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Transport Infrastructure Ireland

TII Publications

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Air Quality Assessment of Proposed National Roads - Standard

PE-ENV-01107
December 2022

PE Planning & Evaluation

Standards

About TII

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TII Publications

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1. Introduction

Transport Infrastructure Ireland (TII) produces and manages a wide range of standards and technical documentation related to its areas of responsibility. These, and other publications, are available to users through the TII Publications system website:

www.tiipublications.ie

1.1 Purpose of this Standard

This Standard Document (SD) PE-ENV-01107 shall be used on proposed national road schemes to assess the potential air quality impacts.

The purpose of the SD is the following:

Box 1: Purpose of the SD

- To outline the application of Air Quality Assessment (AQA) during the planning of proposed national road schemes, motorway service areas, toll schemes, and any associated infrastructure.
- To apply AQA in a manner that is proportionate to the complexity, scale, and likely significance of air quality effects of a national road scheme, motorway service areas, toll scheme, and any associated infrastructure.
- Provide consistency to the consideration of AQA during the planning of a national road projects as set out in TII's Project Management Guidelines (PMG) (TII, 2020a), Project Manager's Manual for Major National Roads (PMM) (TII, 2019) and Project Appraisal Guidelines (PAG) (TII, 2022).

1.2 Using this Standard

This SD (PE-ENV-01107) sets out the step-by-step methodology for the analysis and the production of documents and deliverables as they relate to proposed national roads schemes and associated infrastructure, in terms of air quality. Subject to the overriding requirements in Section 1.9 Implementation, this SD shall be used on all schemes in relation to national roads developments and associated infrastructure.

The pollutants of most concern in relation to emissions from road traffic are nitrogen dioxide (NO_2) and particulate matter in the fractions of equal to or less than 10 µm (PM_{10}) and equal to or less than 2.5 µm ($PM_{2.5}$). In addition, the effects of ammonia and nitrogen oxides (NO_x) shall be considered with respect to the potential effects on sensitive designated habitats. During the construction phase potential effects associated with dust will also need consideration.

This SD is specific to air quality and is informed by, and shall be used in conjunction with existing TII Environmental Standards, Technical Documents and relevant Guidelines, including:

- TII Project Management Guidelines (PMG) (TII, 2020a);
- TII Project Manager's Manual (PMM) for Major National Road Projects (TII, 2019);
- Project Appraisal Guidelines (PAG) (TII, 2022); and

- Guidelines on the information to be contained in Environmental Impact Assessment Reports (Environment Protection Agency (EPA), 2022).

This SD should also be read in conjunction with the TII's Air Quality Assessment of Specified Infrastructure Projects Overarching Technical Guidance (OTD) (PE-ENV-01106). Where UK based guidance is referred to within the SD and OTD this is in the absence of equivalent Irish guidance. A comprehensive glossary of terms, abbreviations and acronyms are available in the OTD.

The Climate OTD and SD are also of relevance as air quality practitioners will be required to use these documents to guide the provision of road user carbon emissions calculations to Climate teams.

TII have developed the TII Road Emissions Model (REM) and the TII Carbon Tool, for use in the assessment of air quality and climate effects for national road schemes and these are described in the SD and OTD for air quality and climate respectively. TII should be contacted by the project team to request access to these tools. A summary of relevant documents and tools is summarised in Table 1.1.

Table 1.1 Relevant Documents and Tools

Document	Reference	Description
Air Quality OTD	PE-ENV-01106	Provides guidance on the methodology, scope and processes underlying the AQA for Specified Infrastructure Projects.
Climate OTD	PE-ENV-01104	Provides guidance on the methodology, scope and processes underlying climate assessment for Specified Infrastructure Projects
Climate SD	PE-ENV-01105	Sets out the methodology for Climate Assessment for proposed national roads and related infrastructure.
TII REM- Model Development Report*****	GE-ENV-01107	The TII REM tool calculates greenhouse and non-greenhouse gas emissions from road transport integrating traffic volumes and speeds for light and heavy vehicles on the Irish national road network with Irish fleet composition information.
TII Carbon Tool-User Guidance Document*****	GE-ENV-01106	The TII Carbon Tool is used for the calculation of emissions arising from the construction (e.g., embodied carbon in construction materials, energy, and fuel use) and maintenance emissions. The TII Carbon Tool uses a series of calculations, emission factors and assumptions to calculate a carbon footprint for proposed road and light rail projects.

** Please note that in order to get access to the REM and Carbon Tools, prospective users should email climatetools@tii.ie to be set up as an authorised user on the TII Web Application Portal.*

The SD is intended for use by a suitably qualified practitioner with appropriate skills, as defined in Section 1.68 of this document. The SD can also be used by project managers, environmental co-ordinators, designers, and contractors that may support the AQA.

1.3 Terms and Definitions

The following verbal forms are used:

- "shall" or "will" indicates a requirement.
- "should" indicates a recommendation.
- "may" indicates a permission.
- "can" indicates a possibility or a capability.

Information marked as “Note” is for guidance in understanding or clarifying the associated requirement.

1.4 Regulation and Policy Framework

European Union (EU) air quality legislation is provided within The Ambient Air Quality and Cleaner Air for Europe (CAFÉ) Directive 2008/50/EC, which is transcribed into Irish legislation by the Air Quality Standards Regulations 2011. The Air Quality Limit Values (AQLVs) are legally binding for Ireland and have been set with the aim of avoiding, preventing, or reducing harmful effects on human health and on the environment.

1.4.1 S.I. No. 180/2011 – Air Quality Standards Regulations 2011

The Air Quality Standards Regulations 2011 implement the European Union Directive 2008/EC/50 on Ambient Air Quality and CAFÉ and designate the Environmental Protection Agency (EPA) as the competent authority responsible for assessing ambient air quality in the territory of the State. The regulations establish legally binding AQLVs and alert thresholds for concentrations of certain pollutants in ambient air, to prevent or reduce harmful effects on human health and the environment. AQLVs were published for seven pollutants, with alert thresholds for an additional five pollutants. National assessments undertaken by the EPA (EPA, 2021) have demonstrated that there is no risk of carbon monoxide (CO), 1,3-butadiene, benzene, lead and sulphur dioxide (SO_2) concentrations exceeding the limits due to emissions from traffic anywhere in Ireland. The remaining pollutants are NO_2, PM_{10} and $PM_{2.5}$ with regards to human health and NO_x with regard to vegetation. The limit values for these pollutants are presented in Table 1.2.

Table 1.2 Relevant Air Quality Standards

Pollutant	Averaging Period	Limit Value
Nitrogen Dioxide (NO_2) Protection of Human Health	1 Hour	200 µg/m³ not to be exceeded more than 18 times a calendar year
	Annual Average	40 µg/m³
Nitrogen Oxides (NO_x) Protection of Vegetation	Annual Average	30 µg/m³
Particulate Matter (PM_{10})	24 Hour	50 µg/m³ not to be exceeded more than 35 times a year
	Annual Average	40 µg/m³
Particulate Matter ($PM_{2.5}$)	Annual Average	20 µg/m³

Source: S.I. No. 180/2011 – Air Quality Standards Regulations 2011

The results of the AQA are compared against these standards to determine if the effect of a proposed scheme will be significant for air quality.

1.4.2 Air Quality - Revision of EU Rules

In September 2021 the World Health Organisation (WHO) updated their air quality guidelines based on the latest scientific evidence for the protection of human health and the environment (WHO, 2021). The guidelines are more stringent than the current Ambient Air Quality Standards.

On 26 October 2022, as part of the European Green Deal, the Commission proposed to revise the Ambient Air Quality Directives. The revision aligns the air quality standards more closely with the recommendations of the World Health Organization. (European Commission (EC), 2022).

Should the Irish Air Quality Standards be updated to reflect new reduced thresholds, then the results of the AQA should be compared against these standards.

1.5 Environmental Impact Assessment Report (EIAR)

General guidance on the scope and detail of an EIAR is available in Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022). TII also prepared Environmental Impact Assessment of National Road Schemes – A Practical Guide, which helps to interpret earlier EIA guidance in the context of road projects (TII).

For further details on the requirements of the EIAR, refer to Section 3.8.7.

1.6 Interaction with Other Subjects

The purpose of the AQA is to identify likely significant air quality effects associated with the construction and operation of proposed national road schemes and associated infrastructure. To undertake the AQA, inputs from other discipline practitioners is required from the project traffic and biodiversity teams, both in terms of provision of traffic data and confirmation of sensitive designated habitats and appropriate critical loads to include in the AQA. Once the AQA is complete, the outputs will be used by practitioners for biodiversity, climate, population and human health. Collaboration with relevant discipline practitioners is essential when undertaking an AQA and this will require liaison and/or workshops between the various specialists at an early stage.

Figure 1.1 Interactions with other environmental factors

1.7 Common Air Quality Effects arising from National Road Developments

National road schemes and associated infrastructure can affect air quality during both the construction and operational phases.

During the operational phase traffic will be re-routed from the existing road network onto the new route (e.g. bypass), while road improvement schemes may relieve congestion and encourage drivers to use the route. As a result, increases and decreases in traffic flows and speeds will be experienced on various routes. Consequently, increases and decreases in air quality are likely to be experienced.

The pollutants of most concern in relation to emissions from road traffic are NO_2 and particulate matter (PM_{10} and $PM_{2.5}$). In addition, the effects of ammonia and NO_x shall be considered with respect to the potential effects on sensitive designated habitats.

During the construction phase, potential air quality effects can occur due to dust emissions and from construction traffic movements. Construction traffic movements include additional vehicle trips associated with the construction of the scheme, as well as traffic management measures. Construction phase impacts will be temporary or short-term in nature.

1.8 Requirements of the Competent Air Quality Practitioner

Directive 2011/92/EU, as amended by Directive 2014/52/EU, stipulates that the EIAR and assessments must be carried out by competent practitioners. Where required for national road projects, the AQA will be carried out by a suitably qualified and competent Air Quality Practitioner who has previous experience in this field. A suitably qualified and competent Air Quality Practitioner will be required for Project Phase 2 and Phase 3 (and any AQA updates in Phase 4). More specifically, the requirements of the Air Quality Practitioner who has overall responsibility for the air quality deliverables are outlined in Appendix A of this document.

1.9 Implementation

This SD shall be used forthwith in the planning, design and construction of national road projects that:

- require approval under Section 51 of the Roads Act, 1993, as amended proposed road development subject to EIA;
- require approval under Section 177AE of the Planning and Development Act, 2000, as amended (certain local authority development subject to Appropriate Assessment); or
- are subject to the procedure established under Section 179 of the Planning and Development Act, 2000, as amended, and Part 8 of the Planning and Development Regulations, 2001, as amended (known as the 'Part 8' procedure).

In addition, where projects requiring approval under Section 51, Section 177AE or Part 8 have, at the date of publication of this SD, commenced planning and design, and in particular, where technical advisor contracts have been executed, this SD should be:

- treated as advice and guidance;
- employed to the greatest extent reasonably practicable; and
- applied in a proportionate manner, having regard to the characteristics and location of the project/maintenance works and the type and characteristics of potential impacts.

2. Overview of Air Quality Assessment Process

Proposed national road schemes can have significant effects on the air quality. AQA is a key approach in identifying, understanding, assessing and mitigating these effects.

The objectives of the AQA process are to:

- Determine baseline air quality within the study area.
- Identify human receptors where a potential significant change in NO_2, PM_{10} or $PM_{2.5}$ concentrations, due to the proposed national road scheme, may occur.
- Identify sensitive designated habitats where a potential significant change in NO_x or ammonia concentrations, due to the proposed national road scheme, may occur.
- Identify human and sensitive designated habitats where there is risk of dust and traffic movement effects occurring during the construction phase.
- Determine suitable mitigation measures to reduce significant air quality effects to an acceptable level.

TII's PMG, PMM and associated PAG provide a framework for a phased and structured approach to the management of the planning, design, development and delivery of National Road Projects. The AQA will follow these guidelines.

Refer to the OTD *PE-ENV-01106* for further detail on the application of AQA.

2.1 Key Principles and Deliverables of the Air Quality Assessment Process

Key principles which will be followed throughout all phases of the assessment process are:

Box 2: Key Principles of the Air Quality Assessment Process

- Be proportional to the nature and scale of the project as it relates to the potential for significant air quality effects.
- Describe the methodology used in the AQA including the citing of key references and sources. Explain the facts, assumptions and basis of the assessment in order to ensure a transparent process and provide a rationale for conclusions and decisions.
- Have an air quality professional with competence and relevant experience, as outlined in Section 1.8 to undertake the assessment.

Figure 2.1 and TII's PMG provide a framework for a phased approach to the management of the development and delivery of national road schemes.

Phase 2: Options Selection
Stage 1: Preliminary Options Assessment

- Determine existing air quality in the study area in relation to NO_2, PM_{10} and $PM_{2.5}$ from available information.
- Identify significant non-road sources.
- Identify and record all sensitive receptor locations (human health and sensitive designated habitats) within 200 m of the carriageway of each option that are or have the potential to be significantly affected by a proposed scheme.
- Discuss any opportunities for mitigation.
- Review relevant previous air quality studies for schemes within the study area.
- Review of planning permissions granted within the study area of relevance from an air quality perspective.

Phase 2 :Options Selection
Stage 2: Project Appraisal Matrix

- Update existing air quality in the study area in relation to NO_2, PM_{10} and $PM_{2.5}$ from available information, if further information is available since Stage 1 assessment was undertaken.
- Calculate of the Index of Overall Change in Exposure.
- Calculate of local scale pollutant (NO_2, PM_{10} and $PM_{2.5}$) concentrations.
- Determine the impacts on sensitive designated habitats.
- Discuss any opportunities for mitigation.

Phase 2: Options Selection
Stage 3: Selection of Preferred Option

- Review assessments undertaken at Stage 1 and 2 and update if necessary.
- Lead in the preparation of the air quality section of the Project Appraisal Balance Sheet (PABS).

Phase 3: Design and Environmental Evaluation

- Undertake walkover of preferred route corridor.
- Update existing air quality in the study area in relation to NO_2 and PM_{10} from available information, if further information is available since Stage 2 was undertaken.
- Obtain existing data with regards to $PM_{2.5}$ concentrations in the study area from available information.
- Install a monitoring campaign, if necessary.
- Participate in the EIA Screening process.
- Re-calculate Index of Overall Change in Exposure if traffic flows or alignments have changed since Stage 2.
- Undertake a local air quality assessment to calculate NO_2, PM_{10} and $PM_{2.5}$ concentrations at representative worse-case human sensitive receptors within the air quality study area.
- Undertake an assessment of NO_x and ammonia concentrations at senistive designated habitats and calculate N deposition and acid deposition.
- Undertake a construction phase assessment.
- Calculate total emissions of NO_x and CO_2e for the existing route and preferred route for the baseline, opening and design years.
- Complete air quality section of EIAR.
- Assist in the preparation of the air quality section of the Project Appraisal Balance Sheet (PABS).

Figure 2.1 AQA Framework up to Phase 4 Statutory Process

(Note: The focus of this SD is on the Planning and Design phases (PMG Phases 2-4). This SD does not provide detailed guidance for Air Quality Practitioners to TII project Phases 5 to 7, which relate to procurement, construction and implementation, closeout and review, or Phases 0 to 1 which are carried out by the Project Manager)

2.1.2 Avoidance and Mitigation of Air Quality Effects

When air quality impacts are unavoidable, a variety of mitigation measures can be introduced to avoid or reduce these impacts.

These mitigation measures will be considered in all of the PMG Project Stages. It is important to be able to demonstrate that measures to mitigate significant negative air quality effects and any enhancement measures are deliverable, safe, and manageable in practice.

2.2 Project Management Guidelines (PMG), Project Manager's Manuals for Major and Minor National Roads Projects (PMMs) and Project Appraisal Guidelines (PAG)

The TII PMG, PMM and PAG are applicable to all projects which are funded through TII and/or have TII as the Approving Authority and they are used by Project Managers and those responsible for the delivery of such projects.

A key objective of the TII PMG and PAG is to ensure the efficient delivery of the national roads programme in a manner which minimises adverse human and environmental effects while maximising the benefits of the new road infrastructure and respecting all applicable legislation. The PMG and PMM follow a consistent, structured, and standardised phased process from an initial Phase 0 Scoping Report through to Phase 1 Concept & Feasibility, Phase 2 Options Selection, Phase 3 Environmental Evaluation and subsequent construction and implementation Phases 5 to 7 (Table 2.1).

Table 2.1 TII Project Phases TII PMG

TII PMG Project Phases		
Planning and Design	Phase 0	Scope and Pre-Appraisal
	Phase 1	Concept & Feasibility
	Phase 2	Option Selection
	Phase 3	Design and Environmental Evaluation
	Phase 4	Statutory Processes
Construction / Implementation	Phase 5	Enabling and Procurement
	Phase 6	Construction and Implementation
	Phase 7	Closeout and Review

The PMG, PMM and PAG also outline the environmental processes required for various scales of project ranging from minor to major projects, including air quality aspects. Public consultation and engagement are key steps which are outlined in Phases 2, 3 and 4 (in accordance with TII Strategy, PMG, and Aarhus Convention).

Air Quality impact assessment will follow TII PMG, PMM and PAG objectives, processes, and outputs.

3. Application of Air Quality Assessment to TII Road Projects

3.1 TII Project Thresholds

TII national road projects are classified as either Minor or Major Projects by project threshold value. Projects are assessed and delivered through various phases (see *PE-PAG-02009 Unit 1.0)*. This section outlines the Project thresholds and phases, and the AQA outputs required for each.

In general, the full extent of these SD do not apply to TII Projects of less than €5 million. There are also other road pavement and safety schemes which are not considered under TII PMG. An AQA will only need to be carried out where there may be the potential to have significant effects on air quality. This will need to be screened by the project developer with personnel who have a competency in considering air quality issues related to road schemes. The assessment will be a proportionate AQA during the project planning and design phases to ensure minimal impact on the receiving environment.

TII projects are classified into three main categories, each requiring a different and proportionate level of appraisal, as defined in PAG Unit 1.0, and are summarised below.

Table 3.1 TII Project Thresholds

Project Threshold	TII Project Classification	Application of the Standard
Up to €0.5 million	Generally, not applicable, unless otherwise instructed by TII	This Standard does not apply.
€0.5 to €5 million	Minor Projects[1]	The full extent of this Standard does not apply to these TII projects, unless an EIA is required, or where there may be potential for likely significant air quality effects.
€5 to €20 million		This Standard will apply, although the level of AQA should be proportionate to the potential for significant effects to occur.
Greater than €20 million	Major Projects	This Standard will apply in full to all major national road projects.

3.2 Overview: Incorporating Air Quality Considerations into TII PMG

PMG and PMM provide a framework for a phased approach to the management of the development and delivery of National Road and Public Transport Capital Projects.

TII's associated PAG provide specific guidance on the appraisal of certain aspects of projects on national roads.

Multi-Criteria Assessment (MCA) is generally used in the ranking of options at options assessment stage.

[1] *It should be noted that projects between €0.5 to €5 million will generally follow the Design Phase Procedure for Road Safety Improvement Schemes, Urban Renewal Schemes and Local Improvement Schemes DN-GEO-03030*

The PAG deliverables are required to be revised and updated as the project moves through the various project PMG phases and as more data and information becomes available.

The focus of this SD is on the Planning and Design phases (PMG Phases 2-4). This SD does not provide detailed guidance for Air Quality Practitioners to TII project Phases 5 to 7, which relate to procurement, construction and implementation, closeout and review, or Phases 0 to 1 which are carried out by the Project Manager. However, Phases 5 to 7 may require support from the Air Quality Practitioners to help procure, implement and review, air quality mitigation and monitoring measures where these are required. Additionally, there may be occasions where the assessments undertaken during Phases 2 and 3 require updating during these latter phases, for example if there was a significant time lag between phases or due to changes brought about during the statutory procedures. If the AQA requires updating, then the methodology outlined in this SD shall be followed.

3.3 Phase 0/1: Scope, Pre-Appraisal/Scheme Concept and Feasibility

As set out in TII's PMG and PMM these initial phases are carried out by the Project Manager to:

- Ensure the project is aligned with the current approving authority strategic programmes and plans; and
- Develop and investigate in further detail the feasibility of the project and to implement the project management structure.

This will not require the input of an air quality professional.

3.4 Phase 2: Options Selection

The Options Selection phase will identify a Preferred Option through a structured, comparative appraisal of alternative options, or 'narrowing of options', to provide a best fit with the environment and other criteria. The process is split into three distinct stages within the TII PAG (TII, 2022), each requiring a greater level of assessment and appraisal (Figure 3.1).

The PAG for National Roads Unit 7.0 – Multi Criteria Analysis is an appraisal tool used during the Phase 2 Options Selection process to evaluate and rank project options against a set of criteria on the basis of a scoring procedure.

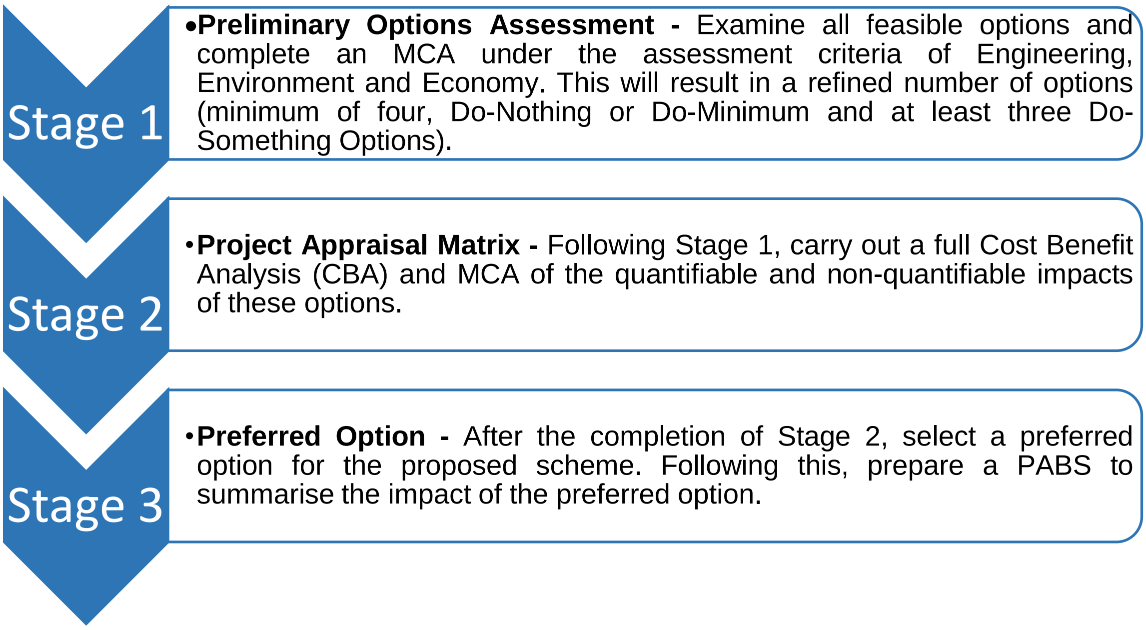


Figure 3.1 Stepped Approach detailed in the PAG

3.5 Phase 2, Stage 1 - Preliminary Options Assessment

The air quality practitioner will undertake the tasks outlined in Table 3.2 for the Phase2, Stage 1 Preliminary Option Assessment.

Table 3.2 AQA approach and process for Stage 1

AQA approach and process for Stage 1
Definition of the purpose and scope of the assessment
A review of the local air quality within the study area in relation to NO_2, PM_{10} and $PM_{2.5}$ from available information (see Section 3.5.1 below).
A review of non-road sources of pollution which could lead to elevated background concentrations or higher incidences of exceedance of short-term standards. This should consider potential sources of NO_2, PM_{10} and $PM_{2.5}$. Non-road sources include industrial sources (both point sources and fugitive emissions), ports and areas with a high density of domestic solid-fuel combustion. Sources within 1 km of the study corridor should be identified; this should be extended to 3 km in the case of large industrial sources, such as power stations.
Identify and record all sensitive receptor locations within 200 m of the carriageway of each option that are or have the potential to be significantly affected by a proposed scheme. European designated sites within 2 km of the route options and all sensitive designated habitats within 200 m of the route options should also be identified.
A review of any opportunities for potential mitigation.
A review of previous studies, local AQA or reports, and any other air quality work undertaken by TII, EPA or local authorities and provide a qualitative statement on what any studies indicate.
A review of future developments which have been granted planning permissions within the study area of relevance for air quality e.g. sensitive receptors and developments likely to impact air quality. Provide a qualitative statement on the air quality implications of any committed receptors.

3.5.1 Baseline Air Quality – Desktop Review

At Stage 1 the gathering of baseline air quality data will focus on NO_2, PM_{10} and $PM_{2.5}$ only, as these pollutants are of most concern in relation to emissions from road traffic. See the OTD (PE-ENV-01106) (Section 4.2.1) for further information on undertaking a desktop review.

3.5.2 Receptor Locations

Table 3.3 presents all receptors which are sensitive to potential human health effects and should be identified within 200 m of the carriageway of each option, that are or have the potential to be significantly affected by a proposed scheme. These receptor types shall be used within the AQA. If additional receptor types are reported, then a justification should be provided in the AQA for which standards apply.

Table 3.3 Human Receptors

Receptor	Pollutant	Standard Type
Residential Properties	NO_2, PM	Annual, 24-hour, 1-hour
Hospitals	NO_2, PM	Annual, 24-hour, 1-hour
Schools	NO_2, PM	Annual, 24-hour, 1-hour
Care Homes	NO_2, PM	Annual, 24-hour, 1-hour
Gardens of residential properties	NO_2, PM	24-hour, 1 hour
Hotels and B&Bs	NO_2, PM	Annual, 24-hour, 1 hour
Place of Worship*	NO_2	1 hour
Sports Centres*	NO_2	1 hour
Shopping Areas*	NO_2	1 hour
Playing Fields*	NO_2	1 hour
Cyclists[2]*	NO_2	1 hour
Outdoor locations including:		
Car Parks*	NO_2	1 hour
Bus Stations*, including park and rides	NO_2	1 hour
Railway Stations*	NO_2	1 hour

where members of the public are not likely to spend 24 hours, the pollutant of concern at these locations is NO_2 only for the 1 hour standard.

Internationally, nationally and locally designated sites of ecological importance (known as sensitive designated habitats) will also be identified. More specifically, European sensitive designated sites within 2 km of the route options and all sensitive designated habitats within 200 m of the route options should be identified.

Sensitive designated habitats to be included in the assessment are listed below:

- Ramsar Sites;
- Special Protected Areas (SPA) and proposed sites (pSPA);

[2] Pollutant concentrations at a point on a cycle route should be predicted and compare with the 1-hour NO_2 standard. This will, however, likely result in an overestimation of concentrations and exposure. The use of 1-hour thresholds should be adopted as a precautionary approach. In the event of any 1-hour exceedance the likely realistic level of exposure should then be considered within the overall evaluation of significance.

- Special Areas of Conservation (SAC) and proposed sites (pSAC);
- Nature Heritage Areas (NHA) and proposed Natural Heritage Areas (pNHA);
- Ancient woodland;
- Veteran trees;
- Nature Reserves;
- National Parks;
- Refuge for Fauna and Flora;
- Wildfowl Sanctuaries;
- Biogenetic Reserves; and
- UNESCO Biosphere Reserves.

Only sites that are sensitive to nitrogen (i.e. sensitive designated habitats) should be identified. It is not necessary to include sites, for example, that have been designated as a geological feature or a water course.

3.5.3 Significance: PAG Unit 7.0 Seven Point Scoring Scale

The PAG Unit 7.0 document sets out a seven-point scale upon which each option should be assigned an appropriate score (1 to 7) at Phase 2 Options Selection, Stage 1. Table 3.4 below sets out in air quality terms how each of the scores (1 to 7) should be assigned.

Practitioners should consider the overall effects of an option to determine whether the balance of improvements and deterioration at human receptors and sensitive designated habitats result in a positive, neutral or negative outcome. The overall evaluation is important and options may include a mixture of positive, neutral or negative outcomes.

Table 3.4 PAG Seven-Point Scale for Stage 1

Seven Point Scale	Stage 1: Local Air Quality (qualitative)
7 – Major or highly positive	Based on professional judgement the option would result in potentially significant positive improvements overall in an area of identified poor air quality.
6 – Moderately positive	Based on professional judgement it is anticipated that the option would not result in potentially significant air quality improvements overall in an area of identified poor air quality. However, the option has the potential to result in large/moderate decreases in pollutant concentrations at human health receptors or sensitive designated habitats.
5 – Minor or slightly positive	Based on professional judgement it is anticipated that the option would not result in potentially significant air quality improvements overall in an area of identified poor air quality. However, the option has the potential to result in small decreases in pollutant concentrations at human health receptors or sensitive designated habitats.
4 – Not significant or neutral	Based on professional judgement it is anticipated that the option would not result in potentially significant air quality changes overall in an area of identified poor air quality.

Seven Point Scale	Stage 1: Local Air Quality (qualitative)
3 – Minor or slightly negative	Based on professional judgement it is anticipated that the option would not result in a potentially significant deterioration overall in air quality in an area of identified poor air quality. However, the option has the potential for small increases in pollutant concentrations at human health receptors or sensitive designated habitats.
2 – Moderately negative	Based on professional judgement it is anticipated that the option would not result in a potentially significant deterioration overall in air quality in an area of identified poor air quality. However, the option has the potential for large/moderate increases in pollutant concentrations at human health receptors or sensitive designated habitats.
1 – Major or highly negative	Based on professional judgement the option would result in potentially significant negative changes overall in an area of identified poor air quality. This would be a ‘show-stopper’ and mitigation would be required for an option to progress.

3.5.4 Stage One Outputs

Box 3: Stage One Outputs

The outputs will include:

- Detailed air quality constraint mapping, identifying the location of receptors both human health and sensitive designated habitats, within 200 m of the carriageway of each option that have the potential to be significantly affected by proposed options;
- Stage 1 report including a description of existing local air quality conditions in relation to NO_2, PM_{10} and $PM_{2.5}$ and identification of non-road sources within the study area, a discussion of any opportunities for mitigation, a review of previous air quality studies and future planning applications which have been granted approval within the study area;
- Completion of the Stage 1 MCA to score each of the options relative to their potential air quality effects; and
- Record that receipt of the outputs has been acknowledged by the overall Project Manager for a scheme.

3.6 Phase 2, Stage 2 - Options Assessment (Project Appraisal Matrix)

The air quality practitioner will undertake the tasks outlined in Table 3.5 for the Phase 2, Stage 2 Project Appraisal Matrix.

Table 3.5 AQA approach and process for Stage 2

AQA approach and process for the Stage 2
Review Stage 1 Report
Definition of the purpose and scope of the assessment which should include a discussion of which parts of the operational AQA have been undertaken (i.e. Index of Overall Change in Exposure, local assessment) and if some parts of the assessment have not been undertaken, justification shall be provided.
An update on any changes to the location of sensitive receptors or local emissions sources since the preparation of the Stage 1 Report was undertaken.
Refine the constraints map to identify the number of sensitive human receptor locations within 200 m of the carriageway of each option that are or have the potential to be significantly affected by a proposed scheme. European designated sites within 2 km of the proposed scheme routes and all sensitive designated habitats within 200 m of the route options should also be identified.
A review of any additional monitoring data that have become available following preparation of the Stage 1 Report.
Prepare a Stage 2 report, including: • A description of the methodology used; • Air quality baseline; • A table showing the Index of Overall Change in Exposure for each of the Options; • The results of the local AQA with predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations reported at a few worse-case relevant locations; • Identification of any locations where concentrations are likely to exceed, or are above 90% of, the standards; • A table showing calculations of the NO_x and ammonia concentrations which should be used to calculate nitrogen (N) deposition and acid deposition at sensitive designated habitats for comparison with the relevant standards; and • A discussion of opportunities for mitigation for each option. If likely significant effects are predicted, appropriate mitigation measures shall be developed for proposed options to be progressed.

3.6.1 Study Area

At Stage 2, the air quality study area will be defined, within which an AQA is undertaken.

3.6.1.1 Traffic Study Area

Prior to determining the air quality study area, following the stepped approach outlined below, the Traffic Study Area (TSA) will be determined. Further details with regards to determining the TSA are provided in the AQ OTD (PE-ENV-01106).

3.6.1.2 Stepped Approach

The study areas are determined for the index of over change and local air quality assessments as described below.

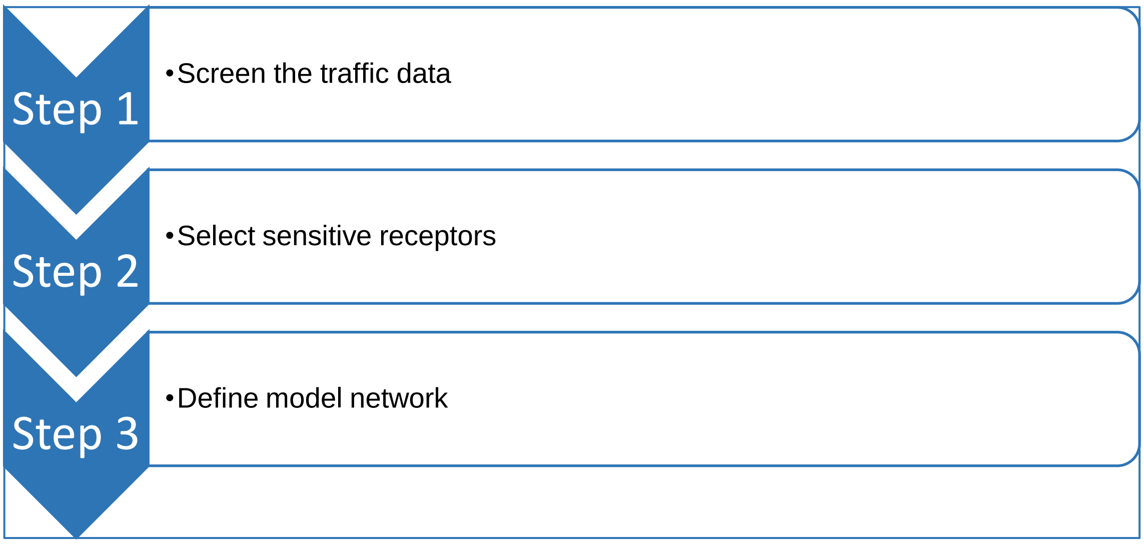


Figure 3.2 Steps to define the air quality study area

3.6.1.3 Step 1: Screen the Traffic Data

The traffic data will be screened to establish if traffic changes are expected due to a proposed scheme and if these changes may affect air quality. The screening is done using the following criteria to determine the affected road network (ARN). The criteria are based on the changes between the Do-Something (DS) traffic compared to the Do-Minimum (DM) traffic in the year of opening:

- Road alignment will change by 5 meters (m) or more; or
- Annual average daily traffic (AADT) flows will change by 1,000 or more; or
- Heavy duty vehicle (HDV) (vehicles greater than 3.5 tonnes, including buses and coaches) flows will change by 200 AADT or more; or
- Daily average speed change by 10 kph or more; or
- Peak hour speed will change by 20 kph or more.

The above criteria will be applied to the TSA only. A statement should be included in the AQA detailing how the study area was defined and that the TSA is appropriate for the AQA.

To ensure a balanced comparison between the options, the same study area should be used for the existing route and each option.

3.6.1.4 Step 2 – Select Sensitive Receptors

For the Index of Overall Change in Exposure assessment all sensitive human receptors located within 50 metres of the ARN will be included in the assessment (See Section 3.5.2 for a list of receptors).

Steps 1 and 2 defines the study area for the Index of Overall Change in Exposure (Step 2).

For the local AQA, worse case sensitive receptors will be selected up to 200 metres from the ARN. Both human and sensitive designated habitats will be selected as applicable.

3.6.1.5 Step 3 – Define Model Network

For the local AQA all roads within 200 meters of the selected receptors, for which traffic data is available, should be included in the study area.

Steps 1, 2 and 3 defines the study area for the local AQA (Step 3).

It is recommended that, following a review of the results of the local AQA, the competent Air Quality Practitioner will consider if any likely significant effects could have been missed from the assessment with particular focus on the edges of the study area. If so, then the Air Quality Practitioner should undertake a detailed level assessment in these areas if traffic data is available to check if there are any significant effects. If traffic data is not available a risk-based review should be undertaken using professional judgement to determine whether likely significant effects may occur (e.g. areas of poor air quality with likely perceptible changes).

3.6.2 Stage 2 Assessment

Once the air quality study area has been defined, the following four steps will be completed in the Stage 2 route options selection (Figure 3.3).

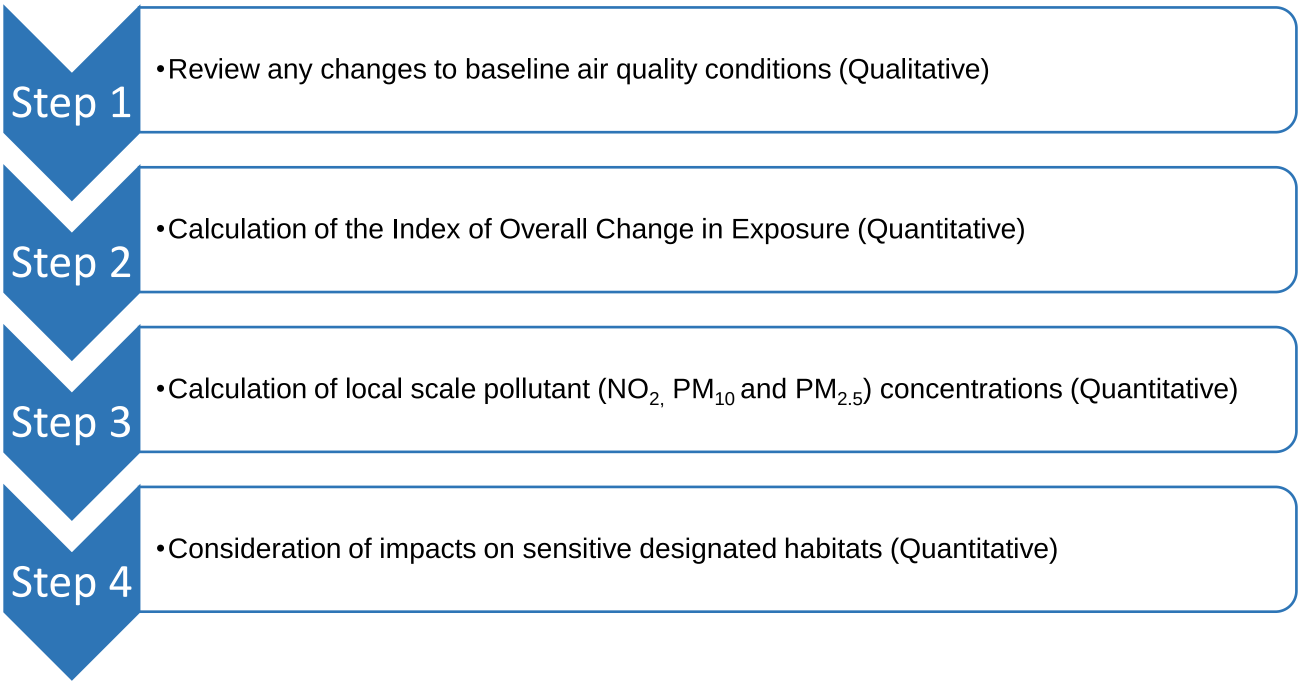


Figure 3.3 Air Quality steps for assessing the route options selection

3.6.3 Step 1: Changes to Baseline Air Quality Conditions

The Air Quality Practitioner will review and update where necessary the baseline conditions reported in the Stage 1 assessment. This review will include:

- Any available monitoring data from the EPA or local authorities for NO_2, PM_{10} and $PM_{2.5}$ concentrations;
- Information about existing non-road pollution sources; and
- Location of human receptors and sensitive designated habitats.

Refer to Section 3.5.1 for further information on desktop monitoring reviews and Section 3.5.2 for identifying sensitive receptors.

3.6.4 Step 2: Calculation of the Index of Overall Change in Exposure

The Air Quality Practitioner will undertake the following steps to calculate the Index of Overall Change in Exposure (Figure 3.4). A worked example is also described below.

Collate traffic information for each link.
Including traffic flows (AADT), % of HDV, speeds (per vehicle type i.e. Light Duty Vehciles (LDV) and HDV), and link lengths. This information is required for the opening year of the proposed scheme, with (DS) and without (DM) the proposed scheme in place.

Define the study area.
As described above in Section 3.6.2.

Calculate total emissions for each link
Using the TII REM, calculate the total emissions for each link, based on link length, vehicle flow, %HDV and speed.

Calculate the difference between DM and DS emissions from each link
Where a new section of road is proposed, an emission of zero should be assumed for the DM situation. Where a road is closed/removed as part of the proposed scheme, an emission of zero should be assumed for the DS. A negative value will represent a decrease in emissions with the proposed scheme, a positive value will represent an increase.

Count the number of sensitive locations within 50 m of the carriageway of each of the links
Where a property falls within 50 m of two or more links, it should be counted as part of the total number of properties for both links (i.e. the property should be 'double counted').

Calculate the change in emission rate (kg/km/yr) for each link being considered in the study area.
This can be calculated by dividing the calculated change in emissions (kg/yr) by the link length (km).

Multiply the change in emission rate from each link by the number of properties within 50 m.
Retain the sign, -ve for a decrease in emissions and +ve for an increase.

Add together the total numbers for each link.
To determine an overall exposure index for each option.

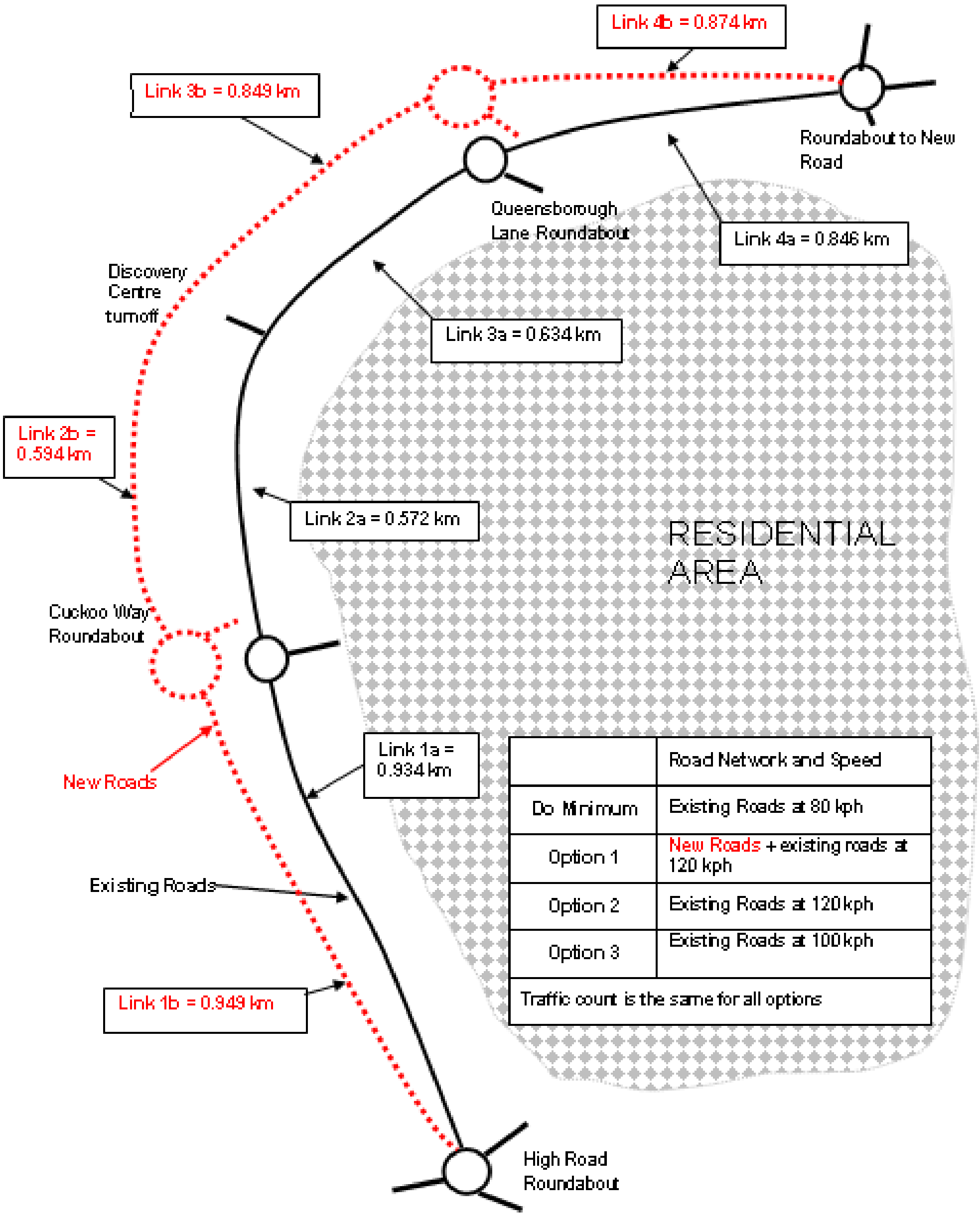
Compare the exposure index for each of the Options.
A negative score indicates that there would be an overall reduction in exposure to pollution, i.e. a benefit, a positive score indicates an increase in exposure to pollution, i.e. adverse impact. The option with the lowest exposure index would be the preferred option from an air quality perspective.

Figure 3.4 Summary of steps to calculate the Index of Overall Change in Exposure

3.6.4.2 Worked Example

An example of the calculation of the index of overall change in exposure for a Stage 2 Options Selection is provided below. The example shown is based on NO_x; the same procedure should also be carried out for PM_{10} emissions.

The scheme is to upgrade an existing bypass to safely accommodate traffic travelling at a faster speed. The current speed is 80 kph. Option 1 involves realigning the road, to reduce the arc in the road to allow vehicles to travel at 120 kph, whilst Options 2 and 3 involve upgrading the existing road to either 100 or 120 kph standard. The scheme is due to open in 2024. Further details of the options are provided in Figure 3.5.



	Road Network and Speed
Do Minimum	Existing Roads at 80 kph
Option 1	New Roads + existing roads at 120 kph
Option 2	Existing Roads at 120 kph
Option 3	Existing Roads at 100 kph
Traffic count is the same for all options	

Figure 3.5 Input Data for Worked Example

Step 1: Collate information about each link.

The following information was obtained from the project traffic consultants for each option.

Table 3.6 Traffic Data for Option 1

a	b	c	d	e	f	g	h	i
2024 Do-Minimum								
Link	**Total LDV flow (AADT)**	**Total HDV flow (AADT)**	**LDV Speed (kph)**	**HDV Speed (kph)**	**Road Type**	**County**	**Link Type**	**Link Length (km)**
1a	20,000	4,000	80	80	Urban	Dublin	TII	0.934
2a	25,000	5,000	80	80	Urban	Dublin	TII	0.572
3a	25,000	5,000	80	80	Urban	Dublin	TII	0.634
4a	20,000	4,000	80	80	Urban	Dublin	TII	0.846
2024 Do-Something								
1b	20,000	4,000	120	90	Urban	Dublin	TII	0.949
2b	25,000	5,000	120	90	Urban	Dublin	TII	0.594
3b	25,000	5,000	120	90	Urban	Dublin	TII	0.849
4b	20,000	4,000	120	90	Urban	Dublin	TII	0.874

Table 3.7 Traffic Data for Option 2

a	b	c	d	e	f	g	h	i
2024 Do-Minimum								
Link	**Total LDV flow (AADT)**	**Total HDV flow (AADT)**	**LDV Speed (kph)**	**HDV Speed (kph)**	**Road Type**	**County**	**Link Type**	**Link Length (km)**
1a	20,000	4,000	80	80	Urban	Dublin	TII	0.934
2a	25,000	5,000	80	80	Urban	Dublin	TII	0.572
3a	25,000	5,000	80	80	Urban	Dublin	TII	0.634
4a	20,000	4,000	80	80	Urban	Dublin	TII	0.846
2024 Do-Something								
1a	20,000	4,000	120	90	Urban	Dublin	TII	0.934
2a	25,000	5,000	120	90	Urban	Dublin	TII	0.572
3a	25,000	5,000	120	90	Urban	Dublin	TII	0.634
4a	20,000	4,000	120	90	Urban	Dublin	TII	0.846

Table 3.8 Traffic Data for Option 3A

a	b	c	d	e	f	g	h	i
2024 Do-Minimum								
Link	**Total LDV flow (AADT)**	**Total HDV flow (AADT)**	**LDV Speed (kph)**	**HDV Speed (kph)**	**Road Type**	**County**	**Link Type**	**Link Length (km)**
1a	20,000	4,000	80	80	Urban	Dublin	TII	0.934
2a	25,000	5,000	80	80	Urban	Dublin	TII	0.572
3a	25,000	5,000	80	80	Urban	Dublin	TII	0.634
4a	20,000	4,000	80	80	Urban	Dublin	TII	0.846
2024 Do-Something								
1a	20,000	4,000	100	80	Urban	Dublin	TII	0.934
2a	25,000	5,000	100	80	Urban	Dublin	TII	0.572
3a	25,000	5,000	100	80	Urban	Dublin	TII	0.634
4a	20,000	4,000	100	80	Urban	Dublin	TII	0.846

Step 2: Define the study area.

Compare the traffic data in Tables 3.6 to 3.8 to the screening criteria outlined in Step 1 defining the study area. Due to the change in road alignment, all of the links in Table 3.6 for Option 1 form the ARN. Similarly, for Options 2 and 3 all links in the tables above form the ARN due to the change in daily speed by more than 10 kph.

The traffic consultants confirmed that there was no change in traffic flow or composition on any other roads due to scheme in any of the options.

Step 3: Calculate total emissions for each link

Calculate total NO_x emissions for each link using the TII REM Tool. The traffic data for each link should be included as provided in the tables above.

The traffic data for each link, as well as the link length and road type, should be added to the TII REM input template spreadsheet as illustrated below for the opening year DM example.

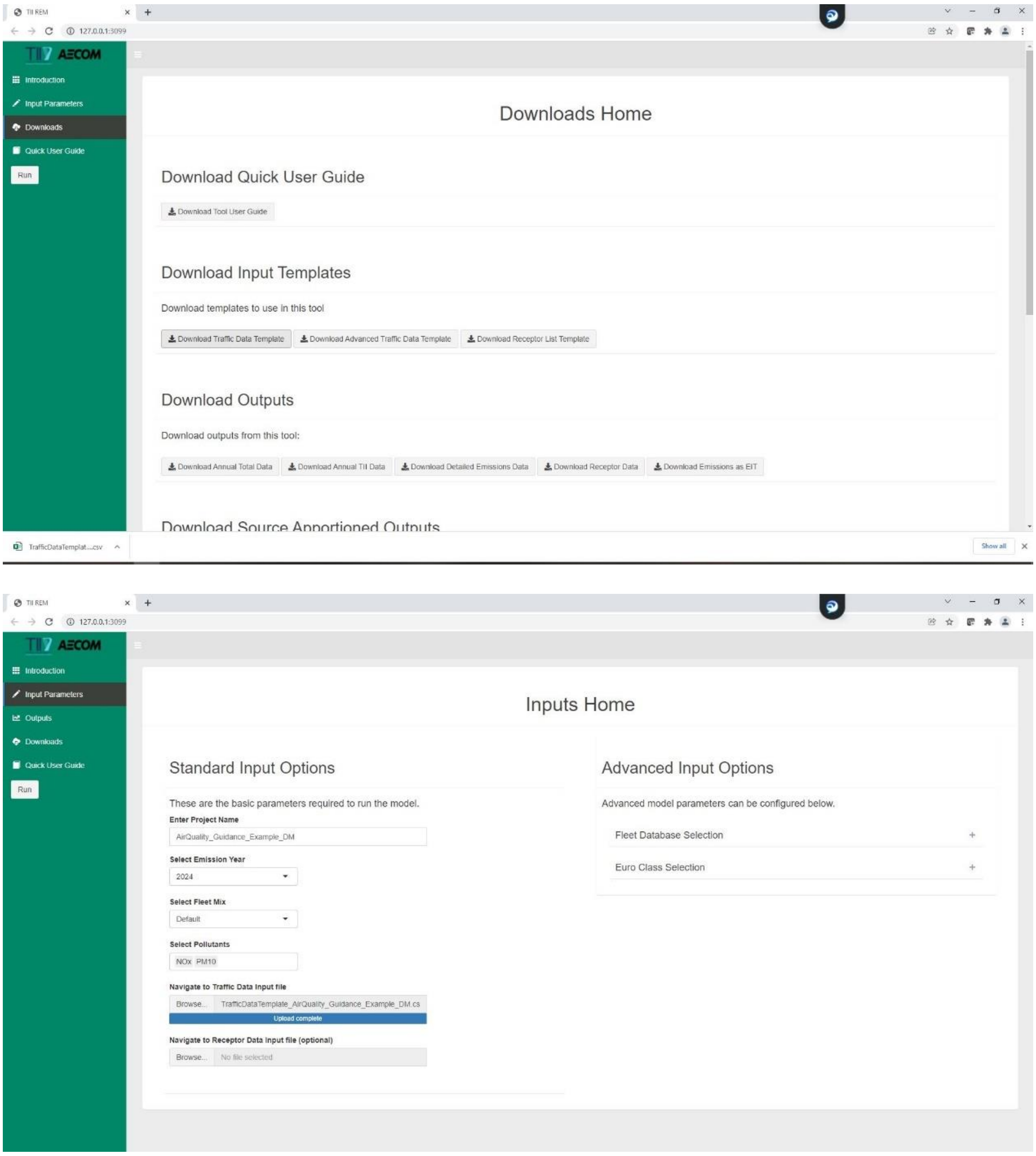


Figure 3.6 TII REM Tool input example, showing the method to download a traffic data input file and upload the completed file into the tool

The outputs for each option should be recorded in column ‘d’ and ‘e’ in the tables below.

Table 3.9 Option 1, NO_x emissions for each link

Option 1								
a	b	c	d	e	f	g	h	i
			NOx emissions (kg/yr)			Change in emissions (%)	Change in NOx emission rate (kg/km/yr)	NOx Index
Link name	Properties within 50m	Link Length (km)	Do-minimum	Do-Something	Change in emissions (kg/yr)			
1a	40	0.934	2,488.2		-2,488.2		-2664.0	-106,561.0
2a	17	0.572	1,904.8		-1,904.8		-3330.1	-56,611.2
3a	40	0.634	2,111.2		-2,111.2		-3330.0	-133,198.7
4a	15	0.846	2,253.8		-2,253.8		-2664.1	-39,961.0
1b	35	0.949		3,578.7	3,578.7	100	3771.0	131,985.8
2b	4	0.594		2,799.9	2,799.9	100	4713.6	18,854.5
3b	3	0.649		4,001.9	4,001.9	100	6166.3	18,498.8
4b	11	0.874		3,295.8	3,295.8	100	3770.9	41,480.3
TOTAL			8,758.0	13,676.3				-125,512.5

Table 3.10 Option 2, NO_x emissions for each link

Option 2								
a	b	c	d	e	f	g	h	i
			NO_x emissions (kg/yr)			Change in emissions (%)	Change in NO_x emission rate (kg/km/yr)	NOx Index
Link name	Properties within 50m	Link Length (km)	Do-minimum	Do-Something	Change in emissions (kg/yr)			
1a	40	0.934	2,488.2	3,522.1	1,033.9	29.4	1,107.0	44,278.4
2a	17	0.572	1,904.8	2,696.2	791.4	29.4	1,383.6	23,520.6
3a	40	0.634	2,111.2	2,988.5	877.3	29.4	1,383.8	55,350.2
4a	15	0.846	2,253.8	3,190.2	936.4	29.4	1,106.9	16,602.8
TOTAL			8,758.0	12,397.0				139,752.0

Table 3.11 Option 3, NO_x emissions for each link

Option 3								
a	b	c	d	e	f	g	h	i
			NO_x emissions (kg/yr)			Change in emissions (%)	Change in NO_x emission rate (kg/km/yr)	NOx Index
Link name	Properties within 50m	Link Length (km)	Do-minimum	Do-Something	Change in emissions (kg/yr)			
1a	40	0.934	2,488.2	2,785.2	297.0	10.7	318.0	12,719.5
2a	17	0.572	1,904.8	2,132.1	227.3	10.7	397.4	6,755.4
3a	40	0.634	2,111.2	2,363.2	252.0	10.7	397.5	15,899.1

Option 3								
a	b	c	d	e	f	g	h	i
			NO_x emissions (kg/yr)			Change in emissions (%)	Change in NO_x emission rate (kg/km/yr)	NOx Index
Link name	Properties within 50m	Link Length (km)	Do-minimum	Do-Something	Change in emissions (kg/yr)			
4a	15	0.846	2,253.8	2,522.8	269.0	10.7	318.0	4,769.5
TOTAL			8,758.0	9,803.3				40,143.5

Step 4: Calculate the difference between do-minimum and do-something emissions from each link.

With Option 1, a new section of road is introduced in a different location to the existing road. The assessment of Option 1 therefore needs to consider both the existing and proposed sections of road. Where a new section of road is introduced, emissions are zero in the do-minimum; where an existing section of road is decommissioned, then the do-something emissions are zero (in most cases existing section of road would continue to be used). In the case of Options 2 and 3, the assessment is more straightforward. Emissions increase in the do-something, as a result of the increased speeds.

Example:

Option 2 Link 1: do-minimum emissions (kg/yr) = 2,488.2

do-something emissions (kg/yr) = 3,522.1

change in emissions (kg/yr) = 3,522.1 –2,488.2 = 1,033.9 (29.4%)

Enter the calculations into columns ‘f’ and ‘g’ of the tables above.

Step 5: Count the number of sensitive locations within 50m of the carriageway of each of the links

An individual property can be counted against more than one link, especially near to junctions. This gives an element of double counting but allows for the impacts of the changes on both roads as they will affect the property. This does not apply in this example. Add this information to column ‘b’ of the table above. The distance should be taken from the centreline of each road.

Step 6: Calculate the change in emission rate (kg/km/yr) for each link being considered in the study area.

To calculate this, column ‘f’ is divided by column ‘c’ of the tables above, the answer should be added to column ‘h’.

Example:

Option 2 Link 1: Change in emissions = 1,033.9 kg/yr

Link length = 0.934 km

Change in emission rate = 1,033.9/0.934 = 1,107.0 kg/km/yr

Step 7: Multiply the change in emission rate for each link by the number of properties within 50m.

To calculate this, column 'b' is multiplied by column 'h', the answer should be added to column 'i'.

Example:

Option 2 Link 1: Change in emission rate = 1,107.0 kg/km/yr

Number of properties within 50m = 40

NO_x Index Score = 40 * 1,107.0 = 44,278.4

(result based on unrounded numbers)

N.B. If there is a reduction in emissions then this Index Score would be negative.

Step 8: Add together total numbers for each link

Add together the total numbers for each link to determine an overall exposure index for each option.

Example:

Option 2: Exposure Index = 44,278.4 + 23,520.6 + 55,350.2 + 16,602.8 = 139,752.0

Step 9: Compare the exposure indices for each of the route options

The Index of Overall Change in Exposure is summarised in Table 3.12 below. The negative score for Option 1 indicates that there would be a reduction in Overall Exposure with the scheme. This would be as a result of moving the road further from properties. Options 2 and 3 have positive Index scores, indicating that they would lead to increases in exposure to pollution, as a result of increasing speeds, which would increase emissions. The higher Index Score for Option 2 shows that increasing the speed to 120 kph would have a greater negative impact than increasing the speed to 100 kph (Option 3). Option 1 would be the preferred option in terms of air quality in this example.

Table 3.12 Summary of Index of Overall Exposure for each Option

Option	NO_x Exposure Index	Better or Worse
1	-125,512.5	Better
2	139,752.0	Worse
3	40,143.5	Worse

3.6.5 Step 3: Calculation of Local Scale Pollutant (NO_2, PM_{10} and $PM_{2.5}$) Concentrations

The Air Quality Practitioner will undertake a quantitative assessment to determine NO_2, PM_{10} and $PM_{2.5}$ concentrations in the base year, opening and design year (15 years after the opening year of the scheme) of the proposed route options, with and without the options operational.

The local AQA will be undertaken using a tool such as TII REM or detailed dispersion modelling software such as ADMS-Roads (CERC, 2022). The decision on the most appropriate modelling software to use is based on existing air quality and the complexity of the proposed scheme. See Table 3.13 for further details on model selection.

Table 3.13 Criteria to determine modelling software to use for the local air quality assessment

Model Type to Use	Criteria
Detailed dispersion modelling e.g. ADMS	• If existing air quality exceeds 90% of the standard (e.g. for annual mean NO_2 standards, >36 µg/m³); or • Where sensitive receptors exist within 50 m of a complex road layout e.g. grade separated junctions or hills with gradients > 2.5%
TII REM	• If existing air quality is less than 90% of the standard (e.g. for annual mean NO_2 standards, <36 µg/m³; and • For simple schemes such as small junction improvements and signalling changes.

It should be noted that it will usually only be necessary to carry out detailed dispersion modelling in the immediate area of the complex feature, such as a specific junction, and not for the proposed scheme as a whole, although practitioners may find it simpler to use a single approach for the proposed scheme assessment.

In the event that an alternate modelling approach is proposed this shall be discussed with TII (e.g. use of TII REM for schemes with complex road layouts).

3.6.5.1 Human Health

The following section describes the process to undertake an AQA to predict pollutant concentrations at receptors sensitive to human health.

3.6.5.2 Receptor Locations

Air Quality Practitioners will model specific worse-case receptors (see Section 3.5.2) and include all receptors where they may contribute to the overall evaluation of significance for a proposed scheme (further information with regards to significance is provided in Section 3.6.5.12). They will cover locations where air quality is expected to improve as well as those where it is expected to deteriorate. In addition, receptor points will need to be included in the modelling exercise to represent monitoring sites that are to be used in model verification.

3.6.5.3 Background Information

Background information which is applicable to all AQA is discussed within the OTD (PE-ENV-01106) (Section 4.6.2).

3.6.5.4 Model Verification

The AQA report shall provide full details of the model verification process and explicitly define any adjustment factors that have been used. Guidance on model verification is provided in DEFRA's LAQM.TG(22) and as also shown in Figure 3.7.

Step 1:
Produce a table of information on monitored and modelled data including:
Modelled and monitored road contribution NO_x
Modelled and monitored road contribution NO_2
Background NO_2
Modelled and monitored Total NO_2
% difference between modelled and monitored total NO_2

Step 2:
At each site, calculate the ratio of monitored road NO_x contribution to modelled road NO_x contribution.
This information is useful to help identify sites which may be performing differently than others. These sites can then be investigated and inputs to the model may be varied to improve the performance of these sites. Alternatively, these ratios can be used to separate locations or zones where dispersion is behaving differently e.g. a street canyon from more open or typical urban sites. The ratio is often much higher at sites which could be considered street canyons as they have limited dispersion and separate adjustments may be required.

Step 3:
Prepare a graph of modelled versus monitored road NO_x contribution. Include a trend line. Derive the equation of the trend line which should be in the format of
Y=mx (intercept at 0)
Y= is monitored road contribution NO_x
x = is modelled road contribution NO_x
m is the regression correction factor to apply to the modelled road contribution NO_x

Step 4:
Apply the adjustment factor(s) for road contribution NO_x at all sites and derive total NO_2 concentrations.

Figure 3.7 Summary of steps to model verification

3.6.5.5 Model Uncertainty

The statistical parameters listed in Table 3.14 shall be calculated prior to and after adjustment and provided in the AQA report in line with LAQM.TG(22).

Table 3.14 Model Uncertainty Statistics

Statistics	Ideal Value
The correlation coefficient.	1.0
Fractional bias.	0.0
Root Mean Square Error (RMSE).	0.0 If the RMSE is higher than ± 25% of the objective being assessed, it is recommended that the model inputs and verification are revisited in order to make improvements

Further information with regards to the calculation of these statistical procedures are provided in DEFRA's LAQM.TG(22).

3.6.5.6 Worked Example: Model Verification

Step 1

Table 3.15 provides a table of information containing both monitored and modelled NO_x and NO_2 concentrations.

The latest version of the DEFRA NO_x to NO_2 calculator has been used with '2019' as the year and 'Armagh, Banbridge and Craigavon' as the local authority to determine monitored road NO_x and modelled road NO_2 concentrations.

Table 3.15 NO_x and NO_2 information for each site

Site	Modelled Road contribution NO_x (µg/m^3)	Monitored Road contribution NO_x (µg/m^3)	Modelled Road contribution NO_2 (µg/m^3)	Monitored Road contribution NO_2 (µg/m^3)	Background NO_2 (µg/m^3)	Total Modelled NO_2 (µg/m^3)	Total 2019 Monitored NO_2 (µg/m^3)	% difference between modelled and monitored total NO_2
A	12.5	16.7	6.8	9.0	11.3	18.1	20.3	-11.0
B	6.7	9.0	3.7	4.9	11.3	15.0	16.2	-7.5
C	19.7	25.4	10.5	13.4	11.3	21.8	24.7	-11.6
D	8.5	12.9	4.6	7.0	11.3	15.9	18.3	-12.9
E	12.5	28.2	6.7	14.7	12.7	19.4	27.4	-29.1
F	14.3	29.8	7.7	15.5	12.7	20.4	28.2	-27.8
G	14.9	33.7	8.0	17.4	12.7	20.7	30.1	-31.3
H	10.4	25.9	5.7	13.6	12.7	18.4	26.3	-30.2
I	11.3	14.6	6.2	7.9	11.3	17.5	19.2	-9.1
J	9.9	11.6	5.4	6.3	11.3	16.7	17.6	-5.3

Note: numbers in the table are calculated based on unrounded numbers.

Step 2

Comparisons of the modelled and monitored roadside NO_x concentrations are provided in Table 3.16. For each site individual adjustment factors are determined.

Table 3.16 highlights that at sites E, F, G and H the model is underpredicting road NO_x concentrations of between 52 to 60% compared to elsewhere, where the model is underpredicting by between 15 and 34%. Further enquiries into such discrepancies shall be undertaken. Further desktop examination of site E to H indicates that these sites are located within a street canyon. As such, a separate verification factor should be determined by the Air Quality Practitioner for sites located within a street canyon.

Table 3.16 Calculation of Adjustment Factors

Site	Modelled Rd contribution NO_x (µg/m^3)	Monitored Rd contribution NO_x (µg/m^3)	Modelled Vs. Monitored NO_x (Roads) %	Adjustment factor
A	12.5	16.7	-25.4	1.3
B	6.7	9.0	-25.0	1.3
C	19.7	25.4	-22.3	1.3
D	8.5	12.9	-34.4	1.5
E	12.5	28.2	-55.7	2.3
F	14.3	29.8	-52.1	2.1
G	14.9	33.7	-55.8	2.3

Site	Modelled Rd contribution NO_x (µg/m³)	Monitored Rd contribution NO_x (µg/m³)	Modelled Vs. Monitored NO_x (Roads) %	Adjustment factor
H	10.4	25.9	-59.7	2.5
I	11.3	14.6	-22.6	1.3
J	9.9	11.6	-15.1	1.2

Note: numbers in the table are calculated based on unrounded numbers.

Step 3

Graphs have been prepared of the modelled versus monitored road concentration NOx as shown in the above table (Step 2). The trendline indicates that the adjustment factor for Zone A is 1.31 and for Zone B (Street canyon) is 2.24. The Graph for Zone A is provided below.

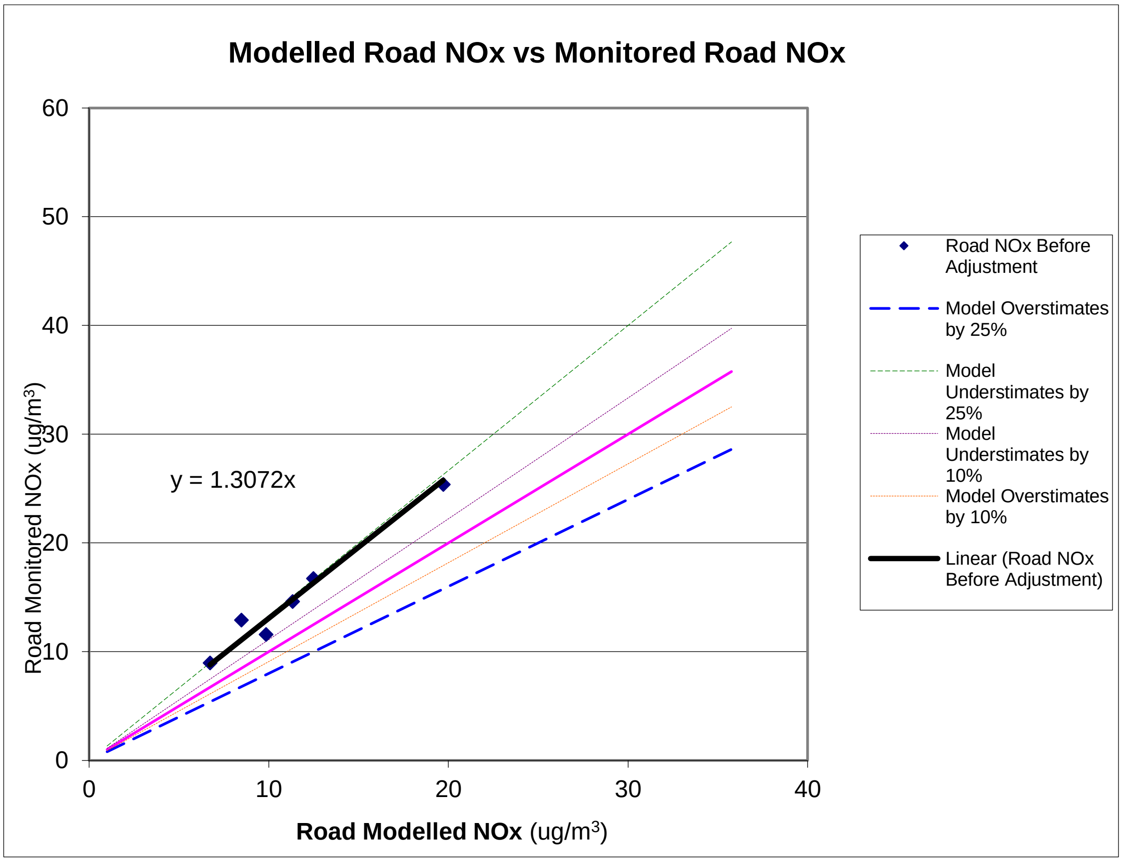


Figure 3.8 Graph of pre-adjusted modelled versus monitored road concentration NO_x

Step 4

Apply the adjustment factor(s) for road contribution NO_x at all sites and derive total NO_2 concentrations.

Table 3.17 Post-adjustment concentrations

Site	Adjusted Modelled Rd contribution NO_x (µg/m³)	Modelled Rd contribution NO_x (µg/m³)	Modelled total NO_2 (followed adjustment)	Monitored total NO_2	Modelled Vs Monitored NO_2 Total % difference
A	16.3	8.8	20.1	20.3	-1.1
B	8.8	4.8	16.1	16.2	-0.6
C	25.8	13.6	24.9	24.7	0.8
D	11.1	6.0	17.3	18.3	-5.3
E	28.0	14.6	27.3	27.4	-0.3
F	32.1	16.6	29.3	28.2	3.9
G	33.4	17.3	30.0	30.1	-0.5
H	23.4	12.4	25.1	26.3	-4.7
I	14.8	8.0	19.3	19.2	0.5
J	12.9	7.0	18.3	17.6	3.9

Note: numbers in the table are calculated based on unrounded numbers in the table.

The following statistical calculations were provided in the EIAR in line with LAQM.TG(22) and as shown in Table 3.14.

Table 3.18 Statistical Calculations

Zone	Prior to Adjustment			Post Adjustment		
	Correlation Coefficient	Fractional Bias	Root Mean Square	Correlation Coefficient	Fractional Bias	Root Mean Square
Zone A	0.98	0.1	2.2	0.98	0.0	0.5
Zone B	0.92	0.3	8.3	0.92	0.0	0.8

3.6.5.7 TII REM

The specific input requirements when using the TII REM are described in Table 3.19. Table 3.19 also describes the outputs that are provided by TII REM.

Table 3.19 TII REM Model Inputs and Outputs

Input	Description
Road type and Traffic data	The TII REM input file is used to define the AADT for each link for light and heavy vehicles, speed and county. The user should also define the road type as urban, rural or motorway, and may also define links as part of the National Road Network (NRN). The link length is defined where total annual emissions are required as an output. There is also the option use 'advanced' inputs, which allows the user to define the traffic database used to perform the calculations (see fleet database below) and omit certain vehicle euro class types from the fleet prior to the calculations being performed.

Input	Description
Fleet Database	The TII REM user must select one of three fleet projections that define the projected changes in fuel technology and vehicle age. TII REM has three fleet projections known as: Business as Usual (BaU), Climate Action Plan (CAP) (Government of Ireland, 2021), or Intermediate. The intermediate fleet projections should be included in the main assessment and used to inform the significance of the proposed scheme. The results of the local AQA using the Business as Usual and Climate Action Plan projections shall be included in appendices, if appropriate.
TII REM Output	The TII REM predicts annual mean emission rates and total annual emissions of NO_X, PM_{10} and $PM_{2.5}$, and concentrations of NO_2, PM_{10} and $PM_{2.5}$ at selected receptor locations. The tool also predicts acidity and N-deposition at selected receptor locations.

3.6.5.8 Detailed Dispersion Models

The specific input requirements when using detailed dispersion models are described in Table 3.20.

Table 3.20 Detailed Dispersion Modelling Inputs

Input	Description
Emissions activity data	Includes traffic flows, speeds and vehicle composition for each of the road links. Traffic data used for dispersion modelling are frequently derived from transport models which may only forecast peak hour flows and speeds, which then need to be adjusted to provide the required input data for the dispersion model. It is important that the approach used for such adjustments is described, or adequately referenced. The input data required for the model is AADT flows to assess the proposed scheme at Phase 2 and period data (AM, inter peak, PM and off peak) when undertaking a Phase 3 assessment for the preferred option.
Complex topography	Different terrain heights and the relative elevation of road-link emission sources and receptors in different situations e.g. road cuttings and flyovers should be considered. However, it is not normally necessary to consider such effects where the gradient in slope is less than 10%. Additional considerations are: • Is the modelling domain sufficiently extensive to justify the inclusion of terrain effects? Where single route corridors are under evaluation, significant effects are unlikely to extend more than 200 m from the line of the carriageway. In addition, the resolution of the terrain file e.g. 100 m, may not be sufficient to reflect terrain changes over such small distances, and • What level of detail does the model use for terrain modelling? Some models interpolate terrain files to a lower resolution to reduce model run times. Guidance from Cambridge Environmental Research Consultants (CERC) and Dispersion Modellers User Group (DMUG) on the tools available to replicate these environments should be followed if ADMS-Roads is used.
Street canyons	If using ADMS-Roads for example, there are two modules for modelling street canyons; the basic street canyon modules based on the Danish Operational Street Pollution Model (OSPM) developed by Hertel and Berkowicz (1989) and the advanced street canyon module developed by Hood et al. (CERC, 2022). Further guidance on the selection and use of the different modules is provided in the CERC User Guide (CERC, 2018).

Input	Description
Meteorological data	In most cases, the user should select the nearest meteorological site to the study area, but account should be taken of any local effects that may make the data unsuitable, for example, coastal effects or complex topography. The year of meteorological data should correspond with the year of baseline traffic and monitoring data that is to be used for the subsequent model verification. In addition, the same year of baseline background pollution and emissions data should be used. When purchasing meteorological data it is important to confirm with the supplier that the proper QA/QC has been undertaken. Users shall confirm whether the data provided are hourly, sequential, as measured or whether missing hours have been filled. It is important that full details of the meteorological data used are reported e.g. the location of the meteorological recording site and its relationship to the study area.
Other Inputs	Within the detailed dispersion model, the surface roughness length and minimum Monin-Obukhov length for the monitoring station and study area shall be selected. The minimum Monin-Obukhov length is used to limit stable stratification in an urban area i.e. the height at which turbulence is generated more by buoyancy than by wind shear.
Assessment of individual traffic lanes	In certain circumstances, it may prove beneficial to assess separate lanes of traffic (moving in different directions). This can be particularly useful where, for example, the characteristics of traffic on one side of the carriageway are different to those on the other, or where there are wide roads with physically separated lanes (such as dual-carriageways or motorways).
Cold starts	Under circumstances where road links may be associated with a significant proportion of vehicles running with cold engines, it will be necessary to account for the excess emissions associated with these “cold start” movements. Such considerations are only likely to apply in specific circumstances such as car parks and in most circumstances are unlikely to affect assessments for the proposed schemes.

3.6.5.9 Modelling Uncertainties and Sensitivity Testing

Air Quality Practitioners may wish to carry out sensitivity tests using a range of parameters at a limited number of receptor locations. The purpose of which would be to evidence confidence in the assessment outcome where the effects are sufficiently close to the air quality standards that changes in outputs could lead to a potentially different outcome (i.e. significant vs not significant). In all cases the model input parameters used should be clearly set out in the AQA. Sensitivity testing for the future scenario should focus on the main sources of uncertainty with regard to air quality; i.e. pollutant background contribution. Additional sensitivity testing may focus on the modelled traffic flow data with tests for core or low growth, where high growth has been used for the main assessment in the AQA.

3.6.5.10 Significance

To describe the air quality effects of the proposed scheme at sensitive human health receptors, the following shall be considered in the AQA as defined in the EPA’s Guidelines on the information to be contained in Environmental Impact Assessment Reports’ (EPA, 2022) including:

- Quality of Effects;
- Describing the Extent and Context of Effects;
- Describing the Probability of Effects;
- Describing the Duration and Frequency of Effects; and
- Describing the significance of Effects.

Quality of effects, extent and context of effects, probability of effects and duration and frequency of effects are described within the OTD (PE-ENV-01106) (Sections 4.10.1.1 to 4.10.1.4).

Significance of the Effects

The significance of the air quality effect at receptors shall be determined. A two stepped approach is to be used as illustrated in Figure 3.9.

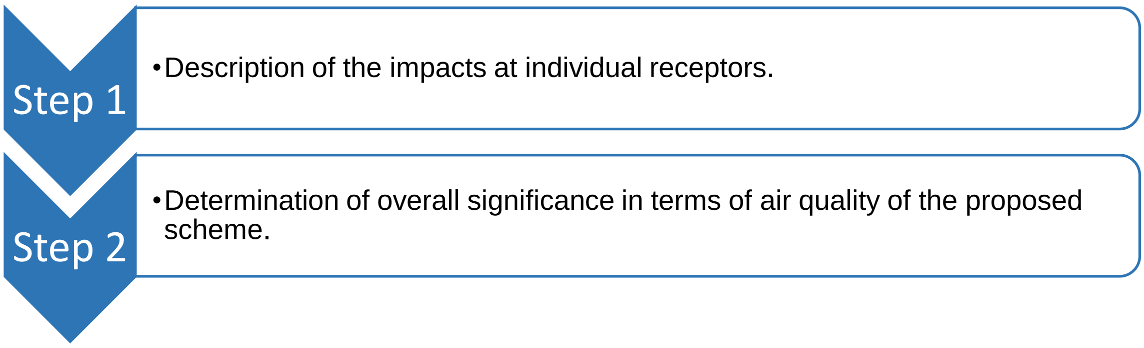


Figure 3.9 Determining the significance of the effect

The impact descriptors in Table 3.21 shall be used to describe the impact at each receptor location, which takes into consideration the percentage change in concentration relative to the air quality standards of the pollutant. The impacts are described as neutral, slight, moderate or substantial.

Table 3.21 Impact Descriptors

Long term average concentration at receptor in assessment year	% Change in concentration relative to Air Quality Standard Value (AQLV)			
	1	2-5	6-10	>10
75% or less of AQLV	Neutral	Neutral	Slight	Moderate
76 – 94% of AQLV	Neutral	Slight	Moderate	Moderate
95 – 102% of AQLV	Slight	Moderate	Moderate	Substantial
103 – 109% of AQLV	Moderate	Moderate	Substantial	Substantial
110% or more of AQLV	Moderate	Substantial	Substantial	Substantial

Shall the Irish Air Quality Standards be updated to reflect new reduced thresholds, for example for PM_{10} and $PM_{2.5}$, the new thresholds shall be adopted and the same % bands and % change criteria as set out in Table 3.21 shall be used.

Step 2 is to determine the significance of the impacts, and this shall align with the terminology in the EPA guidelines (EPA, 2022). Whilst the outcome of Step 1 may determine that there are ‘slight’, ‘moderate’ or ‘substantial’ impacts at one or more receptors the overall effect may not necessarily be judged as being significant in some circumstances. The factors in Table 3.22 shall be used to determine an overall judgement of whether the proposed scheme is ‘significant’ or ‘not significant’ in terms of air quality.

Impacts which are described as neutral or slight i.e. of local importance only, are considered to be ‘not significant’. Impacts described as moderate or substantial shall be considered in the overall evaluation of significance of a proposed scheme. For these impacts, the factors in Table 3.22 shall be applied to determine if the effects are significant or not significant.

The additional terms set out in the EPA Guidance e.g. very significant or profound are not considered to be required within an AQA, as an effect which is significant requires the identification of suitable mitigation measures.

Table 3.22 Factors to consider when determining the overall significance of the proposed scheme

Factors
Number of people affected by increases and/or decreases in concentrations and a judgement on the overall balance.
The number of people exposed to levels above the standard.
Whether or not the exceedance of a standard is predicted to arise in the study area where none existed before, or if the size of an exceedance area is substantially increased.
Whether or not the study area exceeds a standard and this exceedance is removed, or the size of the exceedance area is reduced.
Uncertainty, including the extent to which worse-case assumptions have been made.
The extent to which a standard is exceeded e.g. an annual mean NO_2 of 41 µg/m^3 shall attract less weight in the determination of significance than an annual mean of 51 µg/m^3.

3.6.6 Step 4: Consideration of Impacts on Sensitive Designated Habitats

Any assessment of air quality impacts on sensitive designated habitats will be discussed and agreed with the project biodiversity practitioner.

The TII REM or detailed modelling shall be used as appropriate, to predict concentrations of NO_x. Concentrations of ammonia shall be predicted using the best available method at the time of undertaking the assessment e.g. Calculator for Road Emissions of Ammonia (CREAM) Tool developed by Air Quality Consultants. Following this, N deposition and acid deposition will be calculated and evaluated as described below.

3.6.6.1 Collaborative Working

Collaborative working between the competent practitioner for biodiversity and air quality is essential when undertaking AQA for sensitive designated habitats at all phases. The project's biodiversity practitioner shall advise on the following:

- Scoping designated habitats to include in the assessment. The biodiversity practitioner shall confirm which sites are sensitive to nitrogen and acid deposition and therefore shall be included in the assessment;
- The location of modelled transects within each sensitive designated habitat;
- The most appropriate habitat to model within each of the sensitive designated habitats; and
- The results of the AQA at sensitive designated habitats confirming if the impacts are significant or not.

It is also essential that references to the air quality impacts discussed in the biodiversity chapter and Natura Impact Statement are reviewed by the project's competent practitioner for air quality.

3.6.6.2 Methodology

The following sets out the assessment methodology to consider the potential impacts from NO_x, nitrogen (N) deposition, acid deposition and ammonia (NH_3) at sensitive designated habitats.

Where pollutant concentrations are sufficiently below the standards (taken to be <90% of the standard) and where there are no complex or unusual features, then a screening approach using the TII REM is appropriate. Where pollutant concentrations are above 90% of the standards, then detailed modelling shall be used in the AQA (refer to Table 16).

The assessment of NO_x and N deposition will be based on the methodology set out in Design Manual for Roads and Bridges (DMRB) LA 105 (Highways England, 2019). The assessment will be undertaken as a stepped approach. The steps used to calculate concentrations of NO_x and ammonia are presented in Figure 3.10. The steps used to calculate N deposition and acid deposition are presented in Figure 3.11.

Identify sensitive designated habitats

Identify all sensitive designated habitats (as described above) within 200 m of the affected road network (ARN) and all European designated sites within 2 km. At each sensitive designated habitat (within 200 m of the ARN), receptor points at 10 m intervals should be modelled, starting from the nearest point of the sensitive designated habitat to the road up to a maximum distance of 200 m regardless of whether the habitat extends beyond 200 m.

Calculation of road NO_x

For each point along the transect, the road NO_x concentration shall be calculated for the base year, projected base year, DM and DS scenarios in the opening year and design year, following the methodology outlined in Section 3.6.6. Projected base year represents the opening year of the project assessed with base year traffic and vehicle emission rates for the opening year to inform the assessment of future year projections of NO_x and NO_2.

Calculation of total NO_x

Adjusted Road NO_x should then be added to background NO_x to calculate total NO_x. Total NO_x should then be compared to the critical level of 30 $\mu g/m^3$.

Calculation of road ammonia

For each point along the transect, the road NH_3 concentration shall be calculated for the base year, projected base year, DM and DS scenarios in the opening year and design year.

Ammonia emission factors from road traffic should be used, applying the most up to date knowledge and an appropriate methodology available at the time. Calculated concentrations of ammonia can be inputted in to the REM tool.

Calculation of total ammonia

Road ammonia should then be added to background ammonia to calculate total ammonia.

Total ammonia concentrations should then be compared to the critical levels of 1 $\mu g/m^3$ for lichens and bryophytes and 3 $\mu g/m^3$ for everything else (IAQM, 2020).

Figure 3.10 Summary of steps to calculate road contribution and total NO_x and Ammonia

Calculation of road NO_2

To determine total N deposition rates at each receptor point, road NO_x shall be converted to road NO_2, for the base year, projected base year and Do Minimum and Do Something in the opening year and design year, following the methodology described in Section 3.6.6.

↓

Conversion of road NO_2 to dry nutrient nitrogen (N) deposition rate

The contribution of road NO_2 to dry nutrient N deposition (kg N/ha/yr) shall be calculated using the following conversion factors from the Air Quality Advisory Group Guidance document AQAG06 and IAQM (2020):

Grassland and similar habitats: 1µg/m^3 of NO_2 = 0.14 kg N/ha/yr

Forest and similar habitats: 1µg/m^3 of NO_2 = 0.29 kg N/ha/yr

↓

Conversion of road NH_3 to dry nutrient nitrogen (N) deposition rate

The contribution of road NH_3 to dry nutrient N deposition (kg N/ha/yr) shall be calculated using the following conversion factors from the air quality advisory group Guidance document AQTAG06 and IAQM:

Grassland and similar habitats: 1 µg/m^3 of NH_3 = 5.2 kg N/ha/yr

Forest and similar habitats: 1 µg/m^3 of NH_3 = 7.8 kg N/ha/yr

↓

Conversion of road dry nutrient nitrogen (N) deposition rate to acid deposition

Acid deposition is calculated using the following conversion factor:

All habitats: 1 kg N/ha/yr = 0.071429 keq N/ha/yr

(1 keq N/ha/yr is equal to 14 kg N/ha/yr)

↓

Calculation of total N deposition

The sum of the road N deposition rate (from NO_2 and NH_3, calculated in steps 2 & 3 respectively) for the base year, do minimum and do something in the opening year and design year shall be added to the background N deposition for each point along the transect to calculate the total N deposition. Background N deposition rate shall be obtained from the Air Pollution Information System (APIS) website (Centre for Ecology and Hydrology).

The total N deposition shall then be compared to the critical load for the site.

↓

Calculation of total acid deposition

Acid deposition for the base year, DM and DS in the opening year and design year shall be added to the background acid deposition for each point along the transect to calculate the total acid deposition.

Total Acid deposition shall then be compared to the critical load for the site.

Figure 3.11 Summary of steps to calculate N deposition and acid deposition

The competent practitioner for air quality and biodiversity will review the latest information regarding critical loads, background nitrogen and acid deposition and ammonia at the time of the assessment. At the time of writing the Standard Document, the EPA's research papers 'Research 323: Critical Loads and Soil-Vegetation Modelling' (EPA, 2020) and 'Research 390: Nitrogen-Sulfur Critical Loads: Assessment of the Impacts of Air Pollution on Habitats' (EPA, 2021b) provides information regarding background concentrations and critical loads. If appropriate information is not available in these documents, then the Air Quality Practitioner shall refer to the Air Pollution Information System (APIS) which provides critical loads for different habitats.

3.6.6.3 In Combination Assessment

In combination assessment does not normally require the modelling of any additional scenarios. It does require the project competent practitioner for biodiversity not to consider the impact of the proposed scheme in isolation, but to compare the DS scenario with the projected base year scenario (which assumes no growth in traffic flow from the base year to the opening year) to take full account of the effects of traffic growth without the obscuring effect of improved vehicle emission factors.

3.6.6.4 Worked Example: Calculation of Road Contribution and total NO_x and Ammonia for Comparison with Critical Levels

Step 1: Identification of Designated Habitats

A sensitive designated habitat has been identified within 200 m of the affected road network (ARN). An SAC lies adjacent to the ARN.

Coordinates (x,y) were identified at the closest point within the SAC to the road edge (point A_1 is 1 m from the road edge). Receptor points were located at 10 m intervals along a transect perpendicular to the road, within the SAC, up to 200 m from the road edge (point A_200).

Step 2: Calculation of road NO_x

A dispersion model was run following the methodology outlined above. All receptors within the transect are specified in the model, and road NO_x calculated for each receptor.

The modelled concentration of NO_x from road traffic on road A in the base year is 32.4 µg/m^3 at point A_1, and 1.5 µg/m^3 at point A_200.

This shall be repeated for the projected base, do minimum and do something scenarios.

Step 3: Calculation of total NO_x

The background NO_x at the location of transect A in the base year is 12.8 µg/m^3.

The total NO_x concentration at point A_1 is therefore calculated to be 45.2 µg/m^3, and the concentration at point A_200 is calculated to be 14.3 µg/m^3.

The critical level of 30 µg/m^3 is exceeded at point A_1.

The critical level of 30 µg/m^3 is not reached at point A_200.

The total NO_x concentration for each point on the transect shall be compared with the critical level for the site to determine at which distance the concentration falls below the critical level. In this example, the total NO_x concentration fell below the critical level at 60 m from the road.

This shall be repeated for the projected base, do minimum and do something scenarios.

Step 4: Calculation of road ammonia

All receptors within the transect are specified in the model, and road ammonia calculated for each receptor.

For example, the modelled concentration of ammonia from road traffic on road A in the base year is 0.90 µg/m^3 at point A_1, and 0.04 µg/m^3 at point A_200.

This shall be repeated for the projected base, do minimum and do something scenarios.

Step 5: Calculation of total ammonia

The background ammonia at the location of transect A in the base year is 1.02 µg/m^3.

The total ammonia concentration at point A_1 is therefore calculated to be 1.92 µg/m^3, and the concentration at point A_200 is calculated to be 1.06 µg/m^3.

The critical level of 1 µg/m^3 is exceeded at point A_1 and at A_200. Note that the background concentration is greater than 1 µg/m^3.

The critical level of 3 µg/m^3 is not reached at any point on the transect.

This shall be repeated for the projected base, do minimum and do something scenarios.

3.6.6.5 Worked Example: Calculation of N Deposition and Acid Deposition – Comparison with Critical Loads

Step 1: Calculation of road NO_2

The calculated road NO_x concentrations are converted to NO_2 using the appropriate tools.

Road NO_2 in the base year is calculated to be 16.8 µg/m^3 at point A_1, and 0.9 µg/m^3 at point A_200.

Step 2: Conversion of road NO_2 to dry nutrient nitrogen (N) deposition rate

As the SAC is designated for heathland, the conversion factor for dry nutrient N deposition rate for ‘grassland’ is applied.

Deposited nitrogen from road NO_2 is calculated to be 2.35 kg N/ha/y at point A_1 (16.8 x 0.14), and 0.13 kg N/ha/y at point A_200 (0.9 x 0.14).

This shall be repeated for the projected base, do minimum and do something scenarios.

Step 3: Conversion of road ammonia to dry nutrient nitrogen (N) deposition rate

As the SAC is designated for heathland, the conversion factor for dry nutrient N deposition rate for ‘grassland’ is applied.

Deposited nitrogen from road ammonia is calculated to be 4.68 kg N/ha/y at point A_1 (0.9 x 5.2), and 0.21 kg N/ha/y at point A_200 (0.04 x 5.2).

This shall be repeated for the projected base, do minimum and do something scenarios.

Step 4: Conversion of road dry nutrient nitrogen (N) deposition to acid deposition

The contribution to acid deposition is subsequently calculated.

Acid deposition from road NO_2 is calculated to be 0.17 keq/ha/y at point A_1 (2.35 x 0.071429), and 0.01 keq/ha/y at point A_200 (0.13 x 0.071429).

Acid deposition from road ammonia is calculated to be 0.33 keq/ha/y at point A_1 (4.68 x 0.071429), and 0.01 keq/ha/y at point A_200 (0.21 x 0.071429).

This shall be repeated for the projected base, do minimum and do something scenarios.

Step 5: Calculation of total N deposition

Total N deposition is calculated by adding the background N deposition rate for the appropriate habitat to the road contributions calculated in steps 2 & 3.

The background N deposition rate at the location of transect A in the base year is 13.7 kg N/ha/y, and the critical load for the designated habitat is 10-20 kgN/ha/y.

Total N deposition at point A_1 is calculated to be 20.73 kg N/ha/y (13.7 + 2.35 + 4.68), and 14.03 kg N/ha/y (13.7 + 0.13 + 0.21) at point A_200.

The minimum critical load of 10 kgN/ha/y is exceeded at point A_1 and at A_200. Note that the background N deposition rate is greater than 10 kgN/ha/y.

This shall be repeated for the projected base, do minimum and do something scenarios.

Step 6: Calculation of total acid deposition

Total acid deposition is calculated by adding the background acid deposition rate for the appropriate habitat to the road contributions calculated in step 4.

The background acid deposition rate at the location of transect A in the base year is 1.12 keq N/ha/y, and the critical load for the designated habitat is 0.499-1.479 keq/ha/y.

Total acid deposition at point A_1 is calculated to be 1.62 keq/ha/y (1.12 + 0.17 + 0.33), and 1.14 keq/ha/y (1.12 + 0.01 + 0.01) at point A_200.

The minimum critical load of 0.499 keq/ha/y is exceeded at point A_1 and at A_200. Note that the background N deposition rate is greater than 0.499 keq/ha/y.

This shall be repeated for the projected base, do minimum and do something scenarios.

An example of the results table that shall be provided to the project biodiversity team is below (Table 3.23). The information shall be repeated for the DM, DS and change in concentration.

Table 3.23 Example of information to provide to the project biodiversity specialists

Ecology Receptor	Distance to ARN	Road Annual Mean NO_x (ug/m^3)	Total Annual Mean NO_x (ug/m^3)	Annual Mean N Dep from Road NO_2 (kg N/ha/yr)	Total Annual Mean N Dep NO_2 (kg N/ha/yr)	Annual Mean N Acid Dep from Road NO_2 (keq/ha/yr)	Total Annual Mean N Acid Dep NO_2 (keq/ha/yr)	Road Annual Mean NH_3 (ug/m^3)*	Total Annual Mean NH_3 (ug/m^3)	Annual Mean N Dep from Road NH_3 (kg N/ha/yr)	Total Annual Mean N Dep NH_3 (kg N/ha/yr)	Annual Mean N Acid Dep from Road NH_3 (keq/ha/yr)	Total Annual Mean N Acid Dep NH_3 (keq/ha/yr)	Total Annual Mean N Dep (contribution from NO_2, NH_3 & background) (kg N/ha/yr)	Total Annual Mean N Acid Dep (contribution from NO_2, NH_3 & background) (keq/ha/yr)
E1															
E2															
E3															

3.6.6.6 Significance

The results of the assessment for NO_x, ammonia, N deposition and acid deposition will be discussed with the competent practitioner for biodiversity who will determine the significance of the results.

Table 3.24 describes the process to determine if the results of the assessment are significant or not.

Table 3.24 Significance of effects at Sensitive Designated Habitats

Description of results	Significance
Total N deposition and acid deposition are more than 1% of the critical load.	Discuss further with project biodiversity practitioners (see below).
The total N deposition and acid deposition are less than 1% of the critical load.	Not significant.

To determine if the air quality impacts at a sensitive designated habitat are significant, the project biodiversity practitioner shall consider:

- Factors such as the nature of site management;
- Other factors such as regular flooding in maintaining a suitable habitat;
- The degree of sensitivity of fauna to relatively subtle changes in botanical composition;
- Whether nitrogen or phosphorus is the key limiting nutrient; and
- The extent of the sensitive designated site that is negatively affected shall be taken into consideration.

Where significant effects are determined, site survey information is required to determine if the sensitive habitat of relevance is actually present in the affected area and to inform potential mitigation measures that may be required.

3.6.7 Evaluation of Significance PAG Unit 7.0 Seven Point Scoring Scale

Following the completion of Steps 1 to 4, the results shall be used to assign a score.

The PAG Unit 7.0 document sets out a seven-point scale upon which each option shall be assigned an appropriate score (1 to 7) at Phase 2 Options Selection, Stage 2. Table 3.25 below sets out in air quality terms how each of the scores (1 to 7) shall be assigned.

It shall be noted that the scores shall be assigned based on the overall potential air quality effects on human health receptors and sensitive designated habitats during the operational phase only. Practitioners shall consider the overall effects of an option to determine whether the balance of improvements and deterioration result in a positive, neutral or negative outcome. The overall evaluation is important, and options may include a mixture of positive, neutral or negative outcomes. The biodiversity practitioner shall be consulted with when determining an appropriate score for air quality impacts at sensitive designated habitats.

At Stage 2, a quantitative assessment will be undertaken, with outputs from both the local AQA and index of overall change used to inform the score assigned to each option (Table 3.25). The outcome of the local AQA shall be used as the primary indicator to assign a score to an option, with the outcome from the index of overall change used to support the decision. The Stage 2 MCA shall be completed for each option with the assigned score and comments added.

A score of 1 or 7 would signify that the potential air quality effects from an option would be significant. A score of 7 would indicate a positive significant outcome, while a score of 1 would indicate a negative significant outcome. If a score of 1 is assigned to an option, then it would be considered a "show-stopper" and further work to consider whether the potential significant effects could be mitigated shall be undertaken. If the potentially significant effects cannot be mitigated appropriately then the option shall not be taken forward to the next stage. Whether each option meets the scheme objectives shall also be considered.

Table 3.25 PAG Seven-Point Scale

Seven Point Scale	Local Air Quality (quantitative)	Index of Overall Change in Exposure (quantitative)
7 – Major or highly positive	Overall significant positive air quality effects are predicted at either human health receptors or sensitive designated habitats.	Negative index value
6 – Moderately positive	Overall significant positive air quality effects are not predicted at either human health receptors or sensitive designated habitats. However, the option has a higher potential for significant positive effects e.g. moderate impacts at individual receptors.	Negative index value
5 – Minor or slightly positive	Overall significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. Only positive effects that are at most slight at individual locations are predicted.	Negative index value
4 – Not significant or neutral	Overall significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. Only effects that are neutral at individual locations are predicted.	Low positive or negative index value (less than 100 for NO_X and PM_{10})
3 – Minor or slightly negative	Overall significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. Only negative effects that are at worst slight at individual locations are predicted.	Positive index value
2 – Moderately negative	Overall significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. However, the option has a higher risk of significant effects e.g. moderate impacts at individual receptors.	Positive index value
1 – Major or highly negative	Overall significant adverse air quality effects are predicted for either human health receptors or sensitive designated habitats. This would be a show-stopper and mitigation would be required for a scheme/option to progress.	Positive index value

3.6.8 Stage Two – AQA Output

Box 4: Stage Two Outputs

The outputs will include:

- Further refined mapping to illustrate the location of sensitive air quality receptors including human health receptors sensitive designated habitats;
- Stage 2 report outlining the inputs and outputs of the Index of Overall Change in Exposure and local AQA;
- Completion of the Stage 2 MCA to score each of the options relative to their potential air quality effects;
- Input to the Cost Benefit Analysis (CBA) for Major Projects, if required; and
- Record that receipt of the outputs has been acknowledged by the overall Project Manager.

3.7 Phase 2, Stage 3 - Preferred Option

The AQA approach and process for the Stage 3 preferred option selection includes the tasks set out in Table 3.26.

Table 3.26 AQA approach and process for the Stage 3

AQA approach and process for the Stage 3
Review of the Stage 2 Report.
Definition of the purpose and scope of the assessment.
The air quality practitioner shall review and update where necessary the baseline conditions reported in the Stage 2 Report. This shall include: • any available monitoring data from the EPA or local authorities with regards to NO_2, PM_{10} and $PM_{2.5}$ concentrations; • information about existing non-road pollution sources; and • location of sensitive human receptors and sensitive designated habitats.
Recalculate the Index of Overall Change in Exposure for the preferred option if there are any changes to the traffic data, alignment of the proposed scheme, or number / location of sensitive receptors since Stage 2.
Lead where necessary, the Design team in preparing the air quality section of the Project Appraisal Balance Sheet (PABS).
Undertake a review with the project manager and traffic practitioner to consider the air quality risks associated with the construction of the emerging preferred option with respect to changes in road traffic e.g. additional vehicle trips and traffic management. The intention of the review is to establish the likely level of traffic data that would be required for the Air Quality Practitioner to undertake a proportionate AQA of the construction phase. The focus of the review will be to determine the risk of a likely significant air quality effect. Where a risk of likely significant effect is determined through this review, traffic data suitable for use in air quality screening and assessment would be required. It is recommended that a precautionary approach is taken, and that traffic data is created if there is considered to be a risk of a likely significant air quality effect to avoid later delays to the assessment process.

3.7.1 Stage Three – AQA Output

Box 5: Stage Three Outputs

The outputs will include:

- Further refined constraints mapping to illustrate the location of sensitive air quality receptors (human health and sensitive designated habitats) if the route alignment has been updated since Stage 2.
- Input to the Stage 3 Report to include the inputs and outputs of the Index of Overall Change in Exposure (if undertaken);
- Input into the PABS to summarise the impact of the preferred option; and
- Record that receipt of the outputs has been acknowledged by the overall Project Manager.

3.8 Phase 3 (Design and Assessment)

The environmental assessment will include AQA as part of the EIAR where EIA is required, otherwise AQA may be undertaken where air quality effects are considered sufficiently relevant to be assessed in its own right. In the latter situation, the AQA will either form a standalone report or be compiled within a project specific environmental report.

Following the identification of the preferred option as outlined in Phase 2, the Air Quality Practitioner will participate in the tasks listed in Table 3.27.

Table 3.27 Phase 3 – Air Quality Assessment Processes

Phase 3 – Air Quality Assessment Processes
Site Walkover: Undertake a walkover survey of the air quality study area to confirm that all significant features e.g. non-road pollution sources, sensitive receptors, have been identified and properly assessed in the Phase 2 options selection process.
Baseline air quality conditions: Review and update where necessary the baseline conditions reported in the Stage 3 assessment. This shall include: • any available monitoring data from the EPA or local authorities with regards to NO_2, PM_{10} and $PM_{2.5}$ concentrations; • information about existing non-road pollution sources; and • location of sensitive human and ecological receptors.
EIA Screening: Participate in the EIA Screening process to ascertain whether there is a likelihood of significant environmental effects for air quality.
EIA Scoping: Scope the AQA for the EIAR and establish the extent of new monitoring surveys that will be required.
Monitoring Survey: It may be necessary to carry out air quality monitoring within the air quality study area, depending upon the availability of existing data and the complexity of the proposed scheme i.e. a Greenway scheme would not require monitoring. Monitoring shall only be undertaken for proposed schemes where a quantitative local AQA will be undertaken. The project programme shall take into account the timescales required to complete baseline monitoring surveys; as a minimum, three months monitoring shall be undertaken. Further details regarding the monitoring campaign are provided below.

3.8.1 Baseline Air Quality – Scheme Specific Monitoring

At Phase 3 baseline air quality data will be gathered from desktop reviews and/or monitoring surveys set up specifically for the proposed scheme (scheme specific monitoring). The approach to be taken to desktop reviews is provided in the OTD (PE-ENV-01106) and at Phase 3, any additional monitoring data which has become available since Phase 2 shall be reviewed and documented.

At Phase 3 scheme specific monitoring may also be required. Scheme specific air quality monitoring shall only be undertaken on a proposed scheme where a quantitative local AQA is being undertaken. Furthermore, the need to undertake scheme specific air quality monitoring depends upon the availability of existing air quality data and the complexity of the proposed scheme. If monitoring is required, it shall be undertaken for NO_2, PM_{10}, $PM_{2.5}$ and ammonia as these are the pollutants of most concern in relation to emissions from road traffic. See the following sub-sections for further information on the situations where the different pollutants shall be monitored.

Due to the project programme constraints, scheme specific monitoring is sometimes undertaken prior to receiving final traffic data. This means that a final air quality study area may not be known when monitoring is undertaken. Therefore, the Air Quality Practitioner shall use earlier iterations of traffic data (i.e. Phase 2) and professional judgement to determine a likely air quality study area for proposed schemes. This likely air quality study area can then be used to identify the area for which air quality monitoring data shall be obtained.

3.8.2 Scheme Specific Monitoring – Short Term Monitoring

The duration of the monitoring campaign shall be for at least 6 months; however, a minimum duration of 3 months is acceptable if the project programme does not allow for longer. If the monitoring campaign is less than 6 months, a justification shall be provided.

If data capture for the calendar year is less than 75% but greater than 25%[3], annualisation will need to be completed (Box 6). This process will enable the air quality monitoring results to be compared with relevant air quality standards.

[3] Defra LAQM.TG(22) Box 7.14 states that 3 months or 25 % of data for the calendar year is the minimum to undertake annualisation.

Box 6: Worked Example - Annualising year to year short term NO_2 Diffusion Tube Monitoring Data

A diffusion tube site (D1) has 8 months' worth of data and so it is necessary to annualise. A continuous background site (B1) has greater than 85% data capture for the year. The tubes were set out in accordance with the recommended calendar for 2015.

Start Date	End Date	NO_2 Concentrations (µg/m^3)		
		B1	D1	B1 when D1 is Available
3 January 2019	4 February 2019	15.6	38.4	15.6
4 February 2019	2 March 2019	38.3		
2 March 2019	1 April 2019	22.7	43.1	22.7
1 April 2019	5 May 2019	22.2		
5 May 2019	3 June 2019	24.9	51.3	24.9
3 June 2019	1 July 2019	20.8		
1 July 2019	3 August 2019	18.1	31.3	18.1
3 August 2019	3 September 2019	16.1	26.8	16.1
3 September 2019	1 October 2019	25.5	41.0	25.5
1 October 2019	2 November 2019	21.1		
2 November 2019	1 December 2019	28.1	29.8	28.1
1 December 2019	31 December 2019	32.0	39.8	32.0

Step 1: Calculate the Annual Mean.

Calculate the Annual Mean (AM) of B1= 23.8 µg/m^3.

Step 2: Calculate the Period Mean (months for which data was recorded).

Calculate the period mean (PM) of B1 = 22.9 µg/m^3.

Step 3: Calculate the ratio (r) of the annual mean to period mean.

Calculate the AM/PM= 1.04 (r=1.04).

Step 4: Repeat steps 1 to 3 for all continuous background sites.

Step 5: Calculate the annualisation factor.

Calculate the average of these ratios (R) to determine the annualisation factor.

Step 6: Calculate the annual mean for diffusion tube

The measured period mean concentration of the diffusion tube (M) is 37.7 µg/m^3.

Multiply by the annualisation factor R to give the estimate of the annual mean for 2015.

Assuming that all other background sites yielded an annualisation factor of 1.04, The annualised average of D1 is M × R. Therefore 37.7 ×1.04 = 39.2 µg/m^3.

Note 1: If the exposure periods for the diffusion tubes varied beyond the 4 to 5 week recommendation, then it may be necessary to do a time weighted average in order to calculate M, AM and PM.
Note 2: if the monitoring campaign spans two calendar years, then refer to DEFRA FAQ for the methodology to account for roadside NO_2 projection factors https://laqm.defra.gov.uk/faqs/faq139/ .

Adapted from DEFRA LAQM.TG(22)

3.8.2.1 Monitoring Campaigns

In the design of short-term monitoring campaigns to support the Phase 3 of the EIAR, the following shall be taken into consideration:

- Choice of laboratory.
- Liaison with TII and other stakeholders such as local authority environmental health officer.
- Site selection: Use online mapping platforms to plan site locations, being mindful that once on site there maybe differences (such as vegetation growth) and some judgement will be needed on site as to whether the site remains a suitable location.
- Number of sites: This is dependent on the nature and size of the modelling area. It is recommended that a minimum of 6 sites are setup specifically for verification, to ensure sufficient data is available for the statistical analysis. Consideration shall be given to the likelihood of needing zonal verification and increasing the number of tubes proportionately. Ideally there would be a minimum of 3 tubes per zone.
- Background site: A background site shall be selected away from any major sources of NO_2. This would include large roads, factories, ventilation outlets, multi-story car parks, bus stops/stations and petrol stations. The site shall be at a minimum of 50 m from these sources, but preferably 200 m. Care shall also be taken in placing tubes for backgrounds so they represent sources of NO_2 that are not explicitly modelled in the assessment.
- Co-location with a continuous monitor: If possible, a co-location site shall be set up to obtain a local bias adjustment factor; however, it is not always necessary, depending on the practicalities of installing the co-location and the project requirement. If a co-location site is set up, the following conditions shall be met:
  - Triplicate tubes shall be set up;
  - Tubes shall be located within 1 m of the inlet of the continuous monitor; and;
  - Data capture at the continuous monitor shall be greater than 90%.
- Model verification: If the purpose of the monitoring is to enable the verification of a roads model, then it is important to carefully consider where to place the tubes. The features listed below can result in localised changes in air pollutant concentrations. Therefore additional tubes or care in the selection of locations may be required to produce a useful set of measurement data:
- Availability of traffic data (i.e. no tubes in locations at the edge or outside the traffic network);
  - Distance from the kerb (aim for 1.5 m to 5 m from the road you wish to model, although up to 15 m is acceptable if that is the location of the sensitive receptors);
  - For major routes such as motorways and dual carriageways, monitoring at distances greater than 15 m would be acceptable. Monitoring shall be carried out at locations representative of worst-case exposure of sensitive receptors;
  - Local traffic conditions (queuing/free flow/speeds);
  - Geography – e.g. hill climbs;
  - Proximity to car parking;
  - Distance to major junctions/roundabouts;
  - Proximity to smoking zones/shelters; and

  - Bus stops, schools, laybys, petrol stations (to be avoided, at least 50 m clearance).

- Triplicates, duplicates or singular tubes: The preferred approach, to minimise uncertainty, is to use triplicates at all sites as it provides additional confidence in the data, especially where monitoring has been undertaken for short period e.g. 3 months.
- Duration: Monitoring shall ideally be carried out for a period of six months, including both summer and winter periods. However, for practical reasons, the monitoring period may be shorter and must extend for a minimum of 3 months, and
- Appropriate QA/QC methods shall be applied for calibration and verification and shall be documented within the EIAR.

At this time low-cost continuous sampling techniques (e.g. sensors) are not considered to be mature enough to be the main form of data collection but could be used as part of a broader sampling strategy or in the future as technology develops.

3.8.2.2 Reporting Monitoring Data

When reporting monitoring data the following information shall be recorded:

- site name;
- site location (including height of sampling inlet, site description and six-figure grid reference);
- photographs of the site;
- site type (e.g. kerbside (0-1 m), roadside (1-15 m), urban background, suburban, rural etc.);
- monitoring method (e.g. chemiluminescence, diffusion tube, Tapered Element Oscillating Microbalance (TEOM), Filter Dynamics Measurement System (FDMS), gravimetric sampler etc.);
- details of QA/QC procedures (if data are derived from a monitoring site not within the EPA network) and any adjustments applied e.g. to PM instruments or to NO_2 diffusion tubes to account for laboratory “bias”;
- monitoring period;
- details of any adjustments applied to short-term data;
- concentration units (µg/m^3 or mg/m^3), and
- data capture statistics.

Example of diffusion tube set-ups are provided in Figure 3.12.

Figure 3.12 Examples of Diffusion Tube Set Up

3.8.2.3 Monitoring for NO_2

Where diffusion tubes are used, it is essential that the data is adjusted for laboratory ‘bias’. This is dependent on the laboratory that prepared the tubes, and the method of preparation that was used. Suitable bias adjustment factors may be derived locally (by collocating tubes with an automatic analyser) or national biased adjustment factors may be obtained from the following website https://laqm.defra.gov.uk/air-quality/air-quality-assessment/national-bias/, for some of the laboratories that may be used. The assessment report shall explicitly state what bias adjustment factors have been applied.

3.8.2.4 Monitoring for PM_{10} and $PM_{2.5}$

There is a wide range of methods that may be used to determine concentrations of PM_{10} and $PM_{2.5}$, including manual gravimetric samplers and continuous analysers. $PM_{2.5}$ monitoring is not specifically recommended as monitoring for PM_{10} can be utilised to infer $PM_{2.5}$ concentrations.

Monitoring concentrations of PM in ambient air is not straightforward, due to the variable nature and composition of the particles. There can be significant problems with the loss of semi-volatile components such as ammonium nitrate and the absorption and retention of water vapour. The method that is selected for the collection and determination of PM mass has an influence on the PM concentration that is subsequently reported.

QA/QC procedures are particularly important for PM monitoring and especially where gravimetric samplers and subsequent laboratory weighing is used. Guidance on QA/QC procedures for PM monitoring is given in Annex 1 to LAQM.TG(22) (Department for the Environment, Food & Rural Affairs (DEFRA), 2021).

3.8.2.5 Monitoring for Ammonia

The following methods can be used for sampling ammonia at sensitive designated habitat sites:

- DELTA active samplers (DEnuder for Long-Term Atmospheric sampling).
- ALPHA samplers (Adapted Low-cost Passive High Absorption).
- Diffusion tubes.

It is recommended that when diffusion tubes are used, a co-location study is undertaken with either an ALPHA or DELTA sampler to improve the performance of the diffusion tubes.

3.8.3 Regional Assessment

The assessment of the national/international level impacts of the preferred route will focus on the change in emissions of NO_x and carbon dioxide (CO_2e) in the current (baseline), opening and design years between with and without the scheme.

The study area for the regional assessment will be discussed with the project transportation consultants to ensure roads with changes in traffic flows/composition attributed to the scheme are included. If there is a fully calibrated scheme traffic model, then the outputs from the whole model may be included in the regional assessment.

The TII REM can be used to estimate total NO_x and CO_2e emissions from the road network for each scenario. The wider-scale impacts shall be described principally by comparing the incremental change in emissions between the Do Minimum and Do Something options.

3.8.4 Construction Air Quality Assessment

A 5-step procedure will be followed to screen potential effects, based on the proximity of receptors and baseline conditions in accordance with the Institute of Air Quality Management (IAQM) procedures published in their latest construction dust Guidance.

Figure 3.13 sets out the steps to be taken in the assessment. The latest version of the IAQM guidance is ‘Guidance on the assessment of dust from demolition and construction (V1.1)’ (IAQM, 2014).

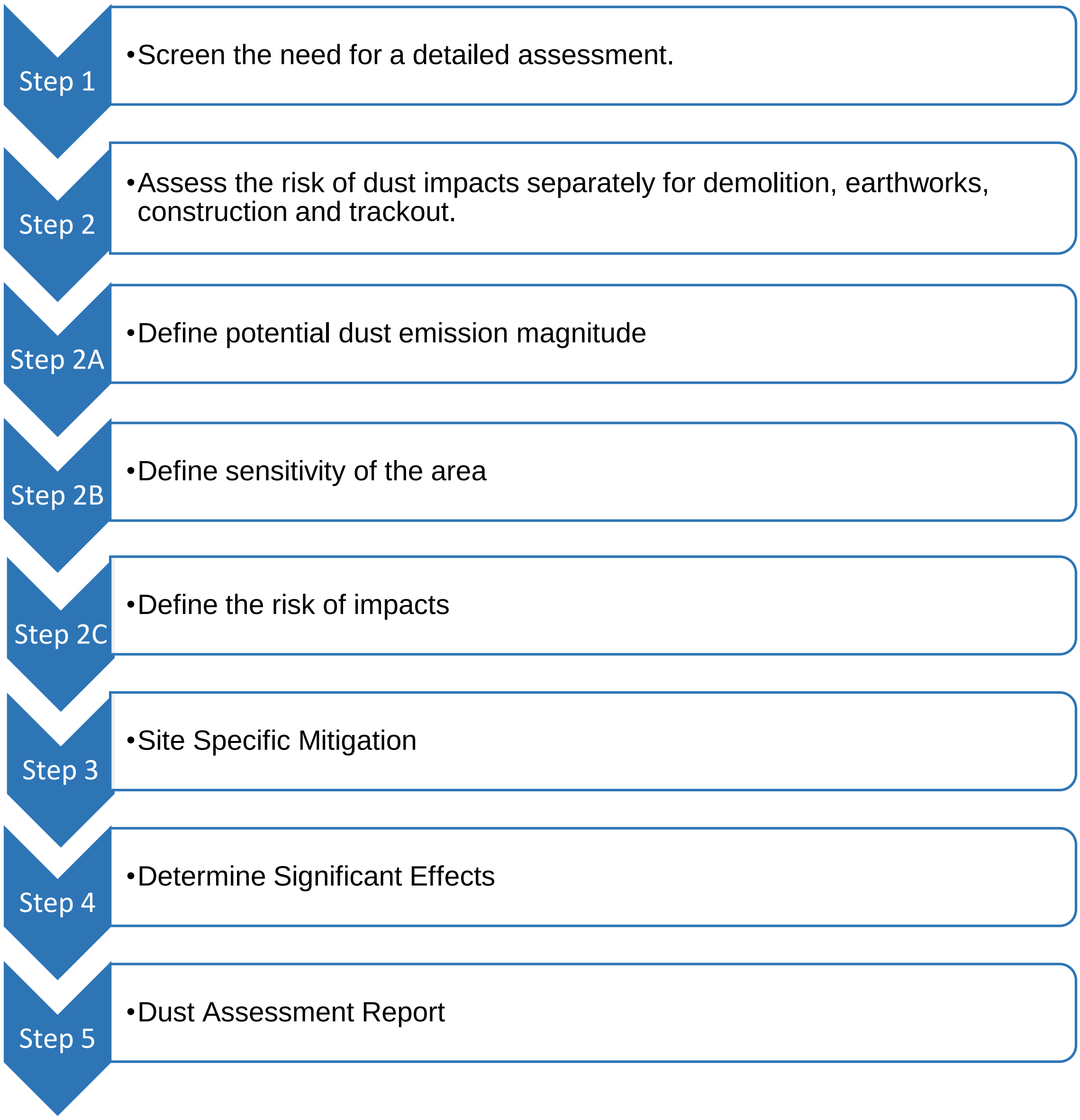


Figure 3.13 Steps to perform a Construction Phase Dust Assessment

3.8.4.2 Step 1: Screen the Need for a Detailed Assessment

An assessment will be required where there are sensitive receptors located within 200 m of the boundary of the site or route used by construction vehicles on the public highway. Table 3.28 provides a list of receptors which are sensitive to potential dust effects. Receptors which are sensitive to human health effects of PM_{10} were provided in Section 3.5.2.

Table 3.28 Receptors Sensitive to Dust

Receptors	Receptor Type
Residential Properties	Amenity
Hospitals	Amenity
Schools	Amenity
Care Homes	Amenity
Playing Fields	Amenity
Parks	Amenity
Footpaths	Amenity
Cultural Heritage Collections- Museums and Galleries	Amenity
Vehicle Showrooms	Amenity
Food manufacturers	Amenity
Hi-tech manufacturing	Amenity
Horticultural operations	Amenity
Car Parks	Amenity
Farmland	Amenity
Roads	Amenity
Places of work	Amenity
Ramsar	Sensitive Designated Habitat
Special Protected Area	Sensitive Designated Habitat
Special Area of Conservation	Sensitive Designated Habitat
Nature Heritage Area	Sensitive Designated Habitat
Proposed Nature Heritage Area	Sensitive Designated Habitat
Nature Reserves	Sensitive Designated Habitat

If no detailed assessment is required, then the report can note that no significant effects are likely.

3.8.4.3 Step 2: Assess the Risk of Dust Impacts.

The risk of potential dust impacts occurring is determined separately for each of the four activities (demolition; earthworks; construction; and trackout) and takes account of two significant risk factors. These are:

- The scale and nature of the works, which determines the potential dust emission magnitude (Step 2A); and
- The sensitivity of the area (Step 2B).

These factors are combined within a matrix (Step 2C) to give the risk of dust impacts.

3.8.4.4 Step 3: Site Specific Mitigation

Site-specific mitigation is determined for each of the four activities (demolition; earthworks; construction; and trackout) and is based on the risk of dust impacts occurring, as defined in Step 2.

3.8.4.5 Step 4: Determine Significant Effects

Step 4 examines the residual effects and determines whether or not these are significant. As described in the IAQM Guidance, for almost all construction activity, the aim shall be to prevent significant effects on receptors through the use of effective mitigation as described in the IAQM Guidance. In most circumstances this is possible and therefore, the residual effects will normally be 'not significant'. There may be a few exceptions to this, for example where there is inadequate access to water for dust suppression to be effective and, even with other mitigation measures in place, there may be a significant effect. Therefore, it is important to consider the specific characteristics of the site and the surrounding area to ensure that the conclusion of no significant effect is robust.

3.8.4.6 Step 5: Dust Assessment Report

Prepare a dust assessment report.

3.8.4.7 Other Considerations

The following shall be considered when undertaking a construction dust assessment are described within the OTD (PE-ENV-01106) (Section 4.9.2).

3.8.4.8 Worked Example

Step 1: Screen the Need for a Detailed Assessment

All sensitive receptors within 200 m of the boundary of the site or route used by construction vehicles on the public highway were identified in the worked example, illustrated in Table 3.29.

Table 3.29 Sensitive receptors within 200m of the site boundary

Receptors	Number of receptors	Distance to Site Boundary
Residential Properties	59	Between 10 m and 180 m
Hospitals	1	168 m
Schools	1	159 m
Parks	1	73 m

Step 2: Assess the risk of dust impacts.

The scheme being assessed is for a new 5 km bypass around a town. As there are no demolition works, the risk of potential dust impacts occurring has been determined separately for earthworks, construction and trackout.

Step 2A: Define the Potential Dust Emission Magnitude

The potential dust emission magnitude was determined for each of the activities as shown in Table 3.30.

Table 3.30 Potential dust emission magnitude

Activity	Potential Dust Effect Magnitude	Justification
Earthworks	Large	Total site area >10,000 m^2
Construction Works	Medium	Length of new road is 5 km and dusty construction material (concrete)
Trackout	Small	Less than 10 HDV movements a day

Step 2B: Define the Sensitivity of the Area

The sensitivity of the area to dust soiling effects on people and property was considered to be medium as there are between 10 and 100 receptors located within 50 m of the site boundary.

The sensitivity of the area to human health impacts was considered to be low as there was between 10 and 100 receptors located within 50 m of the site boundary and annual mean PM_{10} concentrations were 10 µg/m^3.

Step 2C: Define the Risk of Impacts

Taking into consideration the potential dust emission magnitude (Step 2a) and the sensitivity of the area (Step 2b), the risk of impacts occurring for each of the activities was determined separately for dust soiling and human health (Table 3.31).

Table 3.31 Risk of effects

Activity	Risk of Dust Soiling Effect	Risk of Human Health Effects
Earthworks	Medium	Low
Construction Works	Medium	Low
Trackout	Negligible	Negligible

Step 3: Site Specific Mitigation

Appropriate mitigation measures were recommended based on the risk of dust soiling and human health effects. Measures included wind breaks and barriers, frequent cleaning and watering of the construction site, associated access roads, control of vehicle access, vehicle speed restrictions, covering of piles, use of gravel at site exit points to remove caked on dirt from tyres and tracks, washing of equipment at the end of each workday and prevention of on-site burning. Where appropriate and practicable, hard surface roads shall be wet swept to remove any deposited materials; un-surfaced roads shall be restricted to essential site traffic only; and wheel-washing facilities shall be located at all exits from the construction site. Mitigation measures shall be adjusted as necessary to reflect weather conditions that are more likely to generate construction dust, such as dry periods and periods of higher winds.

Step 4: Determine Significant Effects

Once the risk of dust impacts have been determined in Step 2C and the appropriate dust mitigation measures have been identified in Step 3 the final step is to determine whether there are significant effects arising from the construction phase of a scheme.

As described in IAQM (2014), for almost all construction activity, the aim shall be to prevent significant effects on receptors through the use of effective mitigation. Therefore, the residual effect will be 'not significant'.

Step 5: Dust Assessment Report

Air quality mitigation measures would be incorporated into the Dust Management Plan that would form part of each contractor's Construction Environmental Management Plan (CEMP).

3.8.5 Construction Traffic

The following outlines a risk-based approach to determining the need for a construction phase traffic AQA for a proposed scheme. A stepped approach is recommended as illustrated below.

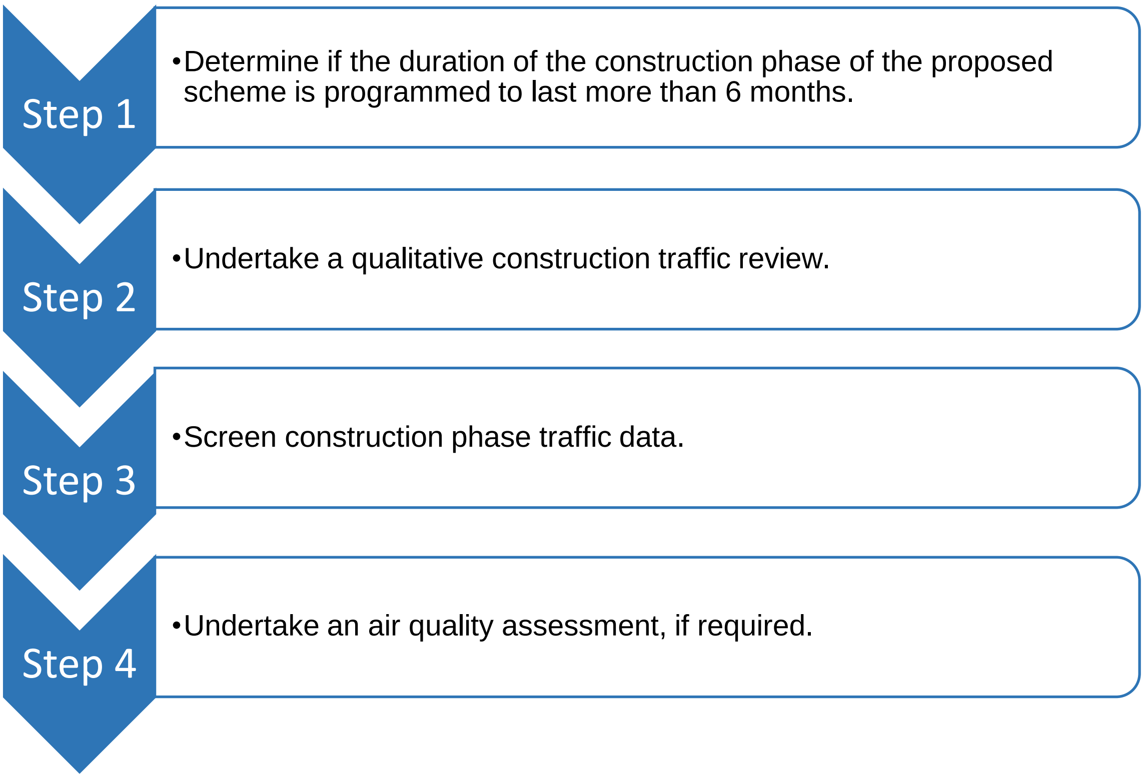


Figure 3.14 Steps to perform a Construction Phase Assessment

3.8.5.1 Step 1 - Duration

Assessment of construction phase traffic impacts will be required, where construction activities are programmed to last for a duration of six months or more. If the construction phase is programmed to last less than 6 months, then the construction activities are unlikely to constitute a significant air quality effect and can be scoped out of the assessment. Six months is proposed as over this period a change in concentration can affect the annual concentration, which is the period that air quality standards have been set for.

3.8.5.2 Step 2 – Phase 3 Qualitative Construction Traffic Review

The Air Quality Practitioner shall liaise with the project manager and traffic practitioner to update the assumptions and risk assessment for the Phase 2, Stage 3 Preferred Option Selection construction traffic review. The update shall consider any new information (e.g. emerging information on traffic management) that was not previously available and check that assumptions and baseline air quality conditions are as previously understood.

For schemes that it was concluded likely significant air quality effects were not expected, the purpose of the review is to confirm that is still the case or not. Conversely the review is also an opportunity to check that those schemes that were considered to have a risk of likely significant air quality effects are still considered to pose a risk or not.

If the update concludes that likely significant effects are not anticipated, taking into account any new information, a qualitative statement shall be included in the EIAR to set out why no likely significant effects are anticipated. The qualitative statement shall set out the rationale for this conclusion.

Shall the update conclude that there is a risk of likely significant air quality effects, the Air Quality Practitioner shall progress to Step 3.

3.8.5.3 Step 3 – Screen the Traffic

Where Step 2 has identified the potential for likely significant air quality effects, construction phase traffic data shall be screened against the following criteria. The screening criteria are based on the changes between the DS traffic (i.e., with construction) compared to the DM traffic:

- Road alignment will change by 5 m or more; or
- Annual average daily traffic (AADT) flows will change by 1,000 or more; or
- Heavy duty vehicle (HDV) (vehicles greater than 3.5 tonnes, including buses and coaches) flows will change by 200 AADT or more; or
- Daily average speed change by 10 kph or more; or
- Peak hour speed will change by 20 kph or more.

This approach is consistent with the operational phase assessment.

If the criteria are not met, then a quantitative assessment of construction traffic can be scoped out and the effects are considered to be not significant. If the criteria are met a local AQA is required.

3.8.5.4 Step 4 – Assessment

The construction phase traffic assessment shall follow the assessment methodology described for the operational phase assessment. A detailed level assessment shall be undertaken where existing concentrations are within 90% of the threshold. For all other areas an assessment using the TII REM shall be undertaken (Table 3.21).

The evaluation of significance for the construction phase assessment of traffic emissions shall be undertaken following the steps outlined in Section 3.6.5.12. However, it shall be noted that effects are temporary and considered reversable once works cease.

3.8.6 Mitigation

3.8.6.1 Construction Phase

For the construction phase, mitigation and monitoring actions will be intrinsically linked to risk level, as defined in the latest IAQM Guidance and as determined for proposed schemes using the IAQM approach. Appropriate mitigation measures are outlined in IAQM Guidance on the assessment of dust from demolition and construction (IAQM, 2014).

The implementation of mitigation measures and monitoring to ensure the measures are effective shall be outlined in the EIAR, with further details provided in a CEMP or similar document and implemented during Phases 5 to 7. The level of construction mitigation and monitoring shall be agreed with TII.

3.8.6.2 Operational Phase

For the operational phase, if significant effects are predicted, appropriate mitigation measures and monitoring shall be outlined in the EIAR which set out the measures that are required to mitigate the effects of the projects and a monitoring regime to determine the effectiveness of the measures. The level of operational mitigation and monitoring shall be agreed with TII.

At sensitive designated habitats, where significant effects are determined, site survey information is required to determine if the sensitive habitat of relevance is present in the affected area and to inform on any potential mitigation measures that may be required. Similarly, appropriate mitigation measures and monitoring shall be included in the EIAR with these agreed with TII and may include:

- Speed limits adjusted for air quality;
- Changes in road alignment;
- Wider route restraint measures to reduce traffic flows; or
- High vertical barriers.

3.8.7 Environmental Impact Assessment Report (EIAR)

In preparing the EIAR, due regard shall be given to the EPA's Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022) and NRA's Environmental Impact Assessment of National Road Schemes – A Practical Guide (NRA, 2008).

The air quality input for the EIAR shall follow on from the work carried out for the Phase 2 Option Selection phase. The input to the EIAR shall include the information listed in Table 3.32.

Table 3.32 Inputs to EIAR

Input to the EIAR
Definition of the purpose and scope of the AQA.
An update on any changes to the location of sensitive receptors or local emissions sources following preparation of the Phase 2 Options Selection.
Any additional monitoring data that will have become available following preparation of the Phase 2 Option Selection. If monitoring has been carried out, then precise details of the methodology, period and annualised concentrations and comparisons with the relevant standards shall be provided.
A table showing the recalculated Index of Overall Change in Exposure for the existing route and the preferred option. This shall include information about the number of properties within 50 m of each link considered.
A description of the local air quality modelling methodology. This shall include: • a description of the model used (including version number); • a justification for the model selection; • the source of any input data such as background concentrations; • traffic data[4]; • meteorological data; and • the methodology used to verify any detailed dispersion modelling (see Section 3.6.5.4).
A suitably scaled map showing the locations of the receptors used in the air quality modelling and the preferred option.

[4] It is important that the traffic data be either reproduced in the Air Quality Chapter of the EIAR, or a specific reference provided as to where they can be found (in the format that was used for the assessment).

Input to the EIAR
Predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at worse-case receptors within 200 m of the ARN in the current (baseline), opening and design years with and without the preferred route in place.
A discussion of the modelling results, including comparison with the air quality standards and any local monitoring data.
An assessment of the significance of the predicted concentrations using the criteria set out in Section 3.6.5.12, taking account of the modelling uncertainties.
Proposed mitigation measures, where appropriate. If significant air quality effects are predicted following mitigation, then TII shall be contacted to discuss.
A table presenting total emissions of NO_x and CO_2e for the existing route and the preferred route in the current (baseline), opening and design years (Regional Assessment).
Predictions of NO_x and ammonia concentrations at sensitive designated habitats and calculations of N deposition and acid deposition. A discussion of results prepared with biodiversity practitioners shall be presented to determine if the impacts are significant.
Discussion of any impacts during the construction phase, proposed mitigation measures and residual impacts, as required.
Where dealing with European sites, reference to the results included in the Natura Impact Statement prepared for the purpose of Appropriate Assessment. Further information is provided in Section 3.6.6.3.

3.8.8 TII Phase 3 – Air Quality Outputs

Box 7: Stage Three Outputs

The outputs will include:

- Detailed air quality mapping, identifying the location of sensitive receptors and description of the baseline air quality in the study area;
- An assessment of likely significant air quality effects;
- Compilation of above information into the formal AQA Chapter of the EIAR
- where EIA is required, or into the project specific environmental report or standalone AQA report where EIA is not required;
- A separate Non-Technical Summary (NTS) of the AQA, where EIA is required;
- Update the PABS to summarise the impact of the preferred option; and
- Record that receipt of the outputs has been acknowledged by the overall Project Manager.

3.9 Phase 4: Statutory Processes

During the statutory process, the air quality professional will respond to third party submissions where pertinent/required and participate in oral hearing(s) as required by the statutory processes, to ensure that the proposed project is developed in accordance with planning and environmental legislation. Air Quality-related inputs in Phase 4 are likely to include those listed in Table 3.33.

Table 3.33 Phase 4 Air Quality Inputs

Phase 4 Air Quality Inputs
Review and draft responses, where warranted, to air quality issues raised in submissions to the consenting process.
Review and draft responses to any air quality requests for further information issued by the consenting authority.
Review and update, if necessary, any aspect of the AQA, and documenting same.
Draft an Air Quality Statement of Evidence, where a public oral hearing is to be held, in relation to air quality aspects, including the AQA and responses to submissions *etc.*
Taking part in oral hearing preparation meetings.
Finalise the Air Quality Statement of Evidence.
Present the Statement of Evidence at the public oral hearing and responding to any questions on air quality aspects direct from the public, other bodies, or the Inspector for the consenting authority.
Review and report on any air quality aspects addressed in the decision of the consenting authority (and Planning Inspector's report).

The Air Quality Practitioner will review statutory and non-statutory submissions and observations submitted during the consenting process. It can be useful for the lead consultant to prepare a summary matrix table of statutory and non-statutory submissions, observations, organised by reference code, geographic area and topics/concerns raised.

For air quality items, the air quality professional will review the relevant concerns and comment and provide a brief summary response with mitigation measures, referencing the proposed road project documentation and EIAR where possible.

For projects where an oral hearing is to be held, it may be required to prepare a brief of evidence. Typically, this will include;

- Background of assessor;
  - Name, practice, years' experience in assessment,
  - Education qualifications and membership of professional bodies, and
  - role on the project.
- A very high-level overview of the assessment process, referencing the EIAR.
- Summary of impact assessment – very high overview, referencing the EIAR;
  - Baseline assessment,
  - Impact assessment (direct, indirect, operational, construction, cumulative),
  - Key mitigation measures, and
  - Residual Impacts.
- Response to third party submissions;
  - Address third party submissions by topic or location, referencing the EIAR where possible.
- Errata;
  - Include details on any errors within the original EIAR.

- Prepare final updated schedule of commitments, which include additional specific mitigation measures which may have arisen during the process. This is a key document in the later phases of Enabling and Procurement; and Construction and Implementation.

3.9.1 Stage 4 Outputs

Box 8: Stage Four Outputs

The outputs will include:

- Summary matrix table of statutory and non-statutory submissions, observations, organised by reference code, geographic area, topics/concerns raised and brief summary response referencing the EIAR where possible.
- Air Quality brief of evidence.
- Updated schedule of commitments, which are very important in the next Phase.

3.10 Phase 5: Enabling and Procurement

During Phase 5, it may be necessary to update the AQA undertaken during Phases 2 and 3, for example if there was a significant time lag between Phases or due to changes brought about during the statutory procedures. If the assessment requires updating, then the methodology outlined above shall be followed.

During Phase 5 a review of the consenting authority's decision, and any conditions and schedule of commitments maybe necessary to further develop air quality mitigation. During the enabling and procurement phase secondary consents (e.g. for concrete batching plants) may also need to be obtained. This may require support from the Air Quality Practitioner.

3.11 Phase 6: Construction and Implementation

The objective of Phase 6 is the administration and execution of the Main Contract in accordance with the design, specification, relevant standards, and legislation. This will include ensuring that the works will be carried out to the intended design, specification, schedule of commitments and planning conditions, as well as relevant best practice standards and legislation.

Similarly, to Phase 5, it may be necessary to update the AQA undertaken during Phases 2 and 3, for example if there was a significant time lag between Phases or due to changes brought about during the statutory procedures.

Implementation of mitigation measures and monitoring to ensure the measures are effective shall be outlined in the EIAR (Phase 3), with further details provided in a CEMP or similar document and implemented during Phases 5 to 7. It may be necessary for the Air Quality Practitioner to review the mitigation and/or monitoring being implemented to ensure it is consistent with the CEMP.

3.12 Phase 7: Closeout and Review

At the completion of any major project, it is a requirement of the TII PMG that a post project review be carried out.

This may include 'Lessons learned' for the air quality aspects, for example;

- Did the air quality mitigation measures deliver the required outcomes set out in the EIAR?
- Are there conclusions or lessons learned that can be drawn and applicable to other projects, to the ongoing assessments of air quality or to associated TII policies and guidelines?

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Appendix A:

Competent Air Quality Practitioner

Recital 33 of the Preamble to Directive 2011/92/EU, as amended by Directive 2014/52/EU, states, *inter alia, 'Experts involved in the preparation of EIAR shall be qualified and competent.' Article 5(3)(a) of the amended EIA Directive states 'the developer shall ensure that the environmental impact assessment report is prepared by competent experts'.* It is therefore reasonable to surmise that Air Quality Practitioners who carry out AQA on TII projects (which require EIA) must be expert, qualified and competent. Furthermore, it is the responsibility of the developer e.g. the road authority, to ensure that this is the case. To assist developers in meeting this responsibility, the following recommendations are made.

It is recommended that the Air Quality Technical Lead involved in the preparation of EIAR and/or the carrying out of AQA in respect of TII projects have the following qualifications:

- Chartership of a professional body;
- Honours degree (National Framework of Qualifications (NFQ) Level 8 (or equivalent level)) in a relevant subject e.g. environmental science (or equivalent discipline); and/or, a
- Master's degree (NFQ Level 9 (or equivalent level)) in a relevant subject e.g. environmental science (or equivalent discipline).

Furthermore, it is recommended that the Air Quality Technical Lead has at least 10 years' relevant post-graduate experience. It is important to note that the minimum number of years' relevant post-graduate experience may change (upwards or downwards) depending on the size, nature, complexity, etc., of the project in question. Furthermore, it is essential to carefully lay down further criteria defining what post-graduate experience is considered relevant in the context of the project at hand.

The developer must document the criteria (along with the underlying rationale) it has devised to ensure that its Air Quality Technical Lead are qualified, competent and expert. The developer shall also document how these criteria have been applied in the selection of its Air Quality Technical Lead.

Again, it is essential to note that it is the developer's responsibility to ensure that its Air Quality Technical Lead, who carry out the AQA on TII projects (which require EIA), are qualified, competent and expert.

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