would involve temporary restrictions on traffic movements as described above and in **Chapter 6: Traffic and Transport**. Temporary road closures may impact businesses due to loss of parking and disruptions to the regular flow of traffic.

The construction of the Proposed Scheme will overall have a temporary imperceptible impact on economic activity.

For population health, the magnitude of change due to the Proposed Scheme is **low**. This reflects a *small scale of change* within the context of the study area employment market from construction employment, and local economic activity from increased demand for local businesses and services. Construction employment would be *medium-term* and would reverse on completion of the construction work. Such jobs are likely to be associated with *minor changes* in morbidity and quality of life for a *small minority* of the population.

As detailed in **Chapter 7: Population**, disruption to local businesses and livelihoods during construction are anticipated to be minimal, with businesses operating normally. It is noted also that construction interruptions to recreational and tourism facilities such as salmon fishing will be kept to a minimum. Any associated changes to income can also be mitigated through the CEMP by designating safe alternative transport through Ballina during construction. There is therefore expected to be limited adverse changes in income and employment through disruptions during construction.

The significance of the population health effect for this determinant of health is **minor beneficial** (not significant). The construction of the Proposed Scheme is likely to have *slight* positive impacts on economic activity as a result of the presence of construction workers in the area. These opportunities are likely to affect a *small* part of population and to last for a relatively short period of time, yet increased income can have beneficial health effects even in the short-term. This conclusion reflects that the scientific literature establishes a *clear relationship* between good quality employment and factors that promote health or are protective against poor health, particularly mental health. The scale and nature of employment is expected be *marginal* in narrowing health inequalities locally, and more generally *supporting delivery of health policy* to improve local population health.

8.4.1.5 Noise and Vibration

This section discusses changed to environmental conditions, in particular, *noise* during the construction of the Proposed Scheme, and related effects on population health.

This section has been informed by **Chapter 15: Noise and Vibration**, which sets out relevant assessment findings and mitigation measures that have been taken into account.

The literature highlights cardiovascular effects, annoyance and sleep disturbance (and consequences arising from inadequate rest) as being the main pathways by which population health may be affected (Peris and Fenech, 2020). The literature also notes the potential for chronic noise to have a detrimental effect on learning outcomes (e.g. noise distracting and affecting communication within classrooms) (Peris and Fenech, 2020). Whilst the literature supports there being thresholds at which effects (such as annoyance and sleep disturbance) are likely, it also acknowledges the subjective nature of responses to noise. In this regard noise effects can be considered to have non-threshold effects, with characteristics other than sound levels also

determining the influence on health outcomes (WHO, 2018). The assessment had regard to the population groups identified in the literature that may be particularly sensitive. For example, children, the elderly, the chronically ill, people with a hearing impairment, shift-workers and people with mental illness (e.g., schizophrenia or autism).

Construction of the Proposed Scheme has the potential to result in noise nuisance from construction activities, particularly night-time noise that may be detrimental to population health where sleep is disturbed to a high degree. Changes in the distribution of day-time noise are also considered. As stated in **Chapter 15: Noise and Vibration**, construction traffic numbers and associated noise levels are below relevant thresholds for detailed assessment, and there is limited potential for noise impacts from construction traffic.

The potential population health effect is considered plausible as there is a theoretical source-pathway-receptor linkage:

- The source is noise generated by construction activities.
- The pathway is pressure waves through the air.
- Receptors are residents and long-term occupiers of nearby properties and community buildings.

Furthermore, the theoretical effect is considered applicable in the context of this Proposed Scheme.

The population groups relevant to this assessment are:

- The 'site-specific' geographic population Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED.
- The sub-population vulnerable due to:
  - Young age vulnerability (children and young people particularly with regard to educational and sleep disruption);
  - Old age vulnerability (older people particularly with regard to sleep disruption);
  - Poor health vulnerability (people with existing poor physical or mental health);
  - Low-income vulnerability (people living in deprivation, including those on low incomes may have fewer resources to adapt, e.g., seek respite or insulation furthermore, those who are economically inactive may spend more time in affected dwellings); and
  - Access and geographical vulnerability (people for whom close proximity to the proposed changes increases sensitivity).

The assessment covers these populations within two groups. The general population for the geographic area, notably residents of Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED, and the vulnerable sub-population for this area. The latter is comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The sensitivity of the general population is **low**. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in **Section 8.2.7.3** of this report. The general population comprise those members of the community in good physical and mental health and with resources that enable a high capacity to adapt to change.

The sensitivity of the vulnerable group population is **high**. This reflects that the sub-population includes a high representation of dependants, both children, elderly and those receiving care due to poor health. This sub-population may experience existing widening inequalities due to living in areas with increasing noise and moderate deprivation, with limited capacity to adapt to changes. Vulnerability particularly relates to those living close to the construction activities, including those spending more time in affected dwellings, e.g., due to low economic activity, shift work or poor health. People who are concerned or have high degrees of uncertainty about construction noise and its effect on their wellbeing may be more sensitive to changes in noise. People with heightened sensitivity to noise effects, including due to existing physical and mental health conditions as well as neurodiversity, are acknowledged as likely to be present within the affected population and have been taken into account by the assessment.

Chapter 15: Noise and Vibration concludes:

- The residual effects due to noise and vibration from elements of the Proposed Scheme range from negligible to moderate depending on the specific location.

- As reported in **Chapter 15: Noise and Vibration**, construction of the Proposed Scheme will involve the various combination of plant items which will be in use at different phases at each of the six construction sites, for instance the use of rock breakers and consaws will be for brief periods when breaking out footpaths or road surfaces before trench excavation.
- Construction noise is predicted to be within limits set to be protective of public health and the environment in most cases. However, when considering a worst-case scenario, **Chapter 15: Noise and Vibration** identifies the potential for construction noise to exceed limits (both daytime and night time) at a small number of individual receptors that are located closest to the construction activities, with the receptors most likely to be impacted being non-residential.
- Changes will be mitigated as set out in **Chapter 15: Noise and Vibration**, which includes the use of silencers for mechanical plant and equipment. Residents will also be informed of the timing and duration of activities that may produce high noise.

For population health, the magnitude of change due to the proposed construction work is **low**. In terms of population health, the *small* scale of change in noise levels is likely to predominantly relate to a *minor* change in quality of life for a *large minority* of the community; and a *very minor* change in cardiovascular and mental wellbeing morbidity for the *small minority* of the community closest to construction activities. The changes would be intermittent, which is considered to represent a series of *short-term* impacts during the construction period and relate to *frequent* construction relates noise exposures. Prolonged periods of construction noise at night or daytime disruption of educational activities at schools are not expected.

Construction noise impacts of the Proposed Scheme are considered to result in a **minor adverse (not significant)** effect on population health. This assessment conclusion reflects that although the scientific literature indicates a *clear association* between elevated and sustained noise disturbance and reduce health outcome, the changes would result in *very limited* effect in the health baseline of the site-specific populations. The temporary and localised construction noise effects are not expected to affect health inequalities or the delivery of health-related policy.

8.4.2 Operational Phase

8.4.2.1 Health and Safety

The Proposed Scheme will undergo continuous regular maintenance during the operational phase to ensure structural integrity and cleaning for visual and residential amenity. Please see **Table 5-8** of **Chapter 5 Project Description**. All maintenance activities will be undertaken in full adherence with the relevant health and safety legislation in place at the time.

8.4.2.2 Housing

This section considers *housing* during the operation of the Proposed Scheme. The Proposed Scheme is anticipated to result in increased protection of residential areas from flood risk, affecting physical and mental health impacts of flooding, as well as reducing the incidence of secondary health effects such as poor housing quality and damp.

This section has been informed by **Chapter 7: Population**, which sets out relevant assessment findings and mitigation measures that have been taken into account.

Housing exerts one of the strongest directly measurable effects on physical and mental health (Ige et al., 2019). The influence of housing on population health, particularly mental health, is strongly linked to community and environmental factors. Flood relief exerts protection against the direct health effects associated with flood water (including skin and gut infections from exposure to contaminated flood water), as well as long-term mental health impacts as a consequence of flooding (including deteriorating mental health, stress and anxiety) (UK Health Security Agency, 2023). A systematic review and meta-analysis of 15 studies in high-income countries found that microbial aerosol exposure (mould) in indoor air environments, including homes, was significantly associated with an increased risk of respiratory symptoms in children (Fakunle et al., 2021). Other systematic reviews suggest that floods are associated with the deterioration of mental health (Weilnhammer et al., 2021), including post-traumatic stress disorder and anxiety (Fernandez et al., 2015).

The potential population health effect is considered plausible as there is a theoretical source-pathway-receptor linkage:

- The source is housing quantum, type, quality and conditions.
- The pathway is housing conditions affecting physical and mental health.
- Receptors are residents in the local communities, including new and existing residents.

Furthermore, the theoretical effect is considered applicable in the context of this Proposed Scheme. The population groups relevant to this assessment are:

- The 'site-specific' population of Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED.
- The 'local' population of Mayo County.
- The sub-population vulnerable due to:
  - Young age vulnerability (including those residing in poor housing that can have lasting health effects across their life course).
  - Disability and older age vulnerability (for whom flood relief would be protective to their health, wellbeing and independence).
  - Low income vulnerability (specifically people with limited resources who are unable to improve their housing conditions).
  - Poor health vulnerability (specifically conditions where flood relief would support better health and wellbeing).
  - Access and geographical vulnerability (specifically the population for whom close proximity to the proposed changes provides additional flood protection).

The assessment covers these populations within two groups. The general population for the geographic area, notably residents of Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED, and the vulnerable sub-population for this area. The latter is comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The sensitivity of the general population is **low**. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in **Section 8.2.7.3** of this report. The general population comprise those members of the community in good physical and mental health and with greater resources to access good housing and/or improve their housing conditions.

The sensitivity of the vulnerable group population is **high**. The sub-population includes a high representation of dependants, including children, elderly, and those receiving care due to poor health. The sub-population also includes those experiencing high levels of deprivation and low incomes. This sub-population may have fewer resources and less capacity to access good quality housing. This group is less able to prevent or respond to flooding events that affect their property, including appropriately avoiding post flooding risks, including linked to mould, infection and mental health.

As reported in **Chapter 7: Population**, Ballina will be less vulnerable to flooding during the operation phase of the Proposed Scheme. The Proposed Scheme will provide flood protection to 341 no. existing residential units. The Proposed Scheme will have a moderate, long term, positive impact on residential amenities.

For population health, the magnitude of change due to the Proposed Scheme is **medium**. The flood protection provided to residential amenities will be long-lasting and will affect a high proportion of residents in the area. The benefits represent a *medium* scale of change relating to a *moderate* protective benefit in physical and mental health morbidity for a *small* minority of the local population. The changes will be *long-term* in duration and relate to *frequent* effects with regard to safeguarded or improved living standards.

The significance of the population health effect for this determinant of health is **moderate beneficial** (significant). This score reflects that the literature establishes a *clear* relationship between housing living standards and health outcomes. The Proposed Scheme is expected to exert a small beneficial effect on the health baseline, as well as being *influential* for health inequalities.

8.4.2.3 Open Space, Leisure and Play

This section considers *open space, leisure and play* during the operation of the Proposed Scheme. Both real and perceived safety of recreational activities support people engaging in physical activity and can be beneficial to physical and mental health (Rojas-Rueda et al., 2021; Yang et al., 2021).

This section has been informed by **Chapter 5: Project Description** and **Chapter 6: Traffic and Transportation** which set out relevant assessment findings and mitigation measures which have been taken into account.

The potential effect is considered likely because there is a plausible source-pathway-receptor relationship:

- The source is the proposed flood relief infrastructure.
- The pathway is changes in access to the River of Moy, including safety (real and perceived) due to improved flood relief infrastructure.
- The receptors are users of the River of Moy and local residents in Ballina.

Furthermore, the theoretical effect is considered applicable in the context of this Proposed Scheme. The population groups relevant to this assessment are:

- The 'site-specific' population of Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED.
- The 'local' population of Mayo County.
- The sub-population vulnerable due to:
  - Young age vulnerability (children and young people as potentially more vulnerable to safety hazards).
  - Old age vulnerability (older people as potentially more vulnerable to safety hazards).
  - Poor health vulnerability (people with existing poor physical and mental health).
  - Low income vulnerability (specifically people with limited access to alternative physical activity opportunities or means of transport).
  - Access and geographical vulnerability (people who experience existing access barriers or who rely on the existing modes of access).
  - Social disadvantage (people who may have limited access to other forms of recreation).

The assessment covers these populations within two groups. The general population for the geographic area, notably residents of Ballina, and the vulnerable sub-population for this area. The latter is comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The sensitivity of the general population is **low.** Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been considered and are listed in **Section 8.2.7.3** of this report. The general population comprise those members of the community in good physical and mental health who are more able to mitigate changes in access to open space and recreation opportunities.

The sensitivity of the vulnerable sub-population is **high**. This reflects that the sub-population includes a high representation of dependants including children, elderly and those receiving care due to poor health. This sub-population may have fewer resources and less capacity to adapt to changes. The population may therefore be more reliant on recreation within the affected area with greater likelihood that any enhancements and safer access could affect physical activity and recreational behaviours.

The Proposed Scheme will improve flood relief measures in Ballina making recreational use of the River Moy including for angling and fishing, as well as recreational use of other public open spaces safer and more accessible. As reported in **Chapter 5: Project Description**, the Proposed Scheme will enhance pedestrian access with the modification of the plaza opposite Muredach's Cathedral along Cathedral Road for incorporation into the future planned Ballina Public Realm. Existing pedestrian access to the river will be maintained, including provision for accessible access.

For population health, the magnitude of change due to the Proposed Scheme is **low**. Improvements to safety associated with the Proposed Scheme will be long-lasting and will affect a high proportion of residents of

Ballina, including those participating in recreational activities as well as visitors. The Proposed Scheme also provides enhanced public amenity space and areas for active travel along the River Moy. Improved flood relief infrastructure will also encourage the continuation and uptake of recreational activities in the area, which will support good physical and mental health, as well as have the potential to support tourism and indirect economic benefits in the area (the latter is discussed further in **Section 8.4.2.5**). The benefits will therefore represent a *small* scale of change relating to a *minor* change in morbidity for a *small* minority of the local population with regards to the uptake of recreational activities, and the *majority* of the population with regards to safe access to the River of Moy. The changes will be *long-term* in duration and relate to *frequent* effects with regard to improved opportunities for recreational users.

Overall, operational impacts on open space, leisure and play are considered to result in a **minor beneficial** (not significant) effect on population health. This assessment conclusion is supported by a strong evidence base in the scientific literature for a *causal* relationship between physical activity and good physical and mental health, and professional judgement on the effect of physical and perceived safety for the uptake of healthy behaviours.

8.4.2.4 Transport Modes, Access and Connections

This section considers population health implications of changes in operational accesses within Ballina, in particular, those affecting emergency response times for urgent medical treatment.

This section has been informed by **Chapter 5: Project Description** and **Chapter 6: Traffic and Transport**, which sets out relevant assessment findings and mitigation measures that have been considered.

Health effects associated with health-related travel times and accessibility include emergency response times or non-emergency treatment outcomes associated with delays or non-attendance.

The potential population health effect is considered plausible as there is a theoretical source-pathway-receptor linkage:

- The source is the proposed flood relief infrastructure.
- The pathway is changes in health-related travel times and accessibility.
- The receptors are residents and users of the River of Moy.

Furthermore, the theoretical effect is considered applicable in the context of this Proposed Scheme.

The population groups relevant to this assessment are:

- The ‘site-specific’ geographic population of Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED.
- The ‘local’ population of Mayo County.
- The sub-population vulnerable due to:
  - Young age vulnerability (children and young people as potentially more vulnerable transport users).
  - Old age vulnerability (older people as potentially more vulnerable transport users and those that require more frequent medical services).
  - Poor health vulnerability (poor people with existing poor physical and mental health in relation to health trip journey times).
  - Low-income vulnerability (people living in deprivation, including those on low incomes for who travel costs or alternatives may be limited).
  - Access and geographical vulnerability (people who experience existing barriers or who rely on the affected routes, including healthcare and other amenities).

The assessment covers these populations within two groups. The general population for the geographic area, notably residents and visitors of Ballina and the vulnerable sub-population for this area. The latter is comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The sensitivity of the general population is **low**. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in **Section 8.2.7.3** of this report. The general population comprise those members of the community with a high capacity to adapt to changes in access, including changes in healthcare access, for example due to greater resources and good physical and mental health.

The sensitivity of the vulnerable group population is **high**. Vulnerability in this case relates to those accessing health services (emergency or non-emergency) at locations affected by flooding. Older people and people in poor or very poor health may be more frequent users of healthcare services and therefore may be more sensitive to access changes. Vulnerability also extends to people who live in areas of greater deprivation, in terms of general access. Deprived populations may already face more access barriers compared to the general population and therefore be more sensitive to access changes. Low incomes may compound access barriers by *limiting* adaptive response.

The magnitude of change due to the Proposed Scheme is **low.** The benefits will therefore represent a *small* scale of change relating to a *minor* change in morbidity for a *small minority* of the population with regards to emergency response times for urgent healthcare needs during flooding, as well general access to services. The changes will be *long-term* in duration and relate to *occasional* effects, although it is noted that the frequency of such flooding events are expected to increase over the long-term

Overall, operational impacts on transport modes, access and connections are considered to result in a **minor beneficial** (not significant) effect on population health. This relates to operational effects when compared to the likely future scenarios of more frequent and severe flooding events without the Proposed Scheme, which could substantially delay emergency response times for people requiring urgent care. This assessment conclusion is supported by a strong evidence base in the scientific literature for a *causal* relationship between access to emergency services and medical supplies and good physical and mental health.

8.4.2.5 Employment and Income

This section considers the effects on *employment and income* from the operation of the Proposed Scheme. In a small town context, even minor changes to employment and income can be influential to population health. This section has been informed by **Chapter 7: Population** which sets out relevant assessment findings and mitigation measures which have been taken into account.

The potential population health effect is considered plausible as there is a theoretical source-pathway-receptor linkage:

- The source is the proposed flood relief infrastructure.
- The pathway is changes in access within Ballina, including safety (real and perceived) due to improved flood relief infrastructure.
- The receptors are local residents and visitors in Ballina.

Furthermore, the theoretical effect is considered applicable in the context of this Proposed Scheme.

The population groups relevant to this assessment are:

- The ‘site-specific’ geographic population of Ballina Rural ED, Ballina Urban ED, Ardnaree South Urban ED, Ardnaree South Rural ED, Ardnaree North ED.
- The sub-population vulnerable due to:
  - Young age vulnerability (children and young people who are dependants, as well as young adults early in their careers).
  - Old age vulnerability (older people who are dependants).
  - Poor health (people with existing poor physical and mental health, including for employment opportunities and as dependants).
  - Low income vulnerability (people on low income, who are economically inactive or unemployed/workless, dependants).
  - Access and geographical factors (people experiencing barriers in access such as the ability to access employment and income outside the local area).

The assessment covers these populations within two groups. The general population for the geographic area, notably residents of Ballina, and the vulnerable sub-population for this area. The latter is comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The sensitivity of the general population is **low**. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in **Section 8.2.7.3** of this report. The general population comprise those members of the community in employment with good socio-economic status and low levels of deprivation.

The sensitivity of the vulnerable sub-population is **high**. As stated in **Chapter 7: Population**, unemployment in Ballina is higher than the national average. Vulnerability in this case relates to people and their dependants who are on low incomes, have poor job security, poor working conditions or who are unemployed. Future young or older people may also come to rely on those employed.

During operation, the Proposed Scheme will safeguard businesses from flooding thus mitigating against loss of income and employment as a result of flooding. As stated in **Chapter 7: Population**, the Proposed Scheme will provide flood protection to 96 no. commercial and business premises within Ballina and the surrounding area. This will safeguard their existing operations and facilitate the growth of existing businesses. The Proposed Scheme will also promote new businesses within Ballina, creating future employment and a positive impact on the local economy. Improved employment and income have positive effects associated with physical health (through e.g., improved health literacy) and mental wellbeing (through e.g., increased self-efficacy).

For population health, the magnitude of change due to the Proposed Scheme is **medium**. Improvements to flood risk and safety associated with the Proposed Scheme will be long-lasting and will affect residents of Ballina, including those participating in economic and revenue-generating activities. The benefits will therefore represent a *medium* scale of change relating to a *minor* change in quality of life for a *large minority* of the local population with regards to the safeguarding of existing and future economic activities. The changes will be *long-term* in duration and relate to *frequent* effects with regard to improved opportunities for the uptake of revenue-generating activities.

Overall, operational impacts on employment and income are considered to result in a **moderate beneficial** (significant) effect on population health. This assessment conclusion is supported by a strong evidence base in the scientific literature for a *causal* relationship between good physical and mental health, and employment, and professional judgement on the effect of physical and perceived safety for the uptake of healthy behaviours.

8.5 Mitigation Measures

8.5.1 Construction Phase

To reduce likelihood of health and safety risks to the public during the Construction Phase, fencing, signage, adherence to road safety guidelines, and other best practice measures, as detailed in the CEMP and CTMP (**Appendix 6-2**) will be adhered to.

8.5.2 Operational Phase

During the operational phase, best practise measures and legislation pertaining to health and safety will be adhered to by all maintenance staff.

8.6 Residual Impacts

The residual effects of the Proposed Scheme during construction and operation remain the same as those presented in **Section 8.4**.

8.7 Monitoring

8.7.1 Construction Phase

No monitoring is proposed for the construction phase of the Proposed Scheme.

8.7.2 Operational Phase

No monitoring is proposed for the operational phase of the Proposed Scheme.

8.8 Interactions and Cumulative Effects

Inter-relationships are the impacts and associated effects of different aspects of the Proposed Scheme on the same receptor. The potential for cumulative effects has been considered for the construction and operation of the Proposed Scheme cumulatively with other projects. Please see **Chapter 20 Interactions and Cumulative Effects** for further details on the potential interactions and cumulative effects for human health.

8.9 Schedule of Environmental Commitments

Please see **Chapter 22 Schedule of Environmental Commitments** which sets out all the mitigation and monitoring commitments to minimise the potential impacts for human health during the construction and operational phase of the Proposed Scheme.

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