The Tecpro Building,
Clonshaugh Business & Technology Park,
Dublin 17, Ireland.

T: + 353 1 847 4220
F: + 353 1 847 4257
E: info@awnconsulting.com
W: www.awnconsulting.com

N24 CARRICK ROAD IMPROVEMENT SCHEME AIR QUALITY & CLIMATE IMPACT ASSESSMENT

Report Prepared For

Barry Transportation

Report Prepared By

Niamh Nolan BSocSc. AMIEnvSc

Our Reference

NN/21/12101AR01

Date Of Issue

26 January 2022

Document History

Document Reference		Original Issue Date	
21/12101AR01		26 January 2022	
Revision Level	Revision Date	Description	Sections Affected

Record of Approval

Details	Written by	Approved by
Signature		
Name	Niamh Nolan	Ciara Nolan
Title	Air Quality Consultant	Air Quality Consultant
Date	26 January 2022	26 January 2022

CONTENTS PAGE

EXECUTIVE SUMMARY

AWN Consulting Ltd. were commissioned to investigate the potential air quality and climate impacts associated with the proposed N24 Carrick Road Improvement Scheme. The potential impacts and the outcome of the assessment are summarised below.

Impacts to air quality and climate can occur during both the construction and operational phases of the proposed scheme. With regard to the construction stage the greatest potential for air quality impacts is from fugitive dust emissions impacting nearby sensitive receptors. Impacts to climate can occur as a result of vehicle and machinery emissions as well as embodied carbon in construction materials. In terms of the operational stage, air quality and climate impacts will predominantly occur as a result of the change in traffic flows or speeds along the proposed scheme.

Potential dust impacts will be mitigated through the use of best practice and minimisation measures which are outlined in this report. Therefore, dust impacts will be short-term and imperceptible at all nearby sensitive receptors. It is not predicted that significant impacts to climate will occur during the construction stage due to the small scale of the scheme. Embodied CO_2 emissions are predicted to be significantly below Ireland's EU 2030 target.

The local air quality modelling assessment concluded that levels of traffic-derived air pollutants resulting from the scheme will not exceed the ambient air quality standards either with or without the proposed scheme in place. Using the assessment criteria outlined in Transport Infrastructure Ireland's guidance document '*Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes'* (2011) the impact of the development in terms of NO_2 is long-term and imperceptible. A positive impact is predicted at the majority of receptors assessed as the proposed alignment is located further from the receptors compared with the existing alignment. However, any impacts are overall imperceptible due to the minor changes in pollutant concentrations.

The proposed development is not predicted to significantly impact climate during the operational stage. Increases in traffic derived levels of CO_2 have been assessed against Ireland's EU GHG Targets for future years. Changes in CO_2 emissions are significantly below the EU targets and therefore the climatic impact in the operational stage is considered long-term, negative and imperceptible.

Overall, the results of the assessment found no significant impacts to either air quality or climate are predicted during the construction or operational phases of the proposed scheme.

1.0 INTRODUCTION

This report assesses the likely air quality and climate impacts, associated with the proposed N24 Carrick road improvement scheme. The scheme is approximately 2.19 km in length and is located north-west of Mooncoin Village, Co. Kilkenny.

2.0 METHODOLOGY

2.1 Criteria for Rating of Impacts

2.1.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set.

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC, which has set limit values for various polluntats. In terms of this assessment, the limit values for NO_2, PM_{10} and $PM_{2.5}$ are applicable (see Table 1).

Pollutant	Regulation Note 1	Limit Type	Value
Nitrogen Dioxide (NO_2)	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m^3
		Annual limit for protection of human health	40 µg/m^3
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3
		Annual limit for protection of human health	40 µg/m^3
Particulate Matter (as $PM_{2.5}$)	2008/50/EC	Annual limit for protection of human health	25 µg/m^3

Note 1 EU 2008/50/EC – Clean Air For Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC

Table 1 Air Quality Standards Regulations

2.1.2 Dust Deposition Guidelines

The concern from a health perspective is focussed on particles of dust which are less than 10 microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$) and the EU ambient air quality standards outlined in Table 1 have set ambient air quality limit values for PM_{10} and $PM_{2.5}$.

With regards to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development in Ireland. Furthermore, no specific criteria have been stipulated for nuisance dust in respect of this development.

With regard to dust deposition, the German TA-Luft standard for dust deposition (non-hazardous dust) (German VDI, 2002) sets a maximum permissible emission level for dust

deposition of 350 mg/(m^2*day) averaged over a one year period at any receptors outside the site boundary. Recommendations from the Department of the Environment, Heritage & Local Government (DEHLG, 2004) apply the Bergerhoff limit value of 350 mg/(m^2*day) to the site boundary of quarries. This limit value can also be implemented with regard to potential dust impacts from construction of the proposed development.

2.1.3 Climate Agreements

Ireland is party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. The Paris Agreement, which entered into force in 2016, is an important milestone in terms of international climate change agreements and includes an aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made in the Paris Agreement on elevating adaption onto the same level as action to cut and curb emissions.

In order to meet the commitments under the Paris Agreement, the EU enacted *Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013* (the Regulation). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30%, respectively, by 2030 compared to 2005. Ireland's obligation under the Regulation is a 30% reduction in non-ETS greenhouse gas emissions by 2030 relative to its 2005 levels.

In 2015, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) was enacted (the Act). The purpose of the Act was to enable Ireland '*to pursue, and achieve, the transition to a low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050*' (3.(1) of No. 46 of 2015). The Act made provision for a national mitigation plan, and a national adaptation framework. In addition, the Act provided for the establishment of the Climate Change Advisory Council with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate obligations.

The first Climate Action Plan (CAP) was published by the Irish Government in June 2019 (Government of Ireland, 2019a). The Climate Action Plan 2019 outlined the current status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlined the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The 2019 CAP also detailed the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas. The Government published the second Climate Action Plan in November 2021 (Government of Ireland, 2021a). The plan contains similar elements as the 2019 CAP and aims to set out how Ireland can reduce our greenhouse gas emissions by 51% by 2030 (compared to 2018 levels) which is in line with the EU ambitions, and a longer-term goal of to achieving net-zero emissions no later than 2050. The 2021 CAP outlines a 42 – 50% reduction in transport sector emissions by 2030 relative to 2018 levels. Transport sector emissions need to be no more than 6 - 7 $MtCO_2e$ by 2030. This will primarily be achieved through the electrification of the fleet, increased use of biofuels and a modal shift to transport modes with a lower energy consumption (i.e. public and active transport).

Following on from Ireland declaring a climate and biodiversity emergency in May 2019 and the European Parliament approving a resolution declaring a climate and environment emergency in Europe in November 2019, the Government approved the publication of the General Scheme for the Climate Action (Amendment) Bill 2019 in December 2019 (Government of Ireland 2019b) followed by the publication of the Climate Action and Low Carbon Development (Amendment) Act 2021 (No. 32 of 2021) (hereafter referred to as the 2021 Climate Act) in July 2021 (Government of Ireland, 2021b). The 2021 Climate Act was prepared for the purposes of giving statutory effect to the core objectives stated within the CAP.

The purpose of the 2021 Climate Act is to provide for the approval of plans '*for the purpose of pursuing the transition to a climate resilient, biodiversity rich and climate neutral economy by no later than the end of the year 2050'*. The 2021 Climate Act will also '*provide for carbon budgets and a decarbonisation target range for certain sectors of the economy*'. The 2021 Climate Act defines the carbon budget as '*the total amount of greenhouse gas emissions that are permitted during the budget period*'. There are currently no sector specific emissions targets outlined for the reduction of GHG emissions. The first round of sectorial carbon budgets were drafted by the Climate Change Advisory Council in October 2021 and must first be approved by the Oireachtas prior to publication. Therefore, there are currently no carbon budgets available to allow for comparison with the proposed scheme. The 2021 Climate Act removes any reference to a national mitigation plan and instead refers to both the Climate Action Plan, as published in 2019, and a series of National Long Term Climate Action Strategies. In addition, the Environment Minister shall request each local authority to make a '*local authority climate action plan'* lasting five years and to specify the mitigation measures and the adaptation measures to be adopted by the local authority.

The Kilkenny County Council Climate Change Adaptation Strategy 2019 – 2024 published in 2019 (Kilkenny County Council & Eastern and Midlands Climate Action Regional Office, 2019) outlines a number of goals and plans to prepare for and adapt to climate change in the key sectors of Energy and Buildings, Flood Resilience, Transport, Resource Management and Nature Based Solutions and Communities. Some of the measures promoted within the Adaptation Strategy relevant to transport include increasing the resilience of roads and transport infrastructure to climate change and to ensure climate adaptation is mainstreamed into all transport activities and operations. A key aspect in relation to transport within the document is promoting a modal shift to more sustainable modes of transport. The Council states that "*The Council will promote walking, cycling, public transport and other more sustainable forms of transport as an alternative to the private car, together with the development of the necessary infrastructure*". It is also committed to investigating the feasibility of enhancing public bus facilities in rural areas. This will require key infrastructure to be in place to support this.

2.2 Construction Phase Methodology

2.2.1 Air Quality

The construction phase assessment focuses on identifying the existing baseline levels of PM_{10} and $PM_{2.5}$ in the region of the proposed road development by an assessment of EPA monitoring data. Thereafter, the impact of the construction phase of the development on air quality was determined by a qualitative assessment of the nature and scale of dust generating construction activities associated with the proposed road development in line with Appendix 8 of the TII document *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (TII, 2011).

Construction phase traffic also has the potential to impact air quality and climate. The UK DMRB guidance (UK Highways Agency, 2019a), states that road links meeting one or more

of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment. Transport Infrastructure Ireland (TII) reference the use of the UK Highways Agency and DEFRA guidance and methodology in their document *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (2011). This approach is considered best practice in the absence of Irish guidance.

- Annual average daily traffic (AADT) changes by 1,000 or more;
- Heavy duty vehicle (HDV) AADT changes by 200 or more;
- A change in speed band;
- A change in carriageway alignment by 5m or greater.

In addition, the impact of construction activities on vehicle movements shall be assessed where construction activities are programmed to last for more than 2 years (UK Highways Agency, 2019a). The construction stage will be shorter than two years (c. 15 months) and the change in traffic is less than the above criteria. As a result, traffic does not meet the above criteria and, therefore, has been scoped out from any further assessment.

2.2.2 Climate

The impact of the construction phase of the proposed road development on climate has been estimated using the Transport Infrastructure Ireland (TII) Carbon Assessment Tool Version 2.0 (2020). This tool is specifically designed to account for the embodied emissions associated with road developments in Ireland. The assessment commences with the high-level design, through the pre-construction (site clearance) stage, followed by the assessment of the embodied carbon associated with all materials used in the construction of the road, the emissions during the construction phase and additionally emissions related to waste generated during the construction phase. The tool also assesses on-going maintenance associated with the default 60-year lifetime of the road development. For roads, it is generally assumed that end-of-life demolition is not relevant and thus there are no emissions associated with this stage. The tool also allows for inputs in relation to carbon sinks (e.g. increased tree planting) and carbon offsetting opportunities through the re-use of materials or the choice of lower carbon intensive materials for example.

The TII Carbon Tool (TII, 2020) uses emission factors from recognized sources including the Civil Engineering Standard Method of Measurement (CESSM) Carbon and Price Book database (CESSM, 2013). The carbon emissions are calculated by multiplying the emission factor by the quantity of the material that will be used over the entire construction / maintenance phase. The outputs are expressed in terms of $kgCO_2e$ (kilograms of carbon dioxide equivalent).

Detailed information regarding the proposed construction materials, waste quantities, material suppliers and site activities was not available at the time of this assessment and will be specified at the detailed design stage. Best estimates have been used in this assessment to provide an estimate of the GHGs associated with construction.

2.3 Operational Phase Methodology

2.3.1 Air Quality

The air quality assessment has been carried out following procedures described in the publications by the EPA (2015; 2017) and using the methodology outlined in the guidance documents published by the UK Highways Agency (2019a) and UK Department of Environment Food and Rural Affairs (DEFRA) (2016; 2018).

In 2019 the UK Highways Agency DMRB air quality guidance was revised with *LA 105 Air Quality* replacing a number of key pieces of guidance (HA 207/07, IAN 170/12, IAN 174/13, IAN 175/13, part of IAN 185/15). This revised document outlines a number of changes for air quality assessments in relation to road schemes but can be applied to any development that causes a change in traffic. Previously the DMRB air quality spreadsheet was used for the majority of assessments in Ireland with detailed modelling only required if this screening tool indicated compliance issues with the EU air quality standards. Guidance from Transport Infrastructure Ireland (TII, 2011) recommends the use of the UK Highways Agency DMRB spreadsheet tool for assessing the air quality impacts from road schemes. However, the DMRB spreadsheet tool was last revised in 2007 and accounts for modelled years up to 2025. Vehicle emission standards up to Euro V are included but since 2017, Euro 6d standards are applicable for the new fleet. In addition, the model does not account for electric or hybrid vehicle use. Therefore, this a somewhat outdated assessment tool. The LA 105 guidance document states that the DMRB spreadsheet tool may still be used for simple air quality assessments where there is unlikely to be a breach of the air quality standards. Due to its use of a "dirtier" fleet, vehicle emissions would be considered to be higher than more modern models and therefore any results will be conservative in nature and will provide a worst-case assessment.

The 2019 UK Highways Agency DMRB air quality revised guidance *LA 105 Air Quality* states that modelling should be conducted for NO_2 for the base, opening and design years for both the do minimum (do nothing) and do something scenarios. Modelling of PM_{10} is only required for the base year to demonstrate that the air quality limit values in relation to PM_{10} are not breached. Where the air quality modelling indicates exceedances of the PM_{10} air quality limits in the base year then PM_{10} should be included in the air quality model in the do minimum and do something scenarios. Modelling of $PM_{2.5}$ is not required as there are currently no issues with compliance with regard to this pollutant. The modelling of PM_{10} can be used to show that the project does not impact on the $PM_{2.5}$ limit value as if compliance with the PM_{10} limit is achieved then compliance with the $PM_{2.5}$ limit will also be achieved. Historically modelling of carbon monoxide (CO) and benzene was required however, this is no longer needed as concentrations of these pollutants have been monitored to be significantly below their air quality limit values in recent years, even in urban centres (EPA, 2021a). The key pollutant reviewed in this assessment is NO_2. Concentrations of PM_{10} have been modelled for the base year to indicate that there are no potential compliance issues. Modelling of operational NO_2 concentrations has been conducted for the base year (2017) and the do nothing and do something scenarios for the opening year (2024), design year (2039) and future year (2054).

The UK Highways Agency guidance *LA 150* (2019a) scoping criteria outlined in Section 2.2.1 was used to determine the road links required for inclusion in the modelling assessment. The TII guidance (2011) states that the assessment must progress to detailed modelling if:

- Concentrations exceed 90% of the air quality limit values when assessed by the screening method; or
- Sensitive receptors exist within 50m of a complex road layout (e.g. grade separated junctions, hills etc).

Sensitive receptors within 200m of impacted road links are included within the modelling assessment. Pollutant concentrations are calculated at these sensitive receptor locations to determine the impact of the proposed development in terms of air quality. The guidance states a proportionate number of representative receptors which are located in areas which will experience the highest concentrations or greatest improvements as a result of the proposed development are to be included in the modelling (UK Highways Agency, 2019a). The TII guidance (2011) defines sensitive receptor locations as: residential housing, schools, hospitals, places of worship, sports centres and shopping areas, i.e. locations where members

of the public are likely to be regularly present. A total of five high sensitivity residential receptors (R1 – R5) were included in the modelling assessment and are detailed in Figure 1.

Figure 1 Sensitive Receptors used in Local Air Quality Modelling Assessment

The following model inputs are required to complete the assessment using the DMRB spreadsheet tool: road layouts, receptor locations, annual average daily traffic movements (AADT), percentage heavy goods vehicles (%HGV), annual average traffic speeds and background concentrations. Using this input data, the model predicts the road traffic contribution to ambient ground level concentrations at the worst-case sensitive receptors using generic meteorological data. The DMRB model uses conservative emission factors, the formulae for which are outlined in the DMRB Volume 11 Section 3 Part 1 – HA 207/07 Annexes B3 and B4. These worst-case road contributions are then added to the existing background concentrations to give the worst-case predicted ambient concentrations. The worst-case ambient concentrations are then compared with the relevant ambient air quality standards to assess the compliance of the proposed development with these ambient air quality standards.

The TII document *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (2011) details a methodology for determining air quality impact significance criteria for road schemes which can be applied to any project that causes a change in traffic. The degree of impact is determined based on both the absolute and relative impact of the proposed development. The TII significance criteria have been adopted for the proposed development and are detailed Table 2 to Table 4. The significance criteria are based on NO_2 and PM_{10} as these pollutants are most likely to exceed the annual mean limit values (40 µg/m^3).

Magnitude of Change	Annual Mean NO_2 / PM_{10}	No. days with PM_{10} concentration > 50 µg/m^3	Annual Mean $PM_{2.5}$
Large	Increase / decrease ≥4 µg/m^3	Increase / decrease >4 days	Increase / decrease ≥2.5 µg/m^3
Medium	Increase / decrease 2 - <4 µg/m^3	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 µg/m^3
Small	Increase / decrease 0.4 - <2 µg/m^3	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 µg/m^3
Imperceptible	Increase / decrease <0.4 µg/m^3	Increase / decrease <1 day	Increase / decrease <0.25 µg/m^3

Table 2 Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration Note 1		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

Note 1 Well Below Standard = <75% of limit value.

Table 3 Air Quality Impact Significance Criteria For Annual Mean NO_2 and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration		
	Small	**Medium**	**Large**
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

Table 4 Air Quality Impact Significance Criteria For Changes to Number of Days with PM_{10} Concentration Greater than 50 µg/m^3 at a Receptor

2.3.1.1 Conversion of NOx to NO_2

NO_X (NO + NO_2) is emitted by vehicles exhausts. The majority of emissions are in the form of NO, however, with greater diesel vehicles and some regenerative particle traps on HGVs the proportion of NO_X emitted as NO_2, rather than NO is increasing. With the correct conditions (presence of sunlight and O_3) emissions in the form of NO, have the potential to be converted to NO_2.

Transport Infrastructure Ireland states the recommended method for the conversion of NOx to NO_2 in "*Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*" (2011). The TII guidelines recommend the use of DEFRAs NOx to NO_2 calculator (2020) which was originally published in 2009 and is currently on version 8.1. This calculator (which can be downloaded in the form of an excel spreadsheet) accounts for the predicted availability of O_3 and proportion of NOx emitted as NO for each local authority across the UK. O_3 is a regional pollutant and therefore concentrations do not vary in the same way as concentrations of NO_2 or PM_{10}.

The calculator includes Local Authorities in Northern Ireland and the TII guidance recommends the use of 'Armagh, Banbridge and Craigavon' as the choice for local authority when using the calculator. The choice of Craigavon provides the most suitable relationship between NO_2 and NO_x for Ireland. The "All Non-Urban UK Traffic" traffic mix option was used.

2.3.1.2 Update to NO_2 Projections using DMRB

In 2011 the UK DEFRA published research (Highways England, 2013) on the long term trends in NO_2 and NO_X for roadside monitoring sites in the UK. This study marked a decrease in NO_2 concentrations between 1996 and 2002, after which the concentrations stabilised with little reduction between 2004 and 2010. The result of this is that there now exists a gap between projected NO_2 concentrations which UK DEFRA previously published and monitored concentrations. The impact of this 'gap' is that the DMRB screening model can under-predict NO_2 concentrations for predicted future years. Subsequently, the UK Highways Agency published an Interim advice note (IAN 170/12) in order to correct the DMRB results for future years. This methodology has been used in the current assessment to predict future concentrations of NO_2 as a result of the proposed development.

2.3.1.3 Traffic Data Used in Modelling Assessment

Traffic flow information was obtained from Tramore House Regional Design Office engineers for the purposes of this assessment. The projected traffic for the high growth scenario has been used in this assessment to provide a worst-case approach. It is expected that all traffic will transfer to the proposed new alignment and in this regard, the do-nothing and do-something traffic will effectively be the same. Therefore, the only change between the existing and the proposed scenario in terms of air quality is the proximity to receptors and a change in traffic speeds. The modelling for the baseline and do nothing scenarios has been conducted at a speed of 80 kph and for the do something scenario at a speed of 70 kph for Ch 0 to Ch 415 as a worst case assessment and 100 kph for Ch 415 to end as per Table 7.1 of the preliminary design report.

Modelling has been conducted for the base year 2017, and the do nothing and do something scenarios for the opening year 2024, design year 2039 and future year 2054. The traffic data is detailed in Table 5. Background concentrations have been included as per Section 3.2 based on available EPA background monitoring data (EPA, 2021a). This traffic data has also been used in the operational stage climate impact assessment.

Road Name		Base	DN	DS	DN	DS	DN	DS
		2017	2024		2039		2054	
N24	AADT	7,875	8,642		10,051		11,187	
	%HGV	5.2%	5.8%		6.8%		8%	

Table 5 Traffic Data used in Modelling Assessment

2.3.2 Air Quality Impact on Ecological Sites

For routes that pass within 2 km of a designated area of conservation (either Irish or European designation) the TII requires consultation with an ecologist (TII, 2011). However, in practice the potential for impact to an ecological site is highest within 200 m of the proposed scheme and when significant changes in AADT (>5%) occur. Only sites that are sensitive to nitrogen deposition should be included in the assessment. In addition, the UK Highways Agency (2019a) states that a detailed assessment does not need to be conducted for areas that have been designated for geological features or watercourses.

Transport Infrastructure Ireland's *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (2009) and *Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities* (DEHLG, 2010) provide details regarding the legal protection of designated conservation areas.

If both of the following assessment criteria are met, an assessment of the potential for impact due to nitrogen deposition should be conducted:

- A designated area of conservation is located within 200 m of the proposed development.
- A significant change in AADT flows (>5%) will occur.

There are no ecological sites within 200 m of the existing or proposed alignment and therefore a detailed assessment has been scoped out.

2.3.3 Climate Assessment

The UK Highways Agency has published an updated DMRB guidance document in relation to climate impact assessments *LA 114 Climate* (UK Highways Agency 2019b). The following scoping criteria are used to determine whether a detailed climate assessment is required for a proposed project during the operational stage. If any of the road links impacted by the proposed development meet or exceed the below criteria, then further assessment is required.

- A change of more than 10% in AADT.
- A change of more than 10% to the number of heavy-duty vehicles.
- A change in daily average speed of more than 20 km/hr.

The speed limit for the proposed scheme is proposed to change from 80 kph to 100 kph which is within the criteria of a 20 kph change. As a result, a detailed modelling assessment has been conducted.

The impact of the proposed scheme at a national / international level has been determined using the procedures given by Transport Infrastructure Ireland (2011) and the methodology provided in Annex D in the UK Design Manual for Roads and Bridges (UK Highways Agency, 2007). The assessment focused on determining the resulting change in emissions of carbon dioxide (CO_2). The Annex provides a method for the prediction of the regional impact of emissions of these pollutants from road schemes. The inputs to the air dispersion model consist of information on road link lengths, AADT movements and annual average traffic speeds (see Table 5).

3.0 BASELINE ENVIRONMENT

3.1 Meteorological Data

A key factor in assessing temporal and spatial variations in air quality are the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels) (WHO, 2006). Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles ($PM_{2.5}$ - PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

The windrose from Johnstown Castle Meteorological Station for the years 2016 – 2020 is shown in Figure 2. Johnstown Castle Meteorological Station is located circa 50 km east of the proposed scheme. Johnstown Castle meteorological station is considered the most representative of the conditions in the region of the proposed scheme. The windrose indicates the prevailing wind speed and direction over the five-year period. The prevailing wind direction is westerly to south-westerly in direction, with generally moderate wind speeds.

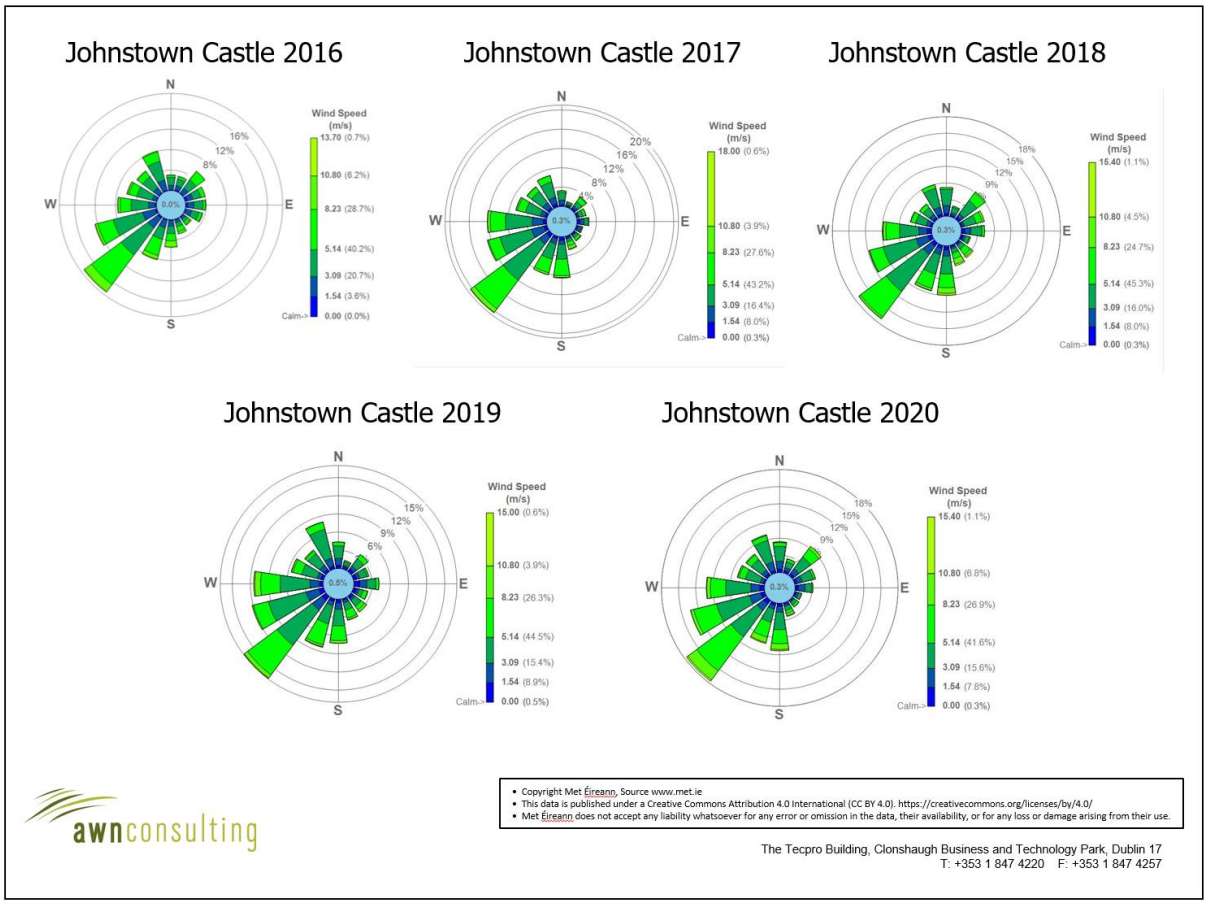

Figure 2 Johnstown Castle Windrose 2016 – 2020

3.2 Baseline Air Quality

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality in Ireland is "*Air Quality In Ireland 2020*" (EPA, 2021a). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments (EPA, 2021b). The TII guidance (2011) suggests the use of publicly available monitoring data where possible in the absence of on-site monitoring data. The data from the EPA provides long-term background data for the region of the site and is considered an appropriate source of background data for the purposes of this assessment.

As part of the implementation of the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2021a). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D.

In terms of air monitoring and assessment, the proposed scheme is within Zone D (EPA, 2021a). The long-term monitoring data has been used to determine background concentrations for the key pollutants in the region of the proposed scheme. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

In 2020 the EPA reported (EPA, 2021a) that Ireland was compliant with EU legal air quality limits at all locations, however this was largely due to the reduction in traffic due to Covid-19 restrictions. The EPA *Air Quality in Ireland 2021* report details the effect that the Covid-19 restrictions had on air monitoring stations, which included reductions of up to 50% at some monitoring stations which have traffic as a dominant source. The report also notes that CSO figures show that while traffic volumes are still slightly below 2019 levels, they have significantly increased since 2020 levels. 2020 concentrations are therefore predicted to be an exceptional year and not consistent with long-term trends. For this reason, they have not been included in the baseline section and previous long-term data has been used to determine baseline levels of pollutants in the vicinity of the proposed scheme.

NO_2 monitoring was carried out at two rural Zone D locations, Emo and Kilkitt and in two urban areas, Enniscorthy and Castlebar (EPA, 2021a) (see Table 6). The NO_2 annual average in 2019 for Castlebar was 8 µg/m^3. The rural Zone D locations of Emo and Kilkitt recorded results of 4 µg/m^3 and 5 µg/m^3 in 2019 respectively. Long-term average concentrations measured at all Zone D locations were significantly lower than the annual average limit value of 40 µg/m^3. The average results over the last five years in Kilkitt and Emo suggests an upper average of no more than 5 µg/m^3 as a background concentration for a completely rural area as shown in Table 6. The annual average results over the last five years in Castlebar and Enniscorthy indicate an upper average concentration of no more than 10 µg/m^3. Based on the above information, a conservative estimate of the current background NO_2 concentration for the region of the proposed scheme is 10 µg/m^3.

Station	Averaging Period [Note 1]	Year				
		2015	2016	2017	2018	2019
Castlebar	Annual Mean NO_2 (µg/m^3)	8	9	7	8	8
	Max 1-hr NO_2 (µg/m^3)	96	91	112	92	86
KilKitt	Annual Mean NO_2 (µg/m^3)	2	3	2	3	5
	Max 1-hr NO_2 (µg/m^3)	97	80	25	37	59
Emo	Annual Mean NO_2 (µg/m^3)	3	4	3	3	4
	Max 1-hr NO_2 (µg/m^3)	34	194	33	91	56
Enniscorthy	Annual Mean NO_2 (µg/m^3)	9	10	-	-	-
	Max 1-hr NO_2 (µg/m^3)	87	136	-	-	-

Note 1 Annual average limit value - 40 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Table 6 Trends In Zone D Air Quality - Nitrogen Dioxide (NO_2)

Long-term PM_{10} monitoring was carried out at the urban Zone D locations of Castlebar, Enniscorthy and Claremorris over the period 2015 – 2019 and the rural location of Kilkitt. The annual average results over the last five years at rural Zone D locations suggests an upper average of 12 µg/m^3 as an annual average background concentration as shown in Table 7 and 16 µg/m^3 for the urban sites. Based on the EPA data, a conservative estimate of the current background PM_{10} concentration in the region of the proposed scheme is 16 µg/m^3.

Station	Averaging Period	Year				
		2015	2016	2017	2018	2019
Castlebar	Annual Mean PM_{10} (µg/m^3)	13	12	11	11	16
	24-hr Mean > 50 µg/m^3 (days)	2	1	1	0	1
Kilkitt	Annual Mean PM_{10} (µg/m^3)	9	8	8	9	7
	24-hr Mean > 50 µg/m^3 (days)	1	0	0	0	1
Claremorris	Annual Mean PM_{10} (µg/m^3)	10	10	11	12	11
	24-hr Mean > 50 µg/m^3 (days)	0	0	1	0	0
Enniscorthy	Annual Mean PM_{10} (µg/m^3)	18	17	-	-	18
	24-hr Mean > 50 µg/m^3 (days)	9	7	-	-	14

Note 1 Annual average limit value - 40 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Table 7 Trends In Zone D Air Quality – PM_{10}

Continuous $PM_{2.5}$ monitoring carried out at the Zone D location of Claremorris showed $PM_{2.5}/PM_{10}$ ratios ranging from 0.36 – 0.60 over the period 2015 – 2019. Based on this information, a conservative ratio of 0.7 was used to generate a background $PM_{2.5}$ concentration in the region of the proposed scheme of 11.2 µg/m^3.

Background concentrations for the opening year of 2024, design year of 2039 and future year of 2054 have been calculated. These have used current estimated background concentrations and the year on year reduction factors provided by Transport Infrastructure Ireland in the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (2011) and the UK Department for Environment, Food and Rural Affairs LAQM.TG(16) (2018).

3.3 Climate Baseline

Anthropogenic emissions of greenhouse gases in Ireland included in the EU 2020 strategy are outlined in the most recent review by the EPA which details provisional emissions up to 2020 (EPA, 2021c). The data published in 2021 states that Ireland will exceed its 2020 annual limit set under the EU's Effort Sharing Decision (ESD), 406/2009/EC1 by an estimated 6.73 Mt. For 2020, total national greenhouse gas emissions are estimated to be 57.70 million tonnes carbon dioxide equivalent (Mt CO_2eq) with 44.38 MtCO_2eq of emissions associated with the ESD sectors for which compliance with the EU targets must be met. Agriculture was the largest contributor in 2020 at 37.1% of the total, with the transport sector accounting for 17.9% of emissions of CO_2.

GHG emissions for 2020 are estimated to be 3.6% lower than those recorded in 2019. Emission reductions have been recorded in 6 of the last 10 years. However, compliance with the annual EU targets has not been met for five years in a row. Emissions from 2016 – 2020 exceeded the annual EU targets by 0.29 MtCO_2eq, 2.94 MtCO_2eq, 5.57 MtCO_2eq, 6.85 MtCO_2eq and 6.73 MtCO_2eq respectively. Agriculture is consistently the largest contributor to emissions with emissions from the transport and energy sectors being the second and third largest contributors respectively in recent years.

The EPA 2020 GHG Emissions Projections Report for 2020 – 2040 (EPA, 2021d) notes that there is a long-term projected decrease in greenhouse gas emissions as a result of inclusion of new climate mitigation policies and measures that formed part of the National Development Plan (NDP) which was published in 2018 and the Climate Action Plan published in 2019. Implementation of these are classed as a "*With Additional Measures scenario*" for future scenarios. A change from generating electricity using coal and peat to wind power and diesel vehicle engines to electric vehicle engines are envisaged under this scenario. While emissions are projected to decrease in these areas, emissions from agriculture are projected to grow

steadily due to an increase in animal numbers. However, over the period 2013 to 2020 Ireland is projected to cumulatively exceed its compliance obligations with the EU's Effort Sharing Decision (Decision No. 406/2009/EC) 2020 targets by approximately 12.2MtCO_2eq under the "With Existing Measures" scenario and under the "With Additional Measures" scenario. The projections indicate that Ireland can meet its non-ETS EU targets over the period 2021 – 2030 assuming full implementation of the 2019 Climate Action Plan (and updated 2021 Climate Acton Plan) and the use of the flexibilities available (EPA, 2021d). The non-ETS sector includes all domestic GHG emitters which do not fall under the ETS scheme and thus includes GHG emissions from transport, residential and commercial buildings and agriculture.

4.0 CHARACTERISTICS OF THE PROPOSED SCHEME

The proposed scheme is located just north-west of Mooncoin village, Co. Kilkenny. The predominant land use in the vicinity of the scheme is primarily farmland and linear residential housing along the length of the existing route. Air quality and climate impacts have been considered for both the construction and operational phases of the scheme.

During the construction phase of the development there will be different sources of potential air quality impacts, primarily construction dust emissions. Construction plant, machinery and site vehicles are a source of GHG emissions which have the potential to impact climate. In addition, the embodied GHG emissions associated with the construction materials for the scheme and their transport to site have the potential to impact climate. The primary sources of air and climatic emissions in the operational context are deemed long term and will involve the change in traffic flows in the local area which are associated with the scheme. The following describes the primary sources of potential air quality and climate impacts which have been assessed as part of this report.

5.0 POTENTIAL IMPACTS OF THE PROPOSED SCHEME

5.1 Construction Phase

5.1.1 Air Quality

The greatest potential impact on air quality during the construction phase of the proposed development is from construction dust emissions and the potential for nuisance dust and PM_{10}/$PM_{2.5}$ emissions. Due to the size and nature of the scheme it can be categorised as minor, indicating that there are potential dust soiling effects within 25 m of the works areas (Table 8). While construction dust tends to be deposited within 350 m of a construction site, the majority of the deposition occurs within the first 50 m. There are a small number of sensitive receptors, predominantly residential properties in close proximity to the proposed scheme. In order to minimise dust emissions during construction, a series of mitigation measures have been prepared (see Section 6.1). Provided the dust minimisation measures are adhered to, the air quality impacts during the construction phase will not be significant.

Source		Potential Distance for Significant Effects (Distance From Source)		
Scale	**Description**	**Soiling**	**PM_{10}**	**Vegetation Effects**
Major	Large construction sites, with high use of haul roads	100m	25m	25m
Moderate	Moderate sized construction sites, with moderate use of haul roads	50m	15m	15m
Minor	Minor construction sites, with limited use of haul roads	25m	10m	10m

Source: TII Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (2011)

Table 8 Assessment Criteria for the Impact of Dust from Construction, with Standard Mitigation in Place

There is also the potential for traffic emissions to impact air quality in the short-term over the construction phase. Particularly due to the increase in HGVs accessing the site. The construction stage traffic has been reviewed and a detailed air quality assessment has been scoped out as none of the road links impacted by the proposed development satisfy the DMRB assessment criteria in Section 2.2.1. It can therefore be determined that the construction stage traffic will have an imperceptible, localised, neutral and short-term impact on air quality.

5.1.2 Climate

The construction phase of the proposed scheme will result in a number of GHG emissions from various sources. Embodied carbon is carbon dioxide emitted during the manufacture, transport and construction of building materials, together with end of life emissions. As part of the proposed road development, construction stage embodied GHG emissions are categorised under the following headings within the TII Carbon Calculator v2 (2020):

- Pre-Construction
- Embodied Carbon of Materials
- Construction Activities
- Construction Waste

Transport GHG emissions associated with delivery of materials to site and removal of waste materials off site can also be included in the calculator, however this information (i.e confirmed locations) is not known at this stage in the project and will be specified during the detailed design/ procurement stages. Best estimates of material quantities, land clearance requirements and waste materials have been input into the carbon tool to account for the embodied carbon associated with the proposed scheme. However, more detailed information will not be known until the detailed design, tendering, procurement and construction stages and therefore not all aspects of the development can be accounted for at this stage.

It is estimated there will be a total of 32,669 m^3 of excavated material as part of the proposed development (11,185 m^3 topsoil and 21,484 m^3 other materials). Approximately 5.82 tonnes of waste aggregate/soil will require transport off-site to a licenced waste processing facility. There is the requirement for approximately 9.94 ha of general land clearance works required as part of the pre-construction activities. Approximately 33,700 m^2 of granular material is required for the construction works.

Table 9 details the embodied carbon emissions associated with each category. The embodied carbon associated with construction materials is the largest contributor to GHG emissions during the construction phase at 70% of the total.

Emissions have been compared against the total national GHG emissions in Ireland for 2020 (57,700,000 tonnes CO_2eq) and against Ireland's EU 2030 target of 33,381,312 tonnes CO_2eq (set out under *Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013*).

The proposed road development will result in total construction phase emissions of 116.1 tonnes CO_2e over the 15-month construction period, this amounts to 0.0002% of Ireland's national GHG emissions in 2020 or 0.0003% of Ireland's 2030 target. The predicted impact to climate during the construction phase is short-term, negative but overall, not significant.

Activity	**Tonnes CO_2e / Total**
Pre-Construction	4.4
Embodied Carbon	81.1
Construction Activities	30.5
Construction Waste	0.1
Total Construction Phase Emissions	**116.1**
Total Emissions as % of Irelands Total GHG emissions (2020 actual)	0.0002%
Total Emissions as % of Irelands 2030 GHG emission target	0.0003%

Table 9 Construction Stage Greenhouse Gas Emissions

5.2 Operational Phase

5.2.1 Air Quality

The impact of the proposed development has been assessed by modelling emissions from the traffic generated as a result of the development. The impact of NO_2 emissions for the opening, design and future years was predicted at the nearest sensitive receptors to the development. This assessment allows the significance of the development, with respect to both relative and absolute impacts, to be determined.

Transport Infrastructure Ireland's document '*Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes'* (2011) detail a methodology for determining air quality impact significance criteria for road schemes and this can be applied to any development that causes a change in traffic. The degree of impact is determined based on both the absolute and relative impact of the proposed development. Results are compared against the 'Do-Nothing' scenario, which assumes that the proposed development is not in place in future years, in order to determine the degree of impact. Impacts were assessed at 5 no. worst-case sensitive receptors, residential properties (R1 – R5), within 200m of the existing and proposed scheme (see Figure 1).

The results of the assessment of the impact of the proposed development on NO_2 in the opening year 2024 are shown in Table 10, for design year 2039 are shown in Table 11 and for future year 2054 are shown in Table 12. The annual average concentration is in compliance with the limit value at all worst-case receptors in 2024, 2039 and 2054. Concentrations of NO_2 are at most 35% of the annual limit value in 2024, 36% of the annual limit in 2039 and 39% of the annual limit in 2054. In addition, the hourly limit value for NO_2 is 200 µg/m^3 and is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2 concentration is not predicted to be exceeded in any modelled year (Table 13).

The impact of the proposed development on annual mean NO_2 concentrations can be assessed relative to "Do Nothing (DN)" levels. Relative to baseline levels, there are predicted to be some imperceptible to large increases and decreases in NO_2 concentrations at the worst-case receptors assessed. Concentrations will increase by at most 0.93 µg/m^3 in 2054 at receptor R5. While at receptor R2 concentrations will decrease by at most 5.89 µg/m^3 in 2054. Using the assessment criteria outlined in Table 2 and Table 3 the impact of the proposed development in terms of NO_2 is considered negligible. Therefore, the overall impact of NO_2 concentrations as a result of the proposed scheme is long-term, positive and imperceptible.

Concentrations of PM_{10} were modelled for the baseline year of 2017. The modelling showed that concentrations were in compliance with the annual limit value of 40 µg/m^3 at all receptors assessed, therefore, further modelling for the opening and design years was not required. Concentrations reached at most 0.60 µg/m^3. When a background concentration of 16 µg/m^3 is included, the overall impact is 42% of the annual limit value at the worst case receptor.

As the proposed alignment moves traffic away from the receptors along the existing alignment the is an overall positive impact to the air quality at these locations. The impact of the proposed development on ambient air quality in the operational stage is considered long-term, localised, positive and imperceptible.

Receptor	Opening Year 2024				
	DN	DS	DS-DN	Magnitude	Description
R1	15.0	14.2	-0.81	Small Decrease	Negligible
R2	14.6	11.1	-3.53	Medium Decrease	Negligible
R3	13.0	11.1	-1.84	Small Decrease	Negligible
R4	15.0	12.3	-2.68	Medium Decrease	Negligible
R5	12.9	13.5	0.58	Small Increase	Negligible

Table 10 Predicted Annual Mean NO_2 Concentrations – Opening Year 2024 (µg/m^3)

Receptor	Design Year 2039				
	DN	DS	DS-DN	Magnitude	Description
R1	15.6	14.5	-1.11	Small Decrease	Negligible
R2	15.1	10.1	-4.95	Large Decrease	Negligible
R3	13.0	10.3	-2.67	Medium Decrease	Negligible
R4	15.5	11.8	-3.73	Medium Decrease	Negligible
R5	12.9	13.7	0.80	Small Increase	Negligible

Table 11 Predicted Annual Mean NO_2 Concentrations – Design Year 2039 (µg/m^3)

Receptor	Future Year 2054				
	DN	DS	DS-DN	Magnitude	Description
R1	16.7	15.4	-1.29	Small Decrease	Negligible
R2	16.2	10.3	-5.89	Large Decrease	Negligible
R3	13.6	10.4	-3.17	Medium Decrease	Negligible
R4	16.7	12.2	-4.46	Large Decrease	Negligible
R5	13.5	14.4	0.93	Small Increase	Negligible

Table 12 Predicted Annual Mean NO_2 Concentrations – Future Year 2054 (µg/m^3)

Receptor	Opening Year 2024		Design Year 2039		Future Year 2054	
	DN	DS	DN	DS	DN	DS
R1	52.4	49.6	54.5	50.6	58.5	54.0
R2	51.1	38.8	52.8	35.5	56.5	35.9
R3	45.4	38.9	45.5	36.1	47.4	36.4
R4	52.4	43	54.4	41.3	58.5	42.8
R5	45.2	47.2	45.2	48	47.1	50.4

Table 13 Predicted 99.8th percentile of Daily Maximum 1-hour NO_2 Concentrations ($\mu g/m^3$)

5.2.2 Climate

Climate change has the potential to alter weather patterns and increase the frequency of rainfall in future years. As a result of this there is the potential for flooding related impacts on site in future years. A detailed flood risk assessment has been undertaken as part of this planning application and adequate attenuation and drainage have been provided for to account for increased rainfall in future years. Therefore, the impact will be imperceptible, localised, neutral and long-term.

There is the potential for a number of greenhouse gas emissions to atmosphere during the operational phase of the development. However, it is predicted that all existing traffic will divert on to the new route and the do nothing traffic is the same as that for the do something scenario. The only change between the do nothing and do something scenarios is that there is a predicted increase in the average speed travelled along the new alignment. The average speed for the do nothing scenario is 80kph with the average speed for the do something scenario 100kph.

The predicted concentrations of CO_2 for the future years of 2024, 2039 and 2054 are detailed in Table 14. The CO_2 emissions are significantly less than the GHG targets set out under EU legislation. It is predicted that in 2024 the proposed development will increase CO_2 emissions by 0.00053% of the EU 2024 target. In 2039 and 2054 CO_2 emissions will increase by 0.00074% and 0.00084% of the 2030 target respectively (targets past 2030 are not available for comparison purposes). Therefore, the climate impact of the proposed development is considered negative, long-term and imperceptible.

Year	Scenario	CO_2 (tonnes/annum)
2024	Do Nothing	1,257
	Do Something	1,468
2039	Do Nothing	1,518
	Do Something	1,766
2054	Do Nothing	1,765
	Do Something	2,043
Increment in 2024		211.1 Tonnes
Increment in 2039		248.1 Tonnes
Increment in 2054		278.8 Tonnes
Emission Ceiling (kilo Tonnes) 2024		**40,113** Note 1
Emission Ceiling (kilo Tonnes) 2030		**33,381** Note 1
Impact in 2024 (%)		0.00053 %
Impact in 2039 (%)		0.00074 %
Impact in 2054 (%)		0.00084 %

Note 1 Target under *Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013*

Table 14 Climate Impact Assessment

6.0 MITIGATION MEASURES

6.1 Construction Phase

6.1.1 Air Quality

The greatest potential impact on air quality during the construction phase is from construction dust emissions and the potential for nuisance dust.

In order to minimise dust emissions during construction, a series of mitigation measures have been prepared. These follow recommendations and guidance contained in the Institute of Air Quality Management document '*Guidance on the Assessment of Dust from Demolition and Construction'* (IAQM, 2014). Provided the dust minimisation measures outlined below are adhered to, the air quality impacts during the construction phase will not be significant. The measures which will be implemented will include:

- Hard surface roads shall be swept to remove mud and aggregate materials from their surface while any un-surfaced roads shall be restricted to essential site traffic.
- Any road that has the potential to give rise to fugitive dust shall be regularly watered, as appropriate, during dry and/or windy conditions.
- Vehicles exiting the site shall make use of a wheel wash facility where appropriate, prior to entering onto public roads.
- Vehicles using site roads shall have their speed restricted, and this speed restriction shall be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates.

- Vehicles delivering material with dust potential (soil, aggregates) shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust.

- Before entrance onto public roads, trucks shall be adequately inspected to ensure no potential for dust emissions.

- Public roads outside the site shall be regularly inspected for cleanliness and cleaned, as necessary.

- Material handling systems and site stockpiling of materials shall be designed and laid out to minimise exposure to wind. Water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods.

- Access gates to site shall be located at least 10 m from sensitive receptors where possible.

- Vehicles shall have engines switched off when stationary – no idling. Similarly, the use of diesel or petrol powered generators shall be avoided, and electricity or battery powered equipment shall be used when practical.

At all times, these procedures will be strictly monitored and assessed by the site contractor. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust shall be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations. The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board shall also include head/regional office contact details. Community engagement before works commence on site shall be put in place, including a communications plan. All dust and air quality complaints shall be recorded and causes identified, along with the measures taken to reduce emissions.

6.1.2 Climate

The embodied energy of construction materials are expected to be the dominant source of greenhouse gas emissions as a result of the construction phase of the development. Good practice to ensure emissions are reduced where possible is the prevention of on-site or delivery vehicles from leaving engines idling, even over short periods. Minimising waste of materials due to poor timing or over ordering on site will aid to minimise the embodied carbon footprint of the site.

6.2 Operational Phase

6.2.1 Air Quality

The operational phase air quality impact is considered imperceptible and therefore no site specific mitigation measures are required. In general mitigation measures in relation to traffic-derived pollutants have focused generally on improvements in both engine technology and fuel quality. EU legislation, based on the EU sponsored Auto-Oil programmes, has imposed stringent emission standards for key pollutants (Regulation (EC) No 715/2007) for passenger cars which was complied with in 2009 (Euro V) and 2014 (Euro VI). Current emission standards which took effect in 2017 are Euro 6c and Euro $6d_{temp}$.

Emissions of pollutants from road traffic can be controlled most effectively by either diverting traffic away from heavily congested areas or ensuring free flowing traffic through good traffic management plans and the use of automatic traffic control systems (UK DEFRA, 2016; 2018).

The Climate Action Plan 2019 (Government of Ireland, 2019a) outlined a number of actions to reduce the use of petrol/diesel vehicles and promote the uptake of electric vehicles. The 2021 CAP also promotes these measures or enhances them in order to achieve the target of 845,000 electric vehicles on the road by 2030. The measures proposed include changes to VRT and motor tax to allow for this to be calculated based on CO_2eq, therefore higher emitting vehicles will pay increased tax rates, thus incentivising the purchase of lower emitting vehicles. VRT relief and Benefit in Kind exemptions as well as a vehicle scrappage scheme are among other measures proposed. In addition, as part of Budget 2020, a NO_X emissions levy to all passenger cars was introduced from January 2020. The levy will be charged on a NO_X mg per kilometre basis. Overall, these measures will reduce pollutant levels in future years thus improving air quality.

6.2.2 Climate

The operational phase climate impacts are considered imperceptible and therefore no site specific mitigation measures are required. In general, improvements in climate are likely over the next few years as a result of the on-going comprehensive vehicle inspection and maintenance program, fiscal measures to encourage the use of alternatively fuelled vehicles and the introduction of cleaner fuels.

Ireland has developed strategies for implementing the Paris Agreement which aims to limit global temperature rise to below 2^{o}C above pre-industrial levels. The first 'Climate Action Plan' (CAP) was published by the Irish Government in June 2019 with the second Climate Action Plan published in November 2021 (Government of Ireland, 2021a). The 2021 CAP contains similar elements as the 2019 CAP and aims to set out how Ireland can reduce our greenhouse gas emissions by 51% by 2030 (compared to 2018 levels) which is in line with the EU ambitions, and a longer-term goal of to achieving net-zero emissions no later than 2050. The 2021 CAP outlines a 42 – 50% reduction in transport sector emissions by 2030 relative to 2018 levels. Stating emissions need to reach no more than 6 - 7 MtCO_2e by 2030.

The 2021 CAP outlines a range of targets for achieving the required reduction in transport sector emissions including:

- Increasing the number of passenger electric vehicles (EVs) on the road to 845,000 by 2030;
- Achieving a target of 95,000 electric vans and 3,500 low emitting trucks by 2030;
- Procuring 1,500 low-emission buses for public transport in cities; and
- Increasing the biofuel blend rate from the current E5 and B5 blends to E10 and B12 in petrol and diesel, respectively.

In addition, the 2021 CAP aims to achieve 500,000 (14%) additional public transport and active travel journeys per day and to reduce internal combustion engine (ICE) car kilometres by c. 10% in order to achieve the 2030 target. The measures outlined within the 2021 CAP are in addition to or enhance the measures previously proposed within the 2019 CAP. The 2019 CAP proposed the introduction of new legislation to ban the sale of fossil fuel cars from 2030 and to stop granting National Car Test (NCT) certificates from 2045 to fossil fuel cars. In addition, at the EU level, carbon emissions from vehicles are continuing to reduce with a target of 130g of CO_2/km applied to new passenger cars since 2015, reducing to 95g of CO_2/km by 2021.

In July 2021, the Climate Action and Low Carbon Development (Amendment) Act 2021 (referred hereafter as the "Climate Act") was published in which amends and enhances the

2015 Climate Act. The 2021 Climate Act will '*provide for carbon budgets and a decarbonisation target range for certain sectors of the economy*'.

7.0 CONCLUSIONS

There is the potential for some dust emissions to occur during the construction phase of the scheme. With the implementation of the mitigation measures outlined in Section 6.1.1 dust impacts will be short-term and imperceptible and will pose no nuisance issue at nearby sensitive receptors.

The embodied CO_2 emissions associated with the construction materials and their transport to site are considered insignificant in terms of Ireland's total annual GHG emissions. Construction stage climate impacts have been assessed to be short-term, negative and imperceptible.

Overall, during operation, the proposed scheme will have an imperceptible impact on air quality at all worst-case receptors assessed. As there are no predicted changes to the traffic flows along the proposed alignment when compared with the do nothing scenario the predicted change in emissions is associated with increased vehicles speeds along the proposed alignment. There is a predicted improvement in air quality at the majority of receptors assessed due to the proposed alignment being further from the properties than the existing alignment. While this is considered a positive impact, it is overall imperceptible.

The operational phase climate impact is considered long-term, negative and imperceptible due to the proposed scheme. As there are no predicted changes to the traffic flows along the proposed alignment when compared with the do nothing scenario the predicted change in emissions is associated with increased vehicles speeds along the proposed alignment. The operational phase traffic emissions will be significantly below Ireland's national EU 2030 target.

References

Department of the Environment, Heritage and Local Government (2004) Quarries and Ancillary Activities, Guidelines for Planning Authorities

Department of the Environment, Heritage and Local Government (2010) Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities

Environmental Protection Agency (2015) Advice Notes for Preparing Environmental Impact Statements – Draft

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

Environmental Protection Agency (2021a) Air Quality Monitoring Report 2020 (& previous annual reports)

Environmental Protection Agency (2021b) EPA website Available at: http://www.epa.ie/whatwedo/monitoring/air/

Environmental Protection Agency (2021c) Ireland's Provisional Greenhouse Gas Emissions 1990 – 2020

Environmental Protection Agency (2021d) GHG Emissions Projections Report - Ireland's Greenhouse Gas Emissions Projections 2020 – 2040

German VDI (2002) Technical Guidelines on Air Quality Control – TA Luft

Government of Ireland (2015) Climate Action and Low Carbon Development Act

Government of Ireland (2019a) Climate Action Plan 2019

Government of Ireland (2019b) General Scheme for the Climate Action (Amendment) Bill 2019

Government of Ireland (2021a) Climate Action Plan 2021

Government of Ireland (2021b) Climate Action and Low Carbon Development (Amendment) Act 2021

Institute of Air Quality Management (IAQM) (2014) Guidance on the Assessment of Dust from Demolition and Construction

Kilkenny County Council & Eastern and Midlands Climate Action Regional Office (2019) Kilkenny County Council Climate Change Adaptation Strategy 2019 – 2024

Met Éireann (2021) Met Eireann website: https://www.met.ie/

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

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

Transport Infrastructure Ireland (2020) Carbon Assessment Tool Version 2.0 (calculation spreadsheet & guidance document)

UK DEFRA (2016) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. PG(16)

UK DEFRA (2018) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. TG(16)

UK DEFRA (2020) NO_x to NO_2 Conversion Spreadsheet (Version 8.1)

UK Highways Agency (2007) Design Manual for Roads and Bridges Vol 11 Chapter 3, HA 207/07 (Document & Calculation Spreadsheet)

UK Highways Agency (2019a) Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 LA 105 Air quality

UK Highways Agency (2019b) UK Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 14 LA 114 Climate

World Health Organisation (2021) Air Quality Guidelines - Global Update 2021 (and previous Air Quality Guideline Reports 1999 & 2000 & 2005)