



Guidance Note for Strategic Noise Mapping

For the
Environmental Noise Regulations 2006

Version 2

August 2011

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Guidance Note for Strategic Noise Mapping

For the Environmental Noise Regulations 2006

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Purpose of this Document

The objective of this guidance note is to provide practical information, advice and guidance to designated Noise Mapping Bodies on the development of strategic noise maps under the Environmental Noise Regulations.

This guidance note is issued as applicable only to the development of strategic noise maps for delivery to the EC during 2012 with reference to the second round of the Regulations.

This guidance note provides a review of the background, aims and objectives of the Regulations. It also sets out a recommended approach for the development of strategic noise maps and a framework process for the assessment of exposure to environmental noise and presentation of information to the public.

Finally the guidance draws attention to the minimum requirements for strategic noise mapping, as defined within the Regulations and Directive, and offers practical advice on how these requirements may be met.

This document should be read in conjunction with the following:

- Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise, Official Journal of the European Communities (OJEC) L189/12-25, 18 July 2002;
- Environmental Noise Regulations 2006, S.I. No. 140 of 2006;
- Commission Recommendation 2003/613/EC of 6 August 2003 concerning the guidelines on the revised interim computation methods for industrial noise, aircraft noise, road traffic noise and railway noise, and related emission data, Official Journal of the European Union (OJEU) L212/49-64, 22 August 2003;
- EC recommended RM2007 “*Reporting Mechanism proposed for reporting under the Environmental Noise Directive 2002/49/EC*”;
- EPA “*Guidance Note for Noise Action Planning*”, July 2009;
- European Commission Working Group Assessment of Exposure to Noise (WG-AEN), *Position Paper, Good Practice Guide for Strategic Noise Mapping and the Production of Associated Data on Noise Exposure*, Version 2, 13th August 2007; and
- European Commission Working Group Assessment of Exposure to Noise (WG-AEN), *Position Paper, Presenting Noise Mapping Information to the Public*, March 2008.

This Guidance Note should not be considered as a legal document, nor does it purport to provide comprehensive legal advice or guidance on all acoustical matters. If, in any circumstance, the recommendations contained in this guidance seem to be at variance with the Directive, or Regulations, then the text of the Directive must be applied in the first instance, or the Regulations in the second. In many situations it may be necessary to seek expert advice and assistance.

CAVEAT: Sections 10.3, 10.4, 11.1, 11.2 and 11.3, plus Appendices F to I, of this Guidance Note remain open to possible amendment due to ongoing work in Europe to provide a common method for undertaking population exposure

assessment, and a revision to the EEA reporting mechanism. It is currently envisaged that a revised version of this guidance document will be issued in the first half of 2012 to include any relevant amendments to these sections. In the meantime it is recommended that noise mapping bodies work towards completion of the noise level calculations at the end of Section 9.

Key Changes from Version 1

The main changes between Version 1, July 2009, and Version 2, May 2011, are outlined below. It is recommended that the full text in the relevant sections is reviewed in order to assess any implications.

1.7.3: Overview of changes in Round 2 mapping compared to Round 1.

1.8: Caveat added with regard to dwelling and population exposure assessment and ENDRM.

2.1: Requirement for NMBs to co-operate with counterparts across the border added. Recommendation that NMBs co-operate with each other to coordinate basis of assessment.

4.1, 4.2.1: Removal of Notes 5 and 7 regarding possible Limerick agglomeration. Limerick is confirmed not to be an agglomeration for Round 2.

4.2.5: Insert Note 6 to clarify definition of “major roads”.

4.3.1: Change to recommended buffer distance around agglomerations.

5: Remove requirement for NMBs to demonstrate equivalence if using National methods

5.4: RMR Interim confirmed as the method to be used for Round 2 railway noise.

5.5: Adapted UK CRTN confirmed as the method to be used for Round 2 road traffic noise.

6.7: Data input requirements for road source amended to UK CRTN method.

7.6: Road traffic modelling amended to UK CRTN method.

8.9.2: Road traffic flow attributes amended to UK CRTN method.

11.4: Recommendations for review of Round 1 strategic noise maps.

Appendix C: Potential Limerick agglomeration removed.

Appendix D: Road traffic source amended to UK CRTN method.

Appendix E: Addition of review into recommended report structure.

Contents

PURPOSE OF THIS DOCUMENT	3
KEY CHANGES FROM VERSION 1	5
CONTENTS	6
1 INTRODUCTION	9
1.1 BACKGROUND	9
1.2 ROLE OF THIS GUIDANCE	9
1.3 WHY PREPARE A STRATEGIC NOISE MAP?	9
1.4 STATUTORY BACKGROUND	11
1.5 SCOPE OF THE STRATEGIC NOISE MAPS	11
1.6 TIMETABLE	12
1.7 OVERVIEW OF STRATEGIC NOISE MAPPING	13
1.8 STRUCTURE OF THIS GUIDANCE	16
2 REQUIREMENTS FOR STRATEGIC NOISE MAPS	18
2.1 DESIGNATED BODIES	18
2.2 GENERAL REQUIREMENTS FOR STRATEGIC NOISE MAPS	19
2.3 THIRD SCHEDULE OF THE REGULATIONS	20
3 OVERVIEW OF THE STRATEGIC NOISE MAPPING PROCESS	26
3.1 INTRODUCTION	26
3.2 STAGE 1 - DEFINE AREAS TO BE MAPPED	27
3.3 STAGE 2 - DEFINE NOISE CALCULATION METHODS	27
3.4 STAGE 3 – DEVELOP DATASET SPECIFICATION	28
3.5 STAGE 4 – PRODUCE DATASETS	29
3.6 STAGE 5 - DEVELOP NOISE MODEL DATASETS	30
3.7 STAGE 6 - NOISE LEVEL CALCULATIONS	30
3.8 STAGE 7 - POST PROCESSING AND ANALYSIS	30
3.9 REPORTING AND PUBLICATION	31
4 STAGE 1 – DEFINE AREAS TO BE MAPPED	32
4.1 CRITERIA FOR MAPPING	32
4.2 AREA TO BE MAPPED	32
4.3 AREA TO BE MODELLED	34
5 STAGE 2 – DEFINE NOISE CALCULATION METHODS	37
5.1 METHODS OF ASSESSMENT	37
5.2 AIRCRAFT NOISE	37
5.3 INDUSTRIAL NOISE	38
5.4 RAILWAY NOISE	40
5.5 ROAD TRAFFIC NOISE	42
6 STAGE 3 - DEVELOP DATASET SPECIFICATION	44
6.1 OVERVIEW	44
6.2 DEVELOPING A DATASET SPECIFICATION	44
6.3 INPUT DATA REQUIREMENTS FOR 3D MODEL PATHWAY ENVIRONMENT	46
6.4 INPUT DATA REQUIREMENTS FOR ASSESSMENT OF AIRCRAFT NOISE	47
6.5 INPUT DATA REQUIREMENTS FOR ASSESSMENT OF INDUSTRIAL NOISE	48
6.6 INPUT DATA REQUIREMENTS FOR ASSESSMENT OF RAILWAY NOISE	48
6.7 INPUT DATA REQUIREMENTS FOR ASSESSMENT OF ROAD TRAFFIC NOISE	49
6.8 INPUT DATA REQUIREMENTS FOR POPULATION EXPOSURE ASSESSMENT	49
6.9 OUTPUT SPECIFICATION FOR CALCULATED NOISE RESULTS	49

7	STAGE 4 - PRODUCE DATASETS	50
7.1	PROCESS	50
7.2	3D MODEL PATHWAY ENVIRONMENT	51
7.3	AIRCRAFT NOISE MODELLING	54
7.4	INDUSTRIAL NOISE MODELLING	55
7.5	RAILWAY NOISE MODELLING	56
7.6	ROAD TRAFFIC NOISE MODELLING	58
7.7	DATA CAPTURE THROUGH FIELD SURVEY	59
8	STAGE 5 – DEVELOP NOISE MODEL DATASETS	61
8.1	GENERAL GIS DATASETS	61
8.2	BASE MODEL - DIGITAL GROUND MODEL	62
8.3	BASE MODEL - BUILDINGS	63
8.4	BASE MODEL – TOPOGRAPHY	63
8.5	BASE MODEL - BARRIERS	64
8.6	NOISE SOURCE LAYER – AIRCRAFT	64
8.7	NOISE SOURCE LAYER – INDUSTRY/PORTS	67
8.8	NOISE SOURCE LAYER – RAILWAYS	68
8.9	NOISE SOURCE LAYER - ROADS	68
9	STAGE 6 – NOISE LEVEL CALCULATIONS	71
9.1	NOISE MAPPING SYSTEM REQUIREMENT CRITERIA	71
9.2	DATA MANAGEMENT STRATEGY	71
9.3	MODEL UNCERTAINTY	73
9.4	USER DEFINED CALCULATION SETTINGS	75
9.5	CALCULATION HARDWARE ENVIRONMENT	76
9.6	PRE-FLIGHT CHECKS	77
9.7	POST CALCULATION CHECKS	77
10	STAGE 7 – POST PROCESSING AND ANALYSIS	78
10.1	NOISE GRID PROCESSING	78
10.2	AREA ANALYSIS	79
10.3	DWELLING ANALYSIS	79
10.4	POPULATION ANALYSIS	79
11	REPORTING REQUIREMENTS	81
11.1	REPORTING MECHANISM	81
11.2	INFORMATION TO BE SENT TO THE EPA	82
11.3	INFORMATION TO THE PUBLIC	83
11.4	REVISION	84
	APPENDIX A: GLOSSARY OF ACOUSTIC AND TECHNICAL TERMS	86
	APPENDIX B: BIBLIOGRAPHY AND REFERENCES	88
	LEGISLATION	88
	IRISH PUBLICATIONS	88
	EPA PUBLICATIONS	88
	EC PUBLICATIONS	89
	BS, ISO STANDARDS AND MISCELLANEOUS GUIDANCE DOCUMENTS	89
	GENERAL TEXTS/REFERENCES	90
	WEB LINKS TO OTHER RELATED INFORMATION	90
	APPENDIX C: EXTRACT FROM S.I. NO. 118 OF 1998	91
	APPENDIX D: EXAMPLE OF CONCEPTUAL DATA MODEL FOR STRATEGIC NOISE MAPPING	93
	APPENDIX E: GUIDELINES ON THE INFORMATION TO BE CONTAINED IN REPORT ON STRATEGIC NOISE MAPPING	101

APPENDIX F: EXTRACT FROM ENDRM SECTION 5.2 REPORTING MAJOR ROAD INFORMATION.....	105
APPENDIX G: EXTRACT FROM ENDRM SECTION 5.5 REPORTING AGGLOMERATION INFORMATION.....	113
APPENDIX H: EXTRACT FROM ENDRM SECTION 6.1 REPORTING OF SUPPLEMENTARY INFORMATION.....	125
APPENDIX I: EXTRACT FROM ENDRM SECTION 6.2 REPORTING OF METADATA.....	127
APPENDIX J: RECOMMENDED COLOUR SCHEME FOR PRESENTATION OF NOISE LEVEL BANDS.....	129

1 Introduction

1.1 Background

This guidance is designed to help relevant designated Noise Mapping Bodies (NMBs) with their strategic noise mapping duties under Article 10 of the Environmental Noise Regulations 2006, S.I. No. 140 of 2006 (Regulations).

It aims to support those noise mapping bodies in carrying out some of their duties under the Regulations. In particular, it covers the requirements for making and approving strategic noise maps for agglomerations, roads, railways, major industrial sites and aircraft departing from and arriving at airports. It also covers the reporting of the strategic noise maps and the presentation of the results to the public. Strategic noise maps have to be developed in the context of the Regulations and should have particular regard to the requirement to provide a suitable basis for the development of noise action plans.

A glossary of acoustic and technical terms used is set out in Appendix A.

1.2 Role of this Guidance

This document is designed to provide a guide to noise mapping bodies about the process and requirements of strategic noise mapping and the submission of the strategic noise maps to the Environmental Protection Agency (EPA).

1.3 Why prepare a Strategic Noise Map?

Directive 2002/49/EC of the European Parliament and of the Council relates to the assessment and management of environmental noise, and is commonly referred to as the Environmental Noise Directive or END¹.

The aim of the Directive is:

“to define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise”.

And to that end three stages are set out:

- Undertake strategic noise mapping to determine exposure to environmental noise;
- Ensure information on environmental noise and its effects is made available to the public;
- Adopt action plans, based upon the noise-mapping results, with a view to preventing and reducing environmental noise where necessary and particularly where exposure levels can induce harmful effects on human health and to preserving environmental noise quality where it is good.

¹ Official Journal of the European Union, L 189, 12-25, 18 July 2002.

Available from: <http://eur-lex.europa.eu/JOIndex.do?ihmlang=en> [accessed May 2011]

The Directive defines noise mapping, strategic noise maps and action plans as:²

- ‘noise mapping’ shall mean the presentation of data on an existing or predicted noise situation in terms of a noise indicator, indicating breaches of any relevant limit value in force, the number of people affected in a certain area, or the number of dwellings exposed to certain values of a noise indicator in a certain area;
- ‘strategic noise map’ shall mean a map designed for the global assessment of noise exposure in a given area due to different noise sources or for overall predictions for such an area;
- ‘action plans’ shall mean plans designed to manage noise issues and effects, including noise reduction if necessary.

The END requires Member States to produce strategic noise maps for the main sources of environmental noise, i.e. major roads, major railways, major airports and agglomerations with a population of more than 100,000 persons in 2012 and subsequent rounds.

For the first round of the Directive, strategic noise mapping was undertaken during 2007 by the designated noise mapping bodies. They were required to undertake the assessment of noise levels from roads, railways, airports and industry within the agglomeration of Dublin, and from major roads across Ireland.

Using these noise level results with population distribution information, derived from census and GeoDirectory data, the noise exposure of the population living within the assessment areas was estimated. The EPA was required to report to the European Commission relevant information on population exposure to noise. This information was delivered to the EC in December 2007.

Information on environmental noise and its effects, including the results of the strategic noise mapping is made available to the public within noise action plans produced by the designated Action Planning Authorities. Strategic noise maps may be presented to the public as graphical plots, numerical data in tables or numerical data in electronic form³.

The third phase of the work under the Directive requires certain designated Action Planning Authorities to produce Action Plans for second round in 2013 and every five years thereafter. The EPA is required to submit summaries of the Action Plans to the EC. Action Plans must be produced based on the results of the noise mapping. It is also required to review and revise the action plans if necessary from time to time, at the request of the EPA, or in the event of a material change⁴ occurring which affects the environmental noise situation. The EPA has also issued a Guidance Note for Noise Action Planning to provide practical advice and guidance to Action Planning Authorities on the development of noise action plans. The Guidance Note for Noise Action Planning suggests that a material change may be *“considered to have occurred if it is known, or thought likely, that greater than 10% of the exposed population within the area of an action plan have experienced a change in the*

² END Article 3 (q), (r) and (t).

³ END Annex IV 2

⁴ Article 11 (7), whilst END Article 8 (5) refers to a “major development”; neither “material change” nor “major development” are defined in the Regulations or the END.

prevailing noise situation of greater than 3dB L_{den} or L_{night} . When such a situation arises the Action Plan should be revised as necessary within the regular 5 year revision cycle required under the Regulations, and such a revision may require a reassessment of the strategic noise maps and the population exposure assessment.” This should be taken in consideration alongside the discussion set out within section 11.4 of this guidance note.

Under the first round of the END in 2007 / 2008 there was one agglomeration (i.e. Dublin), and approximately 710 km of major roads outside the Dublin agglomeration. For the second round of strategic noise mapping and action planning under the END the population threshold for assessment of agglomerations is reduced from 250,000 to 100,000 persons, and the traffic flow thresholds for major roads and major railways are reduced from 6 million to 3 million and 60,000 to 30,000 vehicle passages per year respectively. The flow threshold for major airports remains at 50,000 movements per year.

This change in assessment thresholds has resulted in a significant increase in the coverage of the strategic noise mapping, with the addition of the agglomeration of Cork, alongside approximately a fivefold increase in the length of qualifying major roads. This increase in coverage means that many more local authorities have become designated noise mapping bodies for the second round of the END. It is for this reason that this guidance note is developed at this stage to assist these designated authorities prepare for the strategic noise mapping process.

1.4 Statutory Background

This guidance is issued by the Environmental Protection Agency, pursuant to the Regulations⁵.

In Ireland, the END is transposed by the Regulations and this guidance makes specific reference to clauses in these Regulations. The END is transposed separately in each Member state of the EU.

1.5 Scope of the Strategic Noise Maps

The Strategic Noise Maps are to be made as part of the first phase of work under the Directive. The Regulations set out to:

*“provide an implementation in Ireland of a common approach within the European Community intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise.”*⁶

The Regulations are to apply to environmental noise to which people are exposed, in particular in built up areas, in public parks or other quiet areas in an agglomeration, in quiet areas in open country, near schools, near hospitals, and near other noise-sensitive buildings and areas.⁷

⁵ Article 5 (2)

⁶ Article 4 (1)

⁷ Article 4 (2)

The Regulations shall not apply to noise caused by an exposed person, noise from domestic activities, noise created by neighbours, noise at work places, noise inside means of transport, or noise due to military activities in military areas.⁸

In the context of the Regulations, environmental noise is defined as unwanted or harmful outdoor sound created by human activities, including noise emitted by means of transport, road traffic, rail traffic, air traffic, and from sites of industrial activity.⁹

Furthermore the Strategic Noise Maps are not to cover the whole of Ireland; rather the areas covered by the Strategic Noise Maps are defined as those areas which are affected by environmental noise. This is further discussed in Section 2.1 below.¹⁰

1.6 Timetable

The following timetable applies with regard to strategic noise mapping for the second round:

Note 1: The Directive appears to omit Major Airports from the 2nd round in 2012, and this has been transposed to the Regulations in Articles 7 (2) and 8 (2). Conversely the EC recommended Reporting Mechanism for the END, *Reporting Mechanism proposed for reporting under the Environmental Noise Directive 2002/49/EC*, EC DG Environment, October 2007¹¹ (ENDRM), does indicate that Major airports are to be reported in 2012. It is currently the view of the EPA that the noise impact of major airports is to be assessed using strategic noise mapping in 2012, and subsequently noise action plans are to be drawn up during 2013.

- **31 December 2008** – Report submitted to the European Commission (EC) by the EPA designating the major roads, major railways, major airports and agglomerations relevant to the 2nd round thresholds of the END – ENDRM DF5¹²;
- **30 June 2010** – Report submitted to the EC by the EPA designating the major roads, major railways, major airports and agglomerations relevant to the 1st round thresholds of the END – ENDRM DF1¹³;
- **18 July 2010** - Report submitted to the EC by the EPA designating the competent bodies for strategic noise maps, action plans and data collection relevant to the 2nd round of the END – ENDRM DF2;
- **30 June 2012** – Strategic noise maps to be completed by NMBs for 2nd round agglomerations, major roads, major railways and major airports in respect of the 2011 calendar year¹⁴;
- **31 July 2012** – Strategic noise mapping results to be reported to the EPA by the NMBs for 2nd round agglomerations, major roads, major railways and major airports in respect of the 2011 calendar year¹⁵;

⁸ Article 4 (3)

⁹ Article 3 (1)

¹⁰ Article 10 (1)

¹¹ Available at:

http://circa.europa.eu/Public/irc/env/d_2002_49/library?l=/reporting_mechanism/reporting_mechanism&vm=detailed&sb=Title [accessed May 2011].

¹² Article 13 (2)

¹³ Article 13 (1) (b)

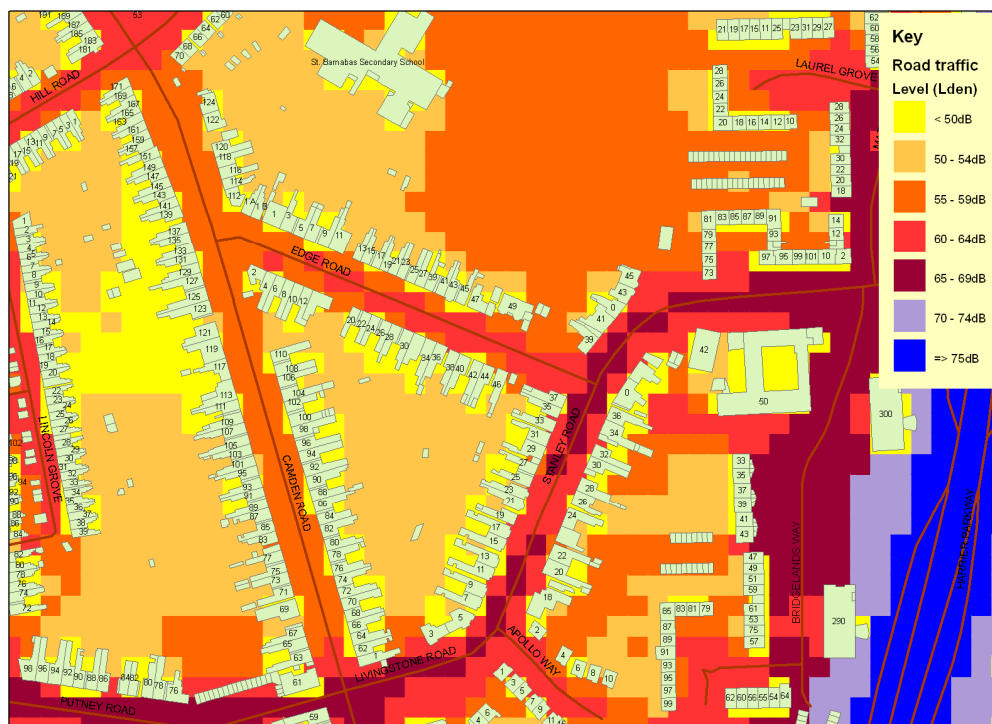
¹⁴ Article 10 (2)

¹⁵ Article 10 (6)

- **31 July 2012** – Information on strategic noise maps to be made available to the public by Noise Mapping Bodies¹⁶; and
- **31 December 2012** – Strategic noise maps to be reported to the EC by the EPA for 2nd round agglomerations, major roads, major railways and major airports in respect of the 2011 calendar year – ENDRM DF8.

1.7 Overview of Strategic Noise Mapping

A strategic noise map is designed for the assessment of noise exposure in a given area, resulting from strategic noise sources such as roads, railways, airports and industry. Just as an Ordnance Survey map may have contours indicating how ground level height changes across an area, a noise map can illustrate how environmental noise levels change across an area. Figure 1.1 shows a typical graphical presentation of a strategic noise map (from WG-AEN Position Paper on Presenting Noise Mapping



Information to the Public).

Figure 1.1: A graphical presentation of strategic noise mapping results

The purpose of strategic noise mapping is primarily threefold:

- to provide information to the public and decision makers on noise exposure locally, nationally and internationally;

¹⁶ Article 12 (1) and (3)

- to develop action plans for the purpose of managing noise exposure, by reducing noise levels where necessary, or preserving quiet areas where appropriate; and
- to provide the European Commission (EC) with strategic estimates of noise exposure across Europe to assist in the future development of European noise policy.

Strategic noise maps are normally produced by computer modelling techniques which calculate the noise level at specific points resulting from the sound emanating from the particular sources. The modelling software utilised source data such as traffic flow, type of road and rail, types of vehicles and the nature of industrial processes. The source data is positioned within a three dimensional (3D) computer model of the area of assessment. The 3D model includes features which can directly affect sound transmission, such as potential barriers, buildings, topography, weather conditions and how reflective or absorbent different surfaces can be. The calculations produce noise levels at receptor points on the facades of buildings, or on a 10 metre grid, at a height of four metres above the ground, there will be approximately 10,000 receptor points every 1 km², or approximately 25,900 receptor points every square mile.

The process of making strategic noise maps is similar to the methodologies used within noise modelling for environmental impact assessments associated with major developments, such as extensions to the national or regional roads network, or expansions to airports. The key difference tends to be the significantly greater area to be covered by the strategic noise mapping within one assessment, and therefore the amount of information required to develop the required computer models. The amount of time and resources required to collect the necessary source and 3D data, build the models, run the calculations and derive the reporting information should not be underestimated. It is typical for a large regional or national scale project to take an experienced team between 6 and 12 months to complete the process.

1.7.1 Existing use of noise modelling

Prior to strategic noise mapping in 2007, noise modelling in Ireland has typically been employed on a scheme specific basis as follows:

- Noise models are used to assess the potential noise impact of both new road schemes and modifications to existing roads. They permit detailed evaluation of “Do Minimum” and “Do Something” scenarios, thereby ensuring that noise mitigation measures are appropriately specified in order to comply with the requirements of the National Roads Authority publication *“Guidelines for the Treatment of Noise and Vibration in National Road Schemes”*.
- The use of noise models in the assessment of “inward noise impact” has become more prevalent in recent years. This involves the assessment of noise levels from existing sources, with particular emphasis on roads, in order to determine the likely associated impact on proposed residential development. At present there is a lack of detailed planning guidance in this regard, resulting in planning conditions which may not always be appropriate.
- The EPA may set noise limits in respect of certain activities that are subject to IPPC licensing; relevant guidance is set out in the EPA publication *“Guidance Note for Noise in Relation to Scheduled Activities”*. This document contains suggested noise limits at “sensitive locations” of 55dB(A) $L_{A_{r,T}}$ for daytime and 45dB(A) $L_{A_{eq,T}}$ for night-time. Noise models are typically used in order to

assess compliance with these limits when the site in question is very large or if new developments are proposed.

- Noise models have also been used in respect of a number of mid to large scale developments that are subject to noise limits in the form of planning conditions or even to demonstrate that a best practice approach is being followed.

It is important to recall that the strategic noise mapping required under the Regulations is undertaken to meet a statutory obligation set out within an EC Directive for a global assessment of noise exposure. These strategic noise maps are quite different in execution in a number of detailed aspects from the localised detailed noise maps which may be produced within the context of an EIA, a planning application or an IPPC license application. These differences ensure that the sets of results obtained from the differing approaches to noise mapping will not be directly comparable.

1.7.2 1st round strategic noise mapping

Under the requirements of the first round of the Directive, strategic noise mapping was undertaken during 2007.

The noise mapping of the agglomeration of Dublin was undertaken by Dublin City Council and Fingal County Council working in collaboration. In order to undertake the strategic noise mapping they utilised support and information supplied to them by Dun Laoghaire / Rathdown County Council, South Dublin County Council, Iarnród Éireann, Railway Procurement Agency, National Roads Authority and OSI. Supplementary information was also provided to Fingal County Council for the area in the buffer around the outside of the three counties area of the agglomeration from the adjacent Local Authorities with the assistance of the Local Government Computer Services Board (LGCSB) now known as the Local Government Management Agency (LGMA).

The strategic noise mapping of the agglomeration of Dublin included sections of major roads and major railways. The area, dwelling and population analysis for the agglomeration was undertaken by Dublin City Council and Fingal County Council.

The strategic noise mapping of the major roads, outside the agglomeration of Dublin, was undertaken by the National Roads Authority. The NRA is the designated noise mapping body for designated national roads. For the noise mapping of the first round in 2007 they extended an offer to the local authorities with non-national roads identified as major roads to undertake the noise mapping of the non-national roads. The local authorities supplied the relevant information to the NRA. Irrespective of the approach to round one, the Regulations designate the Local Authorities as the Noise Mapping Bodies for non-national major roads, and each Local Authorities has a statutory responsibility to ensure that strategic noise mapping of non-national major roads within their area is undertaken.

The strategic noise mapping of the major airport, Dublin International Airport (DIA), was undertaken by Dublin Airport Authority (DAA).

The area, dwelling and population analysis for the areas near the major roads and major airport was undertaken by the EPA on behalf of the NRA, Local Authorities and DAA. It is recommended that all noise mapping bodies make the necessary

provisions for undertaking the population exposure assessment of identified non-national major roads without the support of the EPA.

1.7.3 2nd round strategic noise mapping

Under the requirements of the second round of the Directive, strategic noise mapping is to be completed by 30 June 2012 with regard to the noise situation during 2011.

The flow thresholds for major roads and major railways has halved in comparison to the first round, this results in a requirement to undertake strategic noise mapping for sections of roads and railways which were not included within the first round in 2007.

The flow threshold for major airports is unchanged from the first round, resulting in DIA remaining as the one designated major airport.

The population threshold for agglomerations has reduced from 250,000 to 100,000 people, which means that Dublin and Cork are required to undertake strategic noise mapping for roads, railways, aircraft and industry affecting the agglomeration area, whereas in 2007 only Dublin was a designated agglomeration.

The NMBs have a requirement to review, and where necessary, revise each strategic noise map not later than five years after the date on which the map was made¹⁷. This means that NMBs who undertook strategic noise mapping for the first round in 2007 are to undertake a review of the strategic noise maps in order to determine if it is necessary to revise and update the strategic noise maps for the second round. The recommended approach to such a review is discussed in section 11.4.

1.8 Structure of this Guidance

Section 2 contains information about the requirements of Strategic Noise Mapping.

Section 3 provides an overview of the process of Strategic Noise Mapping.

Sections 4 to 10 set out guidance on how the seven stages of the Strategic Noise Mapping process may be undertaken.

Section 11 provides guidance on the reporting requirements.

The text is supported by text boxes that summarise the key parts of the Regulations and Directive.

Appendix A provides a short glossary of acoustic terms.

Appendix B provides a list of background reference material and information sources.

Appendix C sets out an extract from the First Schedule to the Air Pollution Act 1987 (Marketing, Sale and Distribution of Fuels) Regulations 1998 (S.I. No. 118 of 1998).

Appendix D sets out an example of a conceptual data model for strategic noise mapping.

¹⁷ Article 10 (5)

Appendix E sets out guidelines on information to be contained within strategic noise mapping reports.

Appendices F and G provide extracts from the ENDRM section 5 for major roads and agglomerations.

Appendix H and I presents extracts from ENDRM section 6 reporting of supplementary information and metadata.

Appendix J sets out a recommended colour scheme for presentation of noise level bands.

CAVEAT: Sections 10.3, 10.4, 11.1, 11.2 and 11.3, plus Appendices F to I, of this Guidance Note remain open to possible amendment due to ongoing work in Europe to provide a common method for undertaking population exposure assessment, and a revision to the EEA reporting mechanism. It is currently envisaged that a revised version of this guidance document will be issued in the first half of 2012 to include any relevant amendments to these sections. In the meantime it is recommended that noise mapping bodies work towards completion of the noise level calculations at the end of Section 9.

2 Requirements for Strategic Noise Maps

2.1 Designated Bodies

The Regulations state that the designated noise mapping bodies for making and approving Strategic Noise Maps for:

- The agglomeration of Cork are:
 - Cork City Council; and
 - Cork County Council.¹⁸
- The agglomeration of Dublin are:
 - Dublin City Council;
 - Dun Laoghaire / Rathdown County Council;
 - Fingal County Council; and
 - South Dublin County Council.¹⁹
- Major railways are:
 - Iarnród Éireann; and
 - Railway Procurement Agency.²⁰
- Major roads are:
 - National Roads Authority, for classified national roads; and
 - For non-national roads the relevant road authority or local authorities within whose functional area or areas the road is located.²¹
- Major airports are:
 - The relevant airport operator.²²

The Noise Mapping Bodies has a duty to co-operate, as appropriate, with their counterparts in neighbouring Member States of the EC with regard to strategic noise mapping of border areas²³. This is a due consideration for the NRA, Irish Rail and Local Authorities who border with Northern Ireland.

Furthermore it is recommended that noise mapping bodies liaise and co-operate with each other, in order to achieve a coordinated approach to the strategic noise mapping, with a view to achieving comparable results based upon a consistent assessment. This is a due consideration for the NRA with the Local Authorities with regard to roads; Irish rail with the Local Authorities with regard to railways; and the agglomerations of Dublin and Cork with regard to roads, railways, aircraft and industry.

¹⁸ Article 6 (a)

¹⁹ Article 6 (b)

²⁰ Article 6 (c)

²¹ Article 6 (d)

²² Article 6 (e)

²³ Article 10 (4)

2.2 General Requirements for Strategic Noise Maps

The Strategic Noise Maps are to form the basis of Action Plans. These Action Plans must refer to places near the major roads²⁴, major railways²⁵ and major airports²⁶, and within any relevant agglomeration²⁷, which means those places affected by noise from the major sources, as shown by the results of the noise mapping, and all locations within any relevant agglomeration.

Note 2: This means that Article 6(a), (b), (c) and (d) should be interpreted to mean “on behalf of any local authority or local authorities within whose functional area or areas are affected by the noise from the (road or railway or airport)”.

Note 3: Noise from major sources is regarded as affecting an area if it causes either an L_{den} value of 55dB or greater or an L_{night} value of 50dB or greater anywhere within an area. Which means that the noise maps produced for major roads, major railways and major airports must cover all areas exposed above these noise levels.

Box 1 General requirements for Strategic Noise Mapping

Strategic Noise Maps must

- Meet the objectives of Article 1(a) of the Directive;
- Meet the requirements in the Third Schedule of the Regulations;
- Be completed for the L_{den} and L_{night} indicators;
- Include all relevant roads, railways, airports and industrial sites affecting an agglomeration;
- Include all areas affected by designated major roads, major railways and major airports;
- Be completed using data no more than three years old, and approved by the EPA; and
- Be completed using a method of assessment recommended in Part II of the Second Schedule of the Regulations.

Strategic Noise Maps must meet several general requirements, set out below:

- The Strategic Noise Maps must present data on an existing or predicted situation in terms of a noise indicator, including breaches of any relevant limit value in force, the number of people affected in a certain area, or the number of dwellings exposed to certain values of noise indicator in a certain area²⁸.

²⁴ Article 11 (1) (b)

²⁵ Article 11 (1) (c)

²⁶ Article 11 (1) (d)

²⁷ Article 11 (1) (a)

²⁸ Article 3 (1)

- The Strategic Noise Maps must satisfy the minimum requirements of the Third Schedule of the Regulations²⁹, which in turn is a replication of most of Annex IV of the END. See Section 2.3 below.
- Strategic Noise Maps must be completed for the L_{den} and L_{night} noise indicators³⁰. See Section 3.
- Strategic Noise Maps must be completed using data approved for such use by the EPA, and no more than three years old³¹. See Section 3.
- Strategic Noise Maps must be completed using the assessment methods recommended in Part II of the Second Schedule of the Regulations³².

Additionally, Strategic Noise Maps may be completed for supplementary noise indicators provided that their use has prior approval from the EPA³³.

It is recommended that the NMBs produce a report documenting the process of undertaking the strategic noise mapping. This report should be supplied to the EPA alongside the noise assessment results and the population exposure statistics. Appendix E sets out general guidelines on the possible contents of such a report on strategic noise mapping.

2.3 Third Schedule of the Regulations

The Third Schedule of the Regulations sets out the minimum requirements for Strategic Noise Mapping. These requirements are a replication of most of Annex IV of the END.

²⁹ Article 10 (3)

³⁰ Article 8 (1)

³¹ Article 8 (2) (a) & (b)

³² Article 9

³³ Article 8 (3)

Box 2

Annex IV from the END

Strategic noise mapping must at least meet the following requirements:

- Strategic noise mapping will be used for the following purposes:
 - the provision of the data to be sent to the Commission in accordance with Article 10(2) and Annex VI,
 - a source of information for citizens in accordance with Article 9,
 - a basis for action plans in accordance with Article 8.Each of those applications requires a different type of strategic noise map.
- Minimum requirements for the strategic noise maps concerning the data to be sent to the Commission are set out in paragraphs 1.5, 1.6, 2.5, 2.6 and 2.7 of Annex VI.
- For the purposes of informing the citizen in accordance with Article 9 and the development of action plans in accordance with Article 8, additional and more detailed information must be given, such as
 - a graphical presentation,
 - maps disclosing the exceeding of a limit value,
 - difference maps, in which the existing situation is compared with various possible future situations,
 - maps showing the value of a noise indicator at a height other than 4 m where appropriate.The Member States may lay down rules on the types and formats of these noise maps.
- Strategic noise maps for local or national application must be made for an assessment height of 4 m and the 5dB ranges of L_{den} and L_{night} as defined in Annex VI.
- For agglomerations separate strategic noise maps must be made for road-traffic noise, rail-traffic noise, aircraft noise and industrial noise. Maps for other sources may be added.

Annex IV of END

Annex IV of the END sets out the minimum requirements of strategic noise mapping alongside a number of articles of information and guidance. These minimum requirements are shown in Box 2. The production, presentation and reporting of the strategic noise mapping must meet all of the requirements set out in Annex IV of the Directive.

Appendix E sets out guidance on how the minimum requirements set out in Annex IV of the Directive may be incorporated into a report on the strategic noise mapping process which is to be submitted to the EPA alongside the noise assessment results and the population exposure statistics.

The NMBs should also produce a second report, the short Supplementary Report on the strategic noise mapping, which is required under the ENDRM 2007. It should include the main elements of each of the minimum requirements set out in Annex IV of the Directive. The Technical Guidance on the ENDRM contains a template for content of the Supplementary Report.

In the following paragraphs, guidance is given on how the various elements of Annex IV might be met.

A strategic noise map is the presentation of data on one of the following aspects:

- **an existing, a previous or a predicted noise situation in terms of a noise indicator,**
- **the exceeding of a limit value,**
- **the estimated number of dwellings, schools and hospitals in a certain area that are exposed to specific values of a noise indicator,**
- **the estimated number of people located in an area exposed to noise.**

This defines a strategic noise map as a broad range of indicated results, covering actual assessed noise exposure levels, but also estimated numbers of exposed noise sensitive locations and people. The presentations listed link to the information which is to be reported to the EC using the recommended reporting mechanism, ENDRM 2007. At present there are no statutory noise limit values in Ireland, therefore this presentation would not be used at present.

Strategic noise maps may be presented to the public as:

- **graphical plots,**
- **numerical data in tables,**
- **numerical data in electronic form.**

This defines the means by which the indicated results may be presented to the public.

Strategic noise maps for agglomerations shall put a special emphasis on the noise emitted by:

- **road traffic,**
- **rail traffic,**
- **airports,**
- **industrial activity sites, including ports.**

Within agglomerations roads, railways and airports with annual movement totals below those of designated major sources are to be included within the assessment of noise exposure. Industrial sites, including ports, are also to be assessed within agglomerations, whereas there is no requirement under the Directive to assess noise exposure due to industrial sites outside agglomerations.

Strategic noise mapping will be used for the following purposes:

- **the provision of the data to be sent to the Commission in accordance with Article 10(2) and Annex VI,**
- **a source of information for citizens in accordance with Article 9,**
- **a basis for action plans in accordance with Article 8.**

Each of those applications requires a different type of strategic noise map.

This provides a clear statement that the strategic noise maps drawn up under the requirements of the Directive are to be used to provide information for three main ends, and that each of these ends places a differing need on the strategic noise mapping. The strategic noise mapping process must provide all the information required for the following purposes:

- Article 10(2) and Annex VI refer to the information which is to be submitted to the EC using the recommended reporting mechanism, ENDRM 2007;
- Information to be presented to the public, see section 10.3 of this Guidance;
- Action Plans are to be based upon the results of the strategic noise mapping³⁴, which requires the strategic noise mapping to deliver the coverage, and noise indicators, relevant to the assessment criteria used within the Action Plans.
-

These requirements are discussed further in the next two points.

Minimum requirements for the strategic noise maps concerning the data to be sent to the Commission are set out in paragraphs 1.5, 1.6, 2.5, 2.6 and 2.7 of Annex VI.

The requirements set out within the relevant paragraphs of Annex VI of the Directive are now incorporated within the recommended reporting mechanism ENDRM 2007 data flow 4 (and 8). The reporting templates provide for the submission of three types of data to the EC under DF4 and DF8; data for which there is a legal obligation under the END, data for which there is a recommendation from the END, DG ENV or EEA, and data which is fully optional. Provided that all the data fields are completed and returned for which there is a legal obligation under the END, these minimum requirements will have been met. The minimum requirements include the following information for each type of noise source to be assessed:

- The numbers of people exposed in specified L_{den} and L_{night} noise level bands within agglomerations;
- The numbers of people exposed in specified L_{den} and L_{night} noise level bands outside agglomerations; and
- The total area and total number of dwellings exposed to major sources in specified L_{den} noise level bands, including those within agglomerations.

The requirements for information to be reported to the EC, as set out above, are a series of data tables providing numbers of people, dwellings or area by noise level bands and noise indicators.

For the purposes of informing the citizen in accordance with Article 9 and the development of action plans in accordance with Article 8, additional and more detailed information must be given, such as:

- a graphical presentation,
- maps disclosing the exceeding of a limit value,

³⁴ Article 11 (3) (ii)

- **difference maps, in which the existing situation is compared with various possible future situations,**
- **maps showing the value of a noise indicator at a height other than 4 m where appropriate.**

The Member States may lay down rules on the types and formats of these noise maps.

The tables of results to be reported to the EC are to be used for the purposes of informing the citizens, under END Article 9, and developing Action Plans, under END Article 8. In order to provide information to the public in a clear comprehensible and accessible format, END Article 9 (2), it is also stated that graphical maps should be used as a means of presenting the results. Comparisons with limit values, with potential future scenarios, and with other assessment heights are also introduced as they may be relevant for a clearer public understanding, or to help support the Action Plans.

Strategic noise maps for local or national application must be made for an assessment height of 4 m and the 5 dB ranges of Lden and Lnight as defined in Annex VI.

This sets out the common assessment height for strategic noise maps, and again references the noise level bands which are to be reported, as set out in Annex VI.

For agglomerations separate strategic noise maps must be made for road-traffic noise, rail-traffic noise, aircraft noise and industrial noise. Maps for other sources may be added.

It is the minimum requirement that for all locations within agglomerations there should be strategic noise maps produced for roads, railways, aircraft noise and industrial sites. Strategic noise mapping of other sources may be undertaken should it be relevant within the agglomeration, and relevant to the needs of an Action Plan.

The Commission may develop guidelines providing further guidance on noise maps, noise mapping and mapping softwares in accordance with Article 13(2).

To date the Commission has not developed official guidelines on strategic noise maps, noise mapping and mapping software. The EC, EEA and UK Department for Environment, Food and Rural Affairs (Defra) have supported the work of the European Commission Working Group Assessment of Exposure to Noise (WG-AEN) by funding research and workshops which have aided the development of position papers and a catalogue of noise mapping software. There are two WG-AEN position papers which provide extensive guidance on strategic noise mapping in the context of the Directive, and on presenting noise mapping information to the public:

- **Good Practice Guide for Strategic Noise Mapping and the Production of Associated Data on Noise Exposures, Version 2, 13 August 2007³⁵ (WG-AEN GPG v2);**

³⁵ Available from: <http://ec.europa.eu/environment/noise/pdf/gpg2.pdf> [accessed May 2011]

- Presenting Noise Mapping Information to the Public, March 2008³⁶; and
- Mapping Software Catalogue, April 2008³⁷.

³⁶ Available from: http://circa.europa.eu/Public/irc/env/noise_map/library?l=/wg-aen_001_2008doc/_EN_1.0_&a=d [accessed May 2011]

³⁷ Available from: http://circa.europa.eu/Public/irc/env/noise_map/library?l= [accessed May 2011]

3 Overview of the Strategic Noise Mapping Process

3.1 Introduction

The main structure of the guidance is to present a staged approach to the delivery of strategic noise mapping projects. The approach set out may be summarised as a seven stage process, as shown in Figure 3.1 below.

Each stage of the process is defined by preceding stages such that requirements and specifications are captured ahead of the datasets. These datasets are then processed and concatenated to develop the model datasets, which are checked and tested prior to the final assessment of noise levels.

It is recommended that the data processing is commenced within a GIS environment, then passed to the specialist noise mapping software environment for final sign-off and the assessment of noise levels. The results of this assessment are then passed back to the GIS environment for post processing, analysis and mapping. Step 5 “Develop Noise Model Datasets” starts within the GIS environment, and is completed within the noise mapping software.

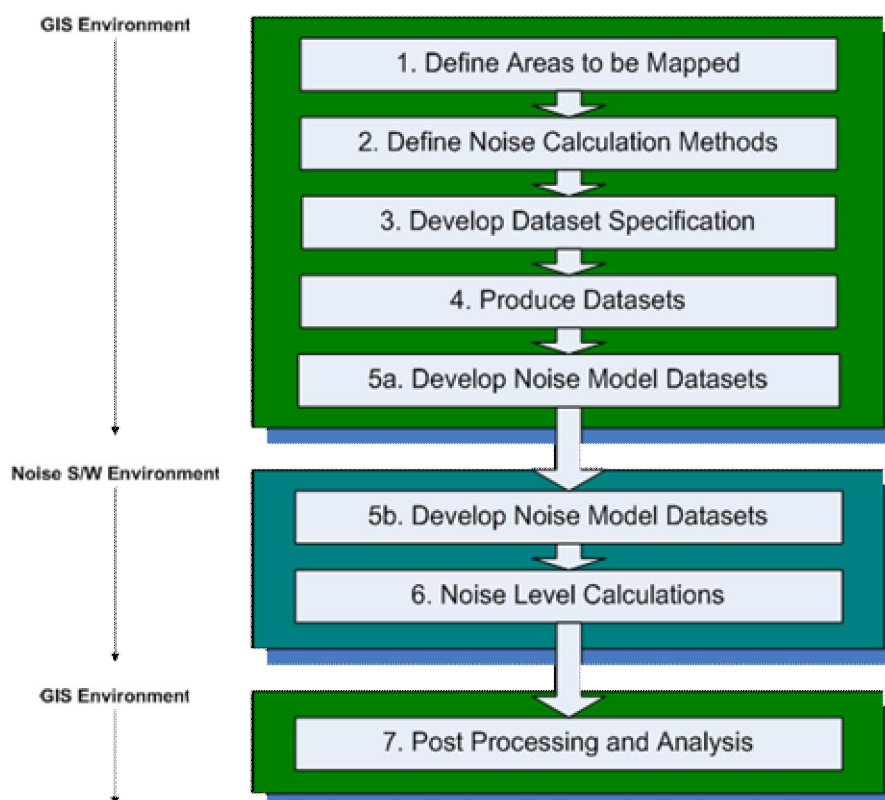


Figure 3.1: Overview of noise mapping process

Following the assessment of noise levels the analysis is undertaken using datasets developed to present dwelling and population locations in order to deliver the statistics required by the EC for the reporting requirements of the Directive.

3.2 Stage 1 - Define Areas to be Mapped

The key first stage in any spatial data project is to gain an understanding of the area under review; in this case there are two types of area of interest:

- The area to be mapped:
 - The specific geographical area for which noise calculation results are required;
 - For agglomerations this is generally a clearly defined boundary set out within the Regulations; and
 - For major roads, railways and airports the area is less specific as it is effectively designed by a minimum noise level which is of interest to be reported to the Commission.
- The area to be modelled:
 - In order for the noise levels on the edge of the agglomeration area to be calculated accurately, it is important to consider the noise sources, and propagation screening objects, from an area beyond and outside the actual area to be mapped; and
 - For major roads, railways and airports the noise source is specifically located, and the area to be modelled is generally the same area as the area to be mapped.

At the end of the stage there will be:

- A specification for the geographical area for which the input datasets are required; and
- A specification for the geographical areas for which noise levels will be calculated.

Guidance on defining the noise mapping and noise modelling areas is set out below in section 4.

3.3 Stage 2 - Define Noise Calculation Methods

The Regulations set out a list of calculation methods which may be used for the production of the strategic noise maps.

For the road and railway calculation methods there is a choice of two within the Regulations. As the options available do not necessarily require exactly the same input datasets as each other, it is important that the noise calculation methods to be utilised are defined at an early stage in order that the data specification developed will deliver the correct input datasets.

After selection of the calculation method, the methodology can be analysed and a catalogue of input data requirements drawn up, including details such as objects, attributes and limiting values as appropriate.

Guidance on the methods of assessment to be used for the round 2 strategic noise mapping is set out in section 5 below.

3.4 Stage 3 – Develop Dataset Specification

Stages 1 and 2 have provided a clear description of what data the chosen calculation methods use, and for what locations it is required. This information combines with the chosen data management strategy to draw up a series of dataset specifications for each of the layers of spatial and attribute data which are required within the noise mapping process.

The dataset specifications become an organised means of centrally managing and combining disparate generic spatial datasets and attribute databases. It also enables multiple organisations and stakeholders to supply data into a data repository to support interoperability and combining of work efforts.

The noise mapping process requires a wide range of input datasets, many of which need to be spatially referenced. An overview of the type of datasets required in order to carry out the noise level calculations is shown below:

- 3D Model Environment:
 - DTM – 3D surface model;
 - DEM – 3D building heights;
 - Break lines;
 - Embankments & Cuttings;
 - Topography;
 - Bridges / Underpasses; and
 - Barriers.
- Road source:
 - Carriageway centreline;
 - Traffic flow;
 - Traffic speed;
 - %HGVs;
 - Road surface type; and
 - Road texture depth.
- Rail source:
 - Rail centreline;
 - Traffic flow;
 - Train speed;
 - Train type; and
 - Railhead roughness.
- Industry source:
 - Location;
 - Process type; and
 - Noise emission level.
- Aircraft Source:
 - Flight track;
 - Aircraft type; and
 - Power level along flight track.

The analysis environment will typically require a number of datasets, including several not required for the noise calculation process:

- Information on residential population numbers;
- Population distribution information;

- Identification of buildings as dwellings or other noise sensitive premises, such as schools and hospitals; and
- Location of premises with special noise insulation measures.

At this stage it is often most efficient to also select the noise calculation software which will be utilised in Stage 6, that way the specification drawn up can match the requirements of the calculation software, and make the transition from GIS to noise calculation environment as seamless as possible.

Guidance on setting up dataset specifications suitable for strategic noise mapping is set out below in section 6.

3.5 Stage 4 – Produce Datasets

Within this stage the raw GIS datasets can be collected, collated and catalogued with the aim of carrying out a gap analysis and audit against the specifications drawn up within Stage 3.

The general areas which are addressed at this point are:

- An appraisal of the available data against the specification, looking into issues such as:
 - Coverage, resolution, accuracy, attributes, maintenance regime, format, metadata, fitness for purpose.
- A gap analysis is then carried out, resulting in details of the data required that is not currently available, and proposing mechanisms for the completion of the input datasets.
- During the process the licensing conditions associated with each of the available datasets is documented and appraised as confirmation of whether the current license enables the use of each dataset within the noise mapping project is required. Some of the licensing issues to be considered could include:
 - current and future IPR, residual IPR, use for what purpose and restrictions on other users and sub-contractors, maintenance of data, duration of license term, residual rights after expiry, internet access, public availability etc.

Following the appraisal, gap analysis and resolution of licensing issues, the input datasets need to be completed in line with the approved approach. This could be via a number of different routes:

- Extended licensing of existing datasets for additional coverage or improved currency;
- Data capture programs to fill gaps in the available datasets; or
- Interpolation or processing of raw datasets to produce relevant derived data products.

Guidance on the production of strategic noise mapping datasets is set out in section 7 below.

3.6 Stage 5 - Develop Noise Model Datasets

At the end of Stage 4 the input datasets should be completely populated for the total coverage of the area to be modelled. At this point the project will have a series of generic GIS datasets.

GIS data is collected for multiple purposes and this will generally not be specifically for the needs of acoustic calculation, hence it is seldom optimised for such a use. This leads to two generalised groups of issues which need to be resolved for the data to be optimised for the noise calculations:

- Tuning dataset resolution to acoustic calculation requirements; and
- Appending datasets to best exploit capabilities of the calculation kernel.

This processing may be carried out within a GIS environment, or within some noise modelling software, but needs to be designed in collaboration between GIS and noise modelling specialists in order to produce an optimised noise modelling dataset ready for the calculation process.

If the specification within Stage 3 was not focused towards a particular noise calculation software tool, the datasets will need to be processed at this stage in order to match into the chosen software tool.

Guidance on developing the noise model datasets is set out in section 8 below.

3.7 Stage 6 - Noise Level Calculations

At this stage the final GIS input datasets are transferred into the noise calculation software. The elements of this stage are typically:

- Final manipulation of the input datasets to optimise for the calculation kernel;
- Selection of the user specified calculation settings within the software tool;
- Running of the noise calculations over the entire area to be mapped, using all the data from the model area; and
- Production of noise results datasets developed from the calculation process.

The resultant noise level datasets may remain within the noise calculation software environment, or more typically be passed to a third party analysis tool or into a GIS system, for map production, secondary analysis and reporting.

Guidance on the noise calculation process is set out below in section 9.

3.8 Stage 7 - Post Processing and Analysis

Following the production of noise level results within Stage 6 the calculated levels need to be analysed in combination with other datasets in order to produce the results required by the Directive and the Commission.

The analysis to be carried out then needs to deliver a number of sets of results including:

- No. of people exposed within noise bands;

- No. of people exposed within noise bands in dwellings with special noise insulation;
- No. of people exposed within noise bands in dwellings with a quiet façade;
- Total area exposed within noise bands;
- No. of dwellings exposed within noise bands; and
- Documentation on the process undertaken to produce the reported analysis results, including metadata for electronic datasets.

Guidance on the post processing and analysis of the noise calculation results is set out in section 10 below.

3.9 Reporting and Publication

Finally the results of the strategic noise mapping are to be submitted to the EPA using the templates from the EC recommended reporting mechanism, ENDRM 2007, or other templates provided by the EPA, along with metadata and a report on the noise mapping process. The results are also to be made available to the public in line with the requirements of the Regulations.

Guidance on these aspects is set out in section 11 below.

Further guidance will be issued by the EPA in relation to this.

4 Stage 1 – Define Areas to be Mapped

4.1 Criteria for Mapping

Under the Regulations there is a requirement to assess the noise levels from roads, railways, industry and airports at locations within any agglomerations. There is also a requirement to assess the noise levels near designated “major roads”, “major railways” and “major airports” at affected locations outside any agglomerations.

For the second round in 2012 the strategic noise mapping must be undertaken for:

- Agglomeration with more than 100,000 inhabitants within their territories:
 - Agglomeration of Cork as defined in the Regulations; and
 - Agglomeration of Dublin as defined in the Regulations;
- “major roads”
 - Sections of road with a flow threshold of 3,000,000 vehicle passages per year;
- “major railways”
 - Sections of rail route above a flow threshold of 30,000 train passages per year; and
- “major airports”
 - Airports which have more than 50,000 movements per year (a movement being a take-off or a landing), excluding those purely for training purposes on light aircraft.

Note 4: Noise from major sources is regarded as affecting an area if it causes either an L_{den} value of 55dB or greater, or an L_{night} value of 50dB or greater, anywhere within an area. Which means that the noise maps produced for major roads, major railways and major airports must cover all areas exposed above these noise levels.

Note 5: The above definition of “major roads” has been clarified to consist of all roads classified as “National” roads or “Regional” roads with a total flow above 3,000,000 vehicle passages per year.

4.2 Area to be Mapped

The areas to be mapped are determined by the requirements set out within the Regulations, which replicate the requirements set out in the Directive.

The agglomerations are defined as areas. The assessment of noise should be undertaken for all the relevant sources for all locations within those areas. Therefore inside agglomerations all roads, railways, industrial areas and aircraft movements should be modelled as sources, regardless of the level of traffic flow, if the noise level exposure of residential dwellings, noise sensitive locations, or quiet areas will exceed 55dB L_{den} and/or 50dB L_{night} at any location within the agglomeration.

The “major airports”, “major railways” and “major roads” are effectively defined by the locations of the sources. The assessments for these major sources must extend to all

places near these major sources. Places should be considered near to these sources if the noise exposure resulting from the sources will exceed either 55dB L_{den} or 50dB L_{night} .

4.2.1 Agglomerations

The Directive requires all agglomerations with a population of more than 100,000 inhabitants within their territories to be mapped in 2012. The Directive does not set out how an agglomeration is to be defined, rather that is left to the Member States to determine. The Regulations set out the following definitions for the agglomerations of Cork and Dublin:

- “agglomeration of Cork” means the restricted area of Cork as specified in the First Schedule to the Air Pollution Act 1987 (Marketing, Sale and Distribution of Fuels) Regulations 1998 (S.I. No. 118 of 1998); and
- “agglomeration of Dublin” means the county borough of Dublin, the administrative county of Dun Laoghaire/Rathdown other than those areas excluded in the First Schedule to the Air Pollution Act 1987 (Marketing, Sale and Distribution of Fuels) Regulations 1998 (S.I. No. 118 of 1998), and the administrative counties of Fingal and South Dublin.

Note 6: The above definition of the agglomeration of Dublin has been clarified to consist of all of the county borough of Dublin, all of the administrative counties of Fingal and South Dublin, and the restricted area of the administrative county of Dun Laoghaire/Rathdown.

Within agglomerations, including the model buffer area, it is required to include all roads, railways, industrial areas and aircraft movements as modelled sources, without applying a traffic flow level filter, if the source will result in a noise level exposure of residential dwellings, noise sensitive locations, or quiet areas which exceeds 55dB L_{den} and/or 50dB L_{night} .

Appendix C contains an extract from the Air Pollution Act 1987 (Marketing, Sale and Distribution of Fuels) Regulations 1998 (S.I. No. 118 of 1998) relevant to the definitions of the Cork and Dublin agglomerations.

4.2.2 Extent of Airports

Within agglomerations there is a requirement to assess the noise levels from all airports with civil movements, whether they are designated major airports or not. Within the agglomerations there may be a number of small airfields. From a practical perspective, these airfields should be mapped if they result in a noise exposure in excess of 55dB L_{den} or 50dB L_{night} at locations outside the boundary of the airfield and within the agglomeration boundary. Information on the noise levels in the vicinity of airports may be available from published annual average summer day noise contours, or could be assessed through suitably designed field surveys.

There is also a requirement to assess the noise levels from “major airports” at any location outside any agglomerations. A “major airport” is defined as one with in excess of 50,000 total movements per year, an average of approximately 137 movements per 24 hours.

4.2.3 *Extent of Industry*

Within the agglomeration there is a requirement to assess the noise levels from sites of industrial activity including those defined in Annex I to Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control³⁸.

Within the agglomerations there may be a number of sites which may be considered industrial, or areas of industrial processes. From a practical perspective, these industrial sites should be mapped if they are thought to result in a noise exposure in excess of 55dB L_{den} or 50dB L_{night} at residential or noise sensitive locations outside the boundary of the site. Information on the noise levels in the vicinity of industrial areas may be available from IPPC licensing reports, or could be assessed through suitably designed field surveys.

4.2.4 *Extent of Railways*

Within agglomerations there is a requirement to assess the impact of all railways, including light rail and tram systems.

There is also a requirement to assess the noise levels from “major railways” at any locations outside any agglomerations. A “major railway” is defined as a rail route with a total flow above 30,000 train passages per year, an average of approximately 82 train passages per 24 hours.

4.2.5 *Extent of Roads*

Within agglomerations there is a requirement to assess the impact of all relevant roads. As noted in WG-AEN GPG v2 the END implies that all roads have to be taken into account and mapped within agglomerations.

There is also a requirement to assess the noise levels from “major roads” at any locations outside any agglomerations. A “major roads” is defined as a road with a total flow above 3,000,000 vehicle passages per year, approximately 8,220 vehicle passages per average 24 hours.

Note 7: The above definition of “major roads” has been clarified to consist of all roads classified as “National” roads or “Regional” roads with a total flow above 3,000,000 vehicle passages per year.

The National Roads Authority, Local Authorities and road authorities across Ireland are responsible for identifying and reporting to the EPA sections of major road above the relevant flow threshold.

4.3 *Area to be Modelled*

The above definition of extents identifies the area of the agglomerations for which noise results are required, and the linear extents of major noise sources outside of agglomerations.

It is now necessary to determine the areas to be modelled, as this defines the areas for which input datasets are required for the strategic mapping process.

³⁸ Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control, O.J. No. L 257 of 10 October 1996, p. 26-40.

In addition to the recommendations below, it is considered appropriate for NMBs to consider WG-AEN GPG v2 Toolkit 1 when forming an estimate of the area to be mapped.

4.3.1 Agglomerations

The strategic noise mapping of agglomerations should provide an assessment of the noise levels from all relevant sources within the agglomeration, for all locations within the agglomeration.

For locations near to the boundaries of the agglomeration, there will most likely be noise sources outside the agglomeration which will have an influence on noise level assessment within the agglomeration. Some roads, railways, industrial sites and aircraft movements located outside the boundary of an agglomeration, may contribute significantly to noise levels within the agglomeration. Such sources must be included for consideration within the modelled area when noise mapping an agglomeration.

The area outside the agglomeration for which model datasets are required is commonly referred to as the buffer. It is not possible to state a simple distance for an appropriate buffer which is suitable in all cases, as roads or railways with low traffic flows may only influence noise levels within an agglomeration when a few hundred meters away, conversely a major motorway may have an influence over 2km away.

It is recommended that the buffer around the agglomerations should be 2 km wide, as this will ensure that all relevant noise sources are captured in all cases, and fits with the precautionary principle of environmental assessment. Where more specific local information is available it may be possible to reduce this buffer to a minimum of 1 km where major sources are absent from areas within the initial 2km buffer. Where major sources are present there should be a minimum of a 2km buffer in the vicinity of the major sources. All the input datasets required for modelling inside the agglomeration boundary should also be developed for the buffer area around the agglomeration, see sections 6 and 7 for further details.

4.3.2 Major Airports

The noise emissions from “major airports” are defined by the locations of the runways, and the flight tracks from inbound and outbound aircraft movements.

It is not generally possible to make an estimate of the extent of the area around a major airport exposed above either 55dB L_{den} or 50dB L_{night} based solely upon a distance criterion due to the nature of the runway alignments, flight tracks and aircraft types in use. It is therefore best practice to produce an initial noise impact assessment due to aircraft movements without the inclusion of datasets related to the 3D terrain environment around the airport. The resulting noise contours for 55dB L_{den} or 50dB L_{night} may then be used to determine the extent of the 3D terrain data which is required for the final assessment of noise levels.

The total extent of the area which falls within either the 55dB L_{den} or 50dB L_{night} noise contours from this final assessment of noise levels may then be used to determine the area for which datasets are required to undertake the population exposure assessment.

4.3.3 Major Railways

The noise emissions from “major railways” are defined by the locations of the sections of rail route above the flow threshold.

As major railways are designated with knowledge of the train movement information, it is possible to undertake an assessment of the emission level of the rail route, and carry out an initial assessment of propagation in open conditions (i.e. without ground terrain, buildings, barriers etc) to estimate the distance of the 55dB L_{den} and 50dB L_{night} noise contours from the sources. This estimated distance should be multiplied by 1.5 in order to set the buffer distance for the model area.

Experience indicates that the maximum required buffer distance, from the source to the edge of the model area, will be in the order of 2km, with it possible in some situations to have a minimum buffer distance of 1km.

It is not recommended that a fixed distance is chosen for the buffer of the whole model area, as this is likely to either lead to a buffer which is too small, or produce an unnecessarily large model area.

4.3.4 Major Roads

The noise emissions from “major roads” are defined by the locations of the sections of road above the flow threshold.

As major roads are designated with knowledge of the traffic movement information, it is possible to undertake an assessment of the emission level of the road sections, and carry out an initial assessment of propagation in open conditions (i.e. without ground terrain, buildings, barriers etc) to estimate the distance of the 55dB L_{den} and 50dB L_{night} noise contours from the sources. This estimated distance should be multiplied by 1.5 in order to set the buffer distance for the model area.

Experience indicates that the maximum required buffer distance, from the source to the edge of the model area, may be in the order of 3km, with it possible in some situations, for sections of major road just above the flow threshold, to have a minimum buffer distance of 1km.

It is not recommended that a fixed distance is chosen for the buffer of the whole model area, as this is likely to either lead to a buffer which is too small, or produce an unnecessarily large model area.

The noise mapping bodies for national and non-national roads are to liaise to ensure that the mapping of slip roads, connecting roads, roundabouts and junctions are coordinated to ensure continuity of coverage of the mapping, and consistency of the traffic flow data and modelling data used.

Any agreements drawn up between NMBs to share or split responsibilities should be forwarded to the EPA for approval.

5 Stage 2 – Define Noise Calculation Methods

5.1 Methods of Assessment

The second schedule of the Regulations sets out the recommended interim computation methods which may be used for the assessment of noise. The methods are referred to as Interim methods as they are to be used until such time as a common method of assessment is adopted³⁹.

The recommended interim methods of assessment set out in the second schedule of the Regulations contain the four EC Recommended Interim Methods set out in Annex II of the Directive. The Directive also provides for Member States to use either the EC Recommended Interim Methods or methods based upon those laid down in their own legislation⁴⁰. As it is common practise for environmental impact assessments to be undertaken in Ireland for roads and railways using the UK national calculation methods, the second schedule of the Regulations also sets out the UK methods CRTN and CRN.

As the Directive calls for the assessment to be undertaken using common noise indicators of L_{den} and L_{night} ⁴¹ it states that the EC Interim methods, and national computational methods, will need to be adapted in order to provide annual average assessments of L_{den} and L_{night} ⁴². The EC published the recommended adaptation of the EC Interim methods in August 2003⁴³.

It is therefore important to note that the strategic noise mapping must be undertaken using the adapted methods, not the published national standard version of the method. For this reason it is important to expressly state both the core methodology and list the relevant adaptations included within the method of assessment used for the strategic noise mapping.

5.2 Aircraft Noise

The Regulations set out the method of assessment:

- For AIRCRAFT NOISE: ECAC.CEAC Doc. 29 'Report on Standard Method of Computing Noise Contours around Civil Airports', 1997. Of the different approaches to the modelling of flight paths, the segmentation technique referred to in section 7.5 of ECAC.CEAC Doc. 29 will be used.

This should be used in accordance with the adaptations set out in:

- Commission Recommendation 2003/613/EC of 6 August 2003.

³⁹ Article 9

⁴⁰ END Article 6 (2)

⁴¹ END Article 5 (1)

⁴² END Article 5 (1) and Annex II 2.1 and 2.2

⁴³ Commission Recommendation of 6 August 2003 concerning the guidelines on the revised interim computation methods for industrial noise, aircraft noise, road traffic noise and railway noise, and related emission data, 2003/613/EC, O.J. No. L 212 of 22 August 2003, p. 49-64.

The method of assessment including the recommended adaptations is referred to as ECAC Doc 29 Interim.

A number of commercial noise mapping software systems provide support for the EC adapted Interim method of ECAC Doc. 29, for further information refer to the WG-AEN “Mapping Software Catalogue”, April 2008⁴⁴.

It should be noted that aircraft noise modelling undertaken in Ireland to date has used the Federal Aviation Authority (FAA) Integrated Noise Model (INM) software⁴⁵. From version 7.0a of INM uses algorithms consistent with the European Civil Aviation Conference (ECAC) Doc 29 (3rd Edition, December 2005) “*Report on Standard Method of Computing Noise Contours around Civil Airports*”⁴⁶. It should be noted, however, that this does not necessarily provide equivalent results to the EC adapted Interim method as it is based upon ECAC Doc 29 3rd Edition 2005, whereas EC adapted Interim method is based upon ECAC Doc 29 1997, and INM does not include the adaptations set out in Commission Recommendation 2003/613/EC.

The use of INM as an alternative to the EC adapted Interim method has been noted in other Member States, including the UK where Defra issued guidance on the noise mapping of airports⁴⁷.

It is therefore recommended that the EC adapted Interim method, ECAC Doc 29 Interim, is used for the assessment of aircraft noise under the Regulations. As an alternative it would be possible to use the most current version of the FAA INM software⁴⁸.

The aircraft noise calculations only take into consideration noise from aircraft movements; i.e. from start-of-roll, acceleration down the runway, the period when the aircraft is airborne and deceleration along the runway after touchdown, including reverse thrust if employed. All ground noise sources such as taxiing aircraft, auxiliary power units and aircraft undergoing engine testing would be excluded from the modelling. If it is known, or considered likely, that residential properties or noise sensitive locations will be exposed to annual average noise levels in excess of either 55dB L_{den} or 50dB L_{night} from these ground operations, it is recommended that they be modelled and assessed as part of the industry/ports noise model in line with guidance in WG-AEN GPG v2.

5.3 Industrial Noise

The Regulations set out the method of assessment:

⁴⁴ Available from: http://circa.europa.eu/Public/irc/env/noise_map/library?l= [accessed May 2011]

⁴⁵ Available at:

http://www.faa.gov/about/office_org/headquarters_offices/apl/research/models/inm_model/ [accessed May 2011]

⁴⁶ Available at:

http://circa.europa.eu/Public/irc/env/noisedir/library?l=/material_mapping/ecac_aimod_doc/doc29_edition_finalpdf/_EN_1.0_&a=d [accessed May 2011]

⁴⁷ “Airport technical guidance: the Environmental Noise (England) Regulations 2006” Available at: <http://archive.defra.gov.uk/environment/quality/noise/environment/background.htm> [accessed May 2011]

⁴⁸ INM Version 7.0b as of May 2011

- “For INDUSTRIAL NOISE: ISO 9613-2: ‘Acoustics — Abatement of sound propagation outdoors, Part 2: General method of calculation’.

Suitable noise-emission data (input data) for this method can be obtained from measurements carried out in accordance with one of the following methods:

- ISO 8297: 1994 ‘Acoustics — Determination of sound power levels of multisource industrial plants for evaluation of sound pressure levels in the environment — Engineering method’,
- EN ISO 3744: 1995 ‘Acoustics — Determination of sound power levels of noise using sound pressure — Engineering method in an essentially free field over a reflecting plane’,
- EN ISO 3746: 1995 ‘Acoustics — Determination of sound power levels of noise sources using an enveloping measurement surface over a reflecting plane’.

This should be used in accordance with the adaptations set out in:

- Commission Recommendation 2003/613/EC of 6 August 2003.

The method of assessment including the recommended adaptations is referred to as ISO 9613 Interim.

The ISO 9613-2 methodology is a means of calculating sound propagation outdoors, and generally regards noise from point sources. The three referenced measurement methods provide a means of determining the sound power levels of industrial sources. These measurement methods are appropriate when the industrial noise sources are to be assessed in some detail within the strategic noise mapping, which may be appropriate where there are known issues with a particular industrial site, or where Action Plans propose specific mitigation measures which need to be considered within the assessment model.

The Interim Method report, AR-INTERIM-CM⁴⁹, considers some of the practical issues surrounding the required input data to utilise the ISO 9613-2 method in strategic noise mapping. It is suggested that:

- “The choice of input data from the set of available data can be based upon:
- the desired accuracy;
 - the practical possibilities; and
 - the established time frame.”

Section 6.2.3 then sets out three potential sound power level formats for the modelling of the industrial premises total noise emission.

⁴⁹ “Adaptation and revision of the interim noise computation methods for the purpose of strategic noise mapping”, Final Report, 25 March 2003. Available at: http://circa.europa.eu/Public/irc/env/noisedir/library?l=/material_mapping/recommended_computation/reports_interim&vm=detailed&sb=Title [accessed May 2011]

- Format 1: Global Sources
- Format 2: Zonal Sources
- Format 3: Individual Sources

These formats have an increasing level of accuracy, which is borne from an increasing requirement for source data accuracy and resolution. This is discussed further in Section 7.4 below.

Where the number of industrial sites to be assessed is significant, or the number of sources on site is large, the discussion within AR-INTERIM-CM alongside the practical guidance, and a decision making hierarchy, within WG-AEN GPG v2 Toolkit 10, enable competent authorities and noise mapping practitioners to make informed decisions regarding the relative costs of the approaches to be considered, in the context of the benefits realised from higher degrees of resolution to the strategic noise maps, and thus lower uncertainty in the results obtained.

The noise mapping of industrial sites should include relevant ground operations from airports within agglomerations, along with the noise from commercial port operations. For guidance on the assessment of noise from ports the NoMEports project has published a “Good Practice Guide on Port Area Noise Mapping and Management”⁵⁰ (NoMEports GPG).

It is recommended that the EC adapted Interim method, ISO 9613 Interim, is used for the assessment of industrial noise levels for the Regulations. The source noise levels used within the calculations should be derived via a methodology in line with the Regulations, or the WG-AEN GPG v2 Toolkit 10. The modelling of area sources should be informed by the AR-INTERIM-CM report, and the modelling of ports should consider the NoMEports GPG.

5.4 Railway Noise

The Regulations set out the following two methods of assessment:

- UK national computation method ‘Calculation of Rail Noise (CRN), Department of Transport, HMSO, London, 1995. This method shall be adapted as set out in paragraph 2.1 of Annex II to the Directive.
- The Netherlands national computation method published in ‘Reken- en Meetvoorschrift Railverkeerslawaaai ’96, Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 20 November 1996’.

Both the above methods require adaptation in order to fulfil the requirements for strategic noise mapping under the Directive. The Defra research project “NANR 208 – Noise Modelling”⁵¹ undertook an investigation into the input data quality requirements of CRN and RMR Interim. In parts 2 and 3 of the Final Report the adaptations to the methods were confirmed prior to the commencement of error propagation testing.

⁵⁰ “Good Practice Guide on Port Area Noise Mapping and Management”, April 2008. Available at: <http://nomeports.ecoports.com/> [accessed May 2011]

⁵¹ NANR 208 – Noise Modelling, Final Report, May 2007. Available at: <http://archive.defra.gov.uk/environment/quality/noise/research/nanr208/> [accessed May 2011]

The UK national computation method 'Calculation of Rail Noise (CRN) adapted for use under the Regulations, is described within the following documents:

- Calculation of railway noise" (Department of Transport, 13th July 1995, HMSO);
- "Calculation of railway noise 1995 Supplement No. 1 Procedure for the calculation of noise from Eurostar trains class 373" (Department for Transport, 20th October 1996, Stationery Office);
- "Rail and wheel roughness – implications for noise mapping based on the Calculation of Railway Noise procedure" (Defra, March 2004); and
- "Additional railway noise source terms for "Calculation of Railway Noise 1995" (Defra, May 2004)

The EC recommended Interim method, referred to as RMR Interim, for use under the Regulations, is described within the following documents:

- The Netherlands national computation method published 'Reken- en Meetvoorschrift Railverkeerslawaaai '96, Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 20 November 1996';

Used in accordance with the adaptations set out in:

- Commission Recommendation 2003/613/EC of 6 August 2003.

The method of assessment including the recommended adaptations is referred to as RMR Interim.

Note 8: RMR contains two emission models, a simple emission model SRM I, and a more complex model SRM II. The Defra research and the AR-INTERIM-CM research projects both conclude that only SRM II should be used for strategic noise mapping under the Directive. For this reason it is proposed that only the SRM II emission model should be used with RMR Interim.

Note 9: There is currently no English translation of the original Dutch text, the only version available to non Dutch speakers is via the edited non-contextual translation into English from WP 3.2.1 of the AR-INTERIM-CM research project.

Note 10: Some caution should be exercised when reading AR-INTERIM-CM as not all of the recommended adaptations were confirmed within the Commission Recommendation 2003/613/EC of 6 August 2003. See Part 2 of the NANR 208 Noise Modelling report for a full discussion on the differences. Only the adaptations within 2003/613/EC should be utilised for strategic noise mapping under the Directive.

In the interest of consistency with Round 1, it is confirmed that the EC adapted Interim Method, RMR Interim, is to be used for the assessment of railway noise levels for Round 2 strategic noise mapping under the Regulations. The SRM II emission model should be used, and details of the methodology and its application should be sought from the AR-INTERIM-CM and NANR 208 Noise Modelling project reports.

5.5 Road Traffic Noise

The Regulations set out the following two methods of assessment:

- UK national computation method 'Calculation of Road Traffic Noise (CRTN)', Department of Transport – Welsh Office, HMSO, London, 1988. This method shall be adapted as set out in paragraph 2.1 of Annex II to the Directive.
- French national computation method 'NMPB-Routes-96 (SETRA-CERTU-LCPCCSTB)', referred to in 'Arrêté du 5 mai 1995 relatif au bruit des infrastructures routières, Journal Officiel du 10 mai 1995, Article 6' and in the French standard 'XPS 31-133'. For input data concerning emission, these documents refer to the 'Guide du bruit des transports terrestres, fascicule prévision des niveaux sonores, CETUR 1980'.

Both the above methods require adaptation in order to fulfil the requirements for strategic noise mapping under the Directive. The Defra research project "NANR 93: WG-AEN's Good Practice Guide and the Implications for Acoustic Accuracy"⁵² undertook an investigation into the input data quality requirements of CRTN and XPS 31-133 Interim. In parts 2 and 3 of the Final Report the adaptations to the methods were confirmed prior to the commencement of error propagation testing.

The UK national computation method 'Calculation of Road Traffic Noise (CRTN)' adapted for use under the Regulations, is described within the following documents:

- Department of Transport publication, 'Calculation of Road Traffic Noise', HMSO, 1988 ISBN 0115508473;
- Converting the UK Traffic Noise Index L_{10,18h} to EU Noise Indices for Noise Mapping, TRL Project report PR/SE/451/02, 2002; and
- Defra, Method for Converting the UK Road Traffic Noise Index LA_{10,18h} to the EU Noise Indices for Road Noise Mapping, st/05/91/AGG04442, 24th January 2006.

Note 11: As an alternative to the Defra conversion factors for CRTN, the NRA produced a set of back end corrections for CRTN to convert from L_{A10} to L_{den} and L_{night} which provide a more robust fit to Irish traffic situations. Details are set out in the NRA Noise Conversion Paper⁵³.

The EC recommended Interim method, referred to as XPS 31-133 Interim, for use under the Regulations, is described within the following documents:

- 'NMPB-Routes-96 (SETRA-CERTU-LCPCCSTB)', referred to in 'Arrêté du 5 mai 1995 relatif au bruit des infrastructures routières, Journal Officiel du 10 mai 1995, Article 6' and in the French standard 'XPS 31-133'. For input data concerning emission, these documents refer to the 'Guide du bruit des transports terrestres, fascicule prévision des niveaux sonores, CETUR 1980'.

⁵² NANR 93: WG-AEN's Good Practice Guide and the Implications for Acoustic Accuracy, May 2005. Available at: <http://archive.defra.gov.uk/environment/quality/noise/research/wgaen-gpguide/> [accessed May 2011]

⁵³ Assessment Methodologies for Calculating Road Traffic Noise Levels in Ireland – Converting CRTN Indicators to the EU Indicators (L_{den}, L_{night}), December 2007.

Used in accordance with the adaptations set out in:

- Commission Recommendation 2003/613/EC of 6 August 2003.

The method of assessment including the recommended adaptations is referred to as XPS 31-133 Interim.

Note 12: There is an English translation of the original French text within the reports produced under the AR-INTERIM-CM research project.

Note 13: Some caution should be exercised when reading AR-INTERIM-CM as not all of the recommended adaptations were confirmed within the Commission Recommendation 2003/613/EC of 6 August 2003. Only the adaptations within 2003/613/EC should be utilised for strategic noise mapping under the Directive.

In the interest of consistency with Round 1, it is confirmed that the adapted version of the UK CRTN methodology is used for the assessment of road traffic noise levels for Round 2 strategic noise mapping under the Regulations. The adapted UK CRTN should be undertaken:

- With reference to the NANR 93 project report⁵⁴;
- With reference to DMRB Volume 11 Section 3 Part 7 HD 213/11 Annex 4, Additional advice to CRTN procedures⁵⁵;
- With reference to TRL Project report PR/SE/451/02, Converting the UK Traffic Noise Index L10,18h to EU Noise Indices for Noise Mapping, 2002⁵⁶ and the summary⁵⁷:
 - Method 1 should be used when hourly traffic data is available;
 - Method 2 should be used when day, evening and night period traffic data is available;
 - Method 3 based upon 18 hour traffic data is discouraged.
- Alternatively with reference to the NRA backend corrections:
 - Provided that hourly traffic flows are available;
 - If only AADT traffic flows are available, the guidance within the NRA “Guidelines for the Treatment of Noise and Vibration in National Road Schemes” should be followed, and the AADT traffic flows factored to hourly flows using the table of diurnal traffic profiles in Appendix 1;
- Using traffic count information, particularly for the night period, wherever practicable.

⁵⁴ Available at: <http://archive.defra.gov.uk/environment/quality/noise/research/wgaen-gpguide/> [Accessed May 2011]

⁵⁵ Available at: <http://www.dft.gov.uk/ha/standards/dmr/vol11/section3/hd21311.pdf> [Accessed May 2011]

⁵⁶ Available at: http://archive.defra.gov.uk/environment/quality/noise/research/crtn/documents/noise_crtn.pdf [Accessed May 2011]

⁵⁷ Available at: http://archive.defra.gov.uk/environment/quality/noise/research/crtn/documents/noise_crtn_summary.pdf [Accessed May 2011]

6 Stage 3 - Develop Dataset Specification

6.1 Overview

In order to be able to develop the datasets required for a 3D model environment to support the assessment of noise from roads, railways, industry and aircraft, it is first necessary to develop a dataset specification. A specification is based upon the various features contained within a noise model, and based on the object definitions required by the noise calculation software to be used within the project for the specific method of assessment being used.

In general, the calculation of noise levels takes place in two stages within the noise mapping software:

- The assessment of the level of noise emitted from a source, the “source noise emission”; and
- The assessment of the attenuation of the emitted noise en-route from the point of emission to the receptor, the “propagation attenuation”.

After the assessment of noise levels across the area of the strategic noise mapping, it is then necessary to undertake statistical analysis to determine the area, dwelling and population exposure data required to be reported to the EC.

Following this concept, the input dataset required can be classified into:

- **Source input data** which defines the position and characteristics of the noise sources;
- **3D model pathway input data** which defines the environment within which propagation occurs; and
- **Population input data** which defines the location of the population exposed to the long term environmental noise sources.

There will also be a requirement for a specification for the output datasets:

- **Output data** which defines the information to be submitted to the EPA.

The following discussion on 3D model pathway data is predominantly concerned with the assessment of noise from roads, railways and industry as these may be undertaken within a common model environment within a commercial noise mapping software package. Whilst it is possible to undertake the assessment of aircraft noise to ECAC Doc 29 Interim within such a common model, it is frequently undertaken using software such as FAA INM where much of the 3D model pathway data is not considered within the assessment.

6.2 Developing a Dataset Specification

Ideally the approach to developing a series of dataset specifications for a complex spatial modelling environment would be to be able to work from a coarse level (abstract) to a detail level (concrete) in the design process.

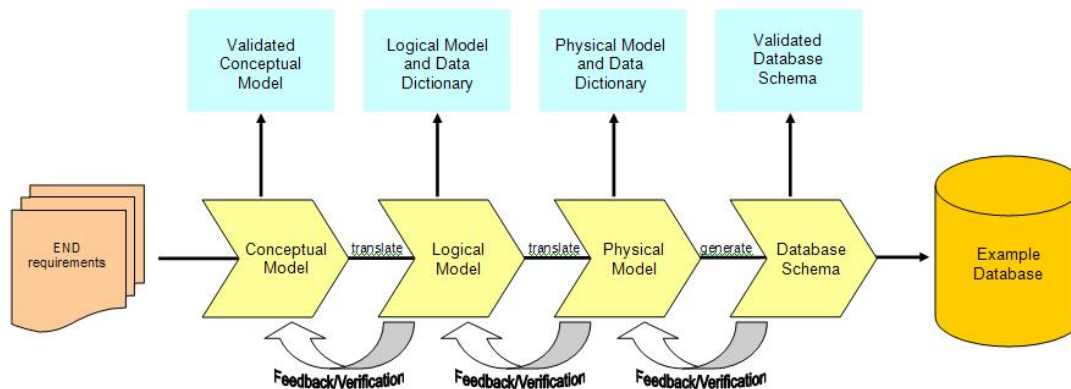


Figure 6.1: Schematic of Approach

There should be a number of stages along the process, including the design of a conceptual model, design of the logical model, and design of a physical model, and then the use of the physical model to generate a physical data schema. This design process has an iterative approach; changes in any one model being fed back into higher and lower models, in order to retain consistency in the set of models.

The first stage is to establish a conceptual model which can be used to guide the development of subsequent stages in the development of a dataset for strategic noise mapping. The data requirements of strategic noise mapping are expansive, and in order to make them more manageable it is useful to break the data requirements into the following categories:

- 3D model pathway input data:
 - data required for the common 3D pathway model;
 - may be used by all models regardless of the source of the noise; and
 - required for major source models, and agglomeration models;
- Road source input data;
- Railway source input data;
- Industry and ports source input data;
- Aircraft source input data;
- Population exposure input data:
 - required to analyse the noise exposure from the results of the strategic noise mapping;
- Noise model output data; and
- Contextual data – necessary to display noise mapping within context.

At this stage an initial conceptual model is proposed for road, railway, industrial and aircraft noise calculations. This has been done to illustrate to extent of input dataset requirements, and to present an overview of the range and types of data required for noise modelling. This conceptual model is set out in Appendix D.

It is not possible to develop this through to logical and physical models as part of this guidance, as this would require selection of the target noise mapping software tool to be used for the assessment, along with selection of the methods of assessment. The selection of a tool, or tools, and methods at this point can have a significant impact

upon the design of the logical and physical models, and ultimately provide a more streamlined path to a completed data schema.

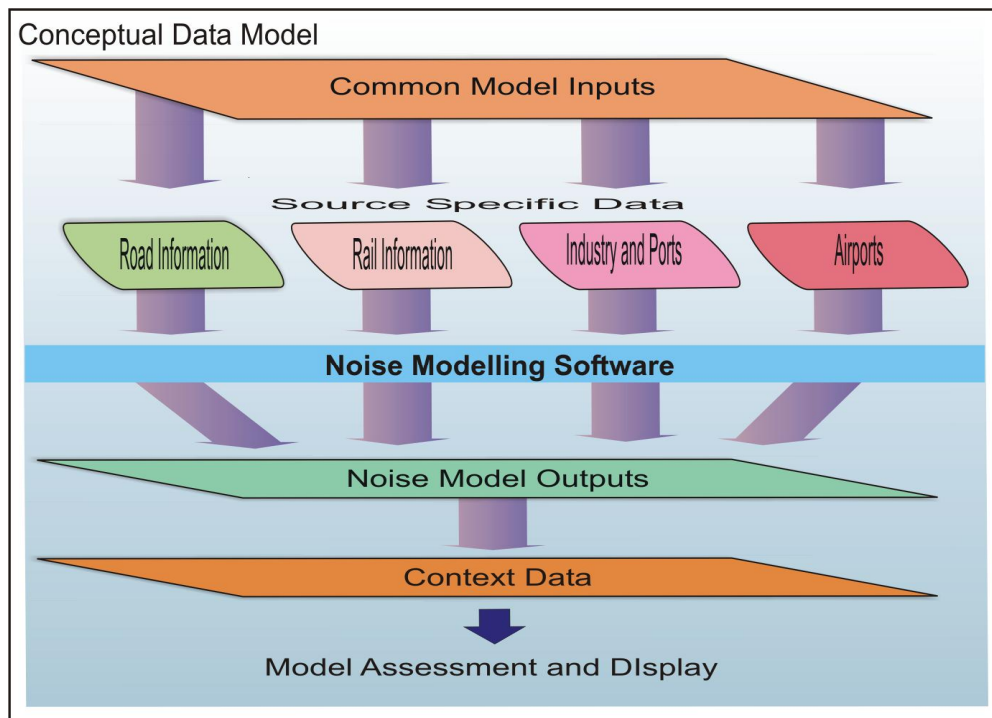


Figure 6.2: Data requirements

6.3 Input Data Requirements for 3D Model Pathway Environment

The road, rail and industry calculation methods require similar information for the definition of the 3D propagation pathway, whilst the source information required is unique to each method. The similarity of the datasets required for defining the acoustic pathway can allow for the development of a single unified 3D model environment, within which the various noise emission sources are located, and propagation to the receptors is assessed. This approach is the basic premise of most of the commercial noise mapping software tools, which enable a variety of noise sources to exist within a single 3D terrain environment. A number of these software tools are also capable of undertaking an assessment of noise from aircraft movements, otherwise a standalone software tool is used for this purpose, and the results brought into a common analysis environment. The elements which make up the 3D model environment include:

- Digital ground model, consisting of:
 - Equal height contour lines;
 - Embankment edges;
 - Escarpment edges; and
 - Bridges.
- Buildings:
 - Polygon objects describing all building footprints within the model.
- Ground cover:
 - Polygon objects defining areas of acoustically absorbent or reflective ground cover.

- Barriers:
 - Polyline objects defining barriers such as walls or fences considered to have potential noise attenuating effects.
- Meteorology information on long term annual average weather conditions:
 - Wind direction and speed e.g. wind rose;
 - Air temperature;
 - Relative humidity;
 - Mean occurrence of favourable conditions; and
 - Local meteorological factors.

6.4 Input Data Requirements for Assessment of Aircraft Noise

For each airport to be assessed the following information is typically required:

6.4.1 Airport Data

For each airport the following information is required, with consideration made to any operational differences between the periods of day, evening and night.

- Runway Centre Point:
 - Centre point coordinate in latitude and longitude; and
 - Elevation of runway centre point (m).
- Runway End Points:
 - Runway end points provided in km referenced from the runway centre point; and
 - Elevation of runway ends (m).
- Runway Width:
 - Width (m).
- Take Off / Landing (per aircraft, destination and periods):
 - Start of roll coordinate referenced to centre point (km);
 - Approach threshold coordinate relative to runway centre point (km);
 - Glide slope (degrees); and
 - Threshold Crossing Height (m).
- Route Definitions (aircraft, route and period dependant):
 - Radar Track Data from NTK (e.g. B&K, GEMS, Lochard); or
 - Plan View Drawing derived from a statistical distribution (CSV, DXF).
- Terrain Data;
 - Ground elevation data such as equal height contours (SHP, DXF).
- Average Airport Meteorological Conditions:
 - Average Airport Temperature (°C);
 - Average Pressure (mm Hg);
 - Average Humidity (%); and
 - Average Headwind (km/h).

6.4.2 Aircraft movement data

For each aircraft the following information is required, with consideration made to any operational differences between the periods of day, evening and night:

- Movement Data (per aircraft);
- Arrival / Departure dates and times:
 - Start of Roll (Not Stand Times); and
 - Provided in local time.

- Route:
 - Departure Route provided per aircraft; and
 - Arrival Route provided per aircraft.
- Destination:
 - Destination of aircraft (used as an indication of fuel load);
 - More critical for major aircraft, long haul and charter flights;
 - Runway; and
 - Runway Direction.
- Aircraft types:
 - ICAO (International Civil Aviation Organization) Codes; and
 - Engine and airframe variant details.

6.5 Input Data Requirements for Assessment of Industrial Noise

The type of information required for each industrial site is determined by the choice of approach being undertaken, and the resolution of the modelling to be carried out. At the most simplistic approach, using area sources to describe operational elements of the industrial site, the following information is typically required:

- Location of industrial area;
- Description of industrial process;
- Sound power emission level(s) for operations on the site; and
- Mean frequency band for assessment of global noise exposure.

If a more detailed assessment is undertaken, more additional information may be required, such as:

- Location, size and height of noise source on site;
- Sound power level(s) for each noise source on site, possibly in octave bands;
- Noise source directivity; and
- Operational periods of each noise source.

6.6 Input Data Requirements for Assessment of Railway Noise

The information required for the source emission model for the road traffic is specific to each method of assessment; the following information is required for each rail section for an assessment using the RMR Interim method:

- Rail centreline location between the two railheads;
- Total traffic volume of all trains along centreline:
 - Annual average day, evening and night traffic flow.
- Traffic volume per train category:
 - Annual average day, evening and night traffic flow.
- Bridges and elevated tracks:
 - Location and type of bridge or track support.
- Number of passes along rail line:
 - For each type of train.
- Train speed:
 - For each type of train.
- Track type and support:
 - Where jointed or continuously welded; and
 - How supported.

- Location of brake gear activation.

6.7 Input Data Requirements for Assessment of Road Traffic Noise

The information required for the source emission model for the road traffic is specific to each method of assessment; the following information is required for each road section for an assessment using the adapted UK CRTN method:

- Road centreline locations, along with data for:
 - Traffic volume, %HGVs, and mean vehicle speed; expressed as an annual average day, evening and night traffic flow;
 - Direction of vehicle flow;
 - Road width;
 - Road surface type;
 - Texture depth; and
 - Road gradient.
- Road classification.

6.8 Input Data Requirements for Population Exposure Assessment

The Directive requires information on the total number of dwellings exposed to noise from major roads, major railways and major airports. It also requires information on the estimated number of people living in dwellings that are exposed to noise for the various scenarios mapped.

The type of information required for mapped area will include:

- GeoDirectory “Buildings” table;
- CSO Utilise Small Area Population Statistics (SAPS) from Central Statistics Office (CSO) census data. The themes required are:
 - Number of persons in private households by type of household; and
 - Number of private households by type of accommodation.
- Attribute CSO data to Ordnance Survey Ireland (OSI) Electoral Divisions (ED).

6.9 Output Specification for Calculated Noise Results

At the completion of the strategic noise mapping the NMBs have a series of noise level results sets along with statistical results from the area, dwelling and population exposure analysis.

The noise calculation results may be submitted to the EPA as ESRI ASC Grid files, or ESRI point Shapefiles. A detailed specification document will be provided by the EPA.

The statistical results may be submitted to the EPA using the relevant EC recommended reporting mechanism, ENDRM 2007, MS Excel template files. More details are provided in section 11 below.

7 Stage 4 - Produce Datasets

7.1 Process

Stages 1 to 3 have led to a definition of the area for which data is required, and the design of a database schema suitable to support the END noise mapping process. At this stage the data schema needs to be populated using the datasets available to the noise mapping bodies and other stakeholders to the process.

The general aim of this stage of the process is to undertake an initial collection of the raw GIS, electronic and paper datasets. It is then necessary to collate and catalogue the information available, and carry out an audit against the specifications draw up within Stage 3. The audit process will provide a gap analysis highlighting any data shortcomings and provide an indication of the processing requirements of the data.

The general areas which are addressed at this point are:

- Appraisal of the available data against the specification, looking into issues such as:
 - Coverage, resolution, accuracy, attributes, maintenance regime, format, metadata, fitness for purpose.
- A gap analysis to result in details of the data required which is not currently available; and proposes mechanisms for the completion of the input datasets.
- The license conditions of each of the available datasets should be documented and appraised to confirm that they may be used within the noise mapping project. Some of the licensing issues which should be considered could include:
 - current and future IPR, residual IPR, use for what purpose and restrictions on other users and sub-contractors, maintenance of data, duration of license term, residual rights after expiry, internet access, public availability etc.

Following the appraisal, gap analysis and resolution of licensing issues, the input datasets need to be completed in line with the approved approach. This could be via a number of different routes:

- Extended licensing of existing datasets for additional coverage or improved currency;
- Data capture programs to fill gaps in the available datasets; and
- Interpolation or processing of raw datasets to produce relevant derived data products.

The WG-AEN GPG v2 provides a number of Toolkits which provide a series of options for sources of genuine data, or guidance on interpolation or use of default datasets. Many WG-AEN GPG v2 Toolkits provide quantified accuracy statements where the impact on the acoustic quality of the results is indicated alongside the description of the option in order for the quality of the strategic noise mapping to be estimated. In general it is recommended that the best approach available, with the lowest uncertainty, should be used. Where interpolation or default values are used, following the use of WG-AEN GPG v2 Toolkits, it is recommended that a review is undertaken to investigate other potential sources of data, and balance the relevant

costs and benefits of these sources. The DEFRA research project NANR 93 provides CRTN versions of some of these Toolkits, along with guidance on input data quality requirements for CRTN mapping. These reviews should be documented in the report submitted to the EPA, see Appendix E.

7.2 3D Model Pathway Environment

The assessment of noise levels from industry, railways and roads requires the development of a 3D model environment. The assessment of noise from aircraft requires a 3D terrain model.

The 3D model environment is required for the whole coverage area for agglomeration models, and for the model area for major sources outside the agglomerations.

7.2.1 OSI Datasets

A wide range of mapping products are available for use within strategic noise mapping. Some of these may be available under existing licensing schemes with suppliers; others may require additional licensing to be taken out. Some of the datasets which may prove useful include the following:

- OSI Large Scale vector mapping:
 - 1:1,000 scale in urban areas;
 - 1:2,500 in suburban areas; and
 - 1:5,000 in rural areas.
- OSI Boundaries:
 - County, ED and Townlands boundaries.
- OSI High Resolution Ortho Photography:
 - 25cm per pixel.
- OSI LiDAR:
 - Laser scanned remote sensing height or elevation data;
 - 2m postings in urban areas; and
 - 10m postings in rural areas.
- OSI Discovery Height Data:
 - 10m gridded Digital Terrain Model.

7.2.2 Base Model - Digital Ground Model

The foundation of the 3D model environment is the digital terrain model (DTM) describing the ground elevation across the mapping area. DTMs are generally available in three formats:

- Points:
 - Regular grids derived from ortho photography; and
 - Higher resolution regular or irregular grids derived from LiDAR survey.
- Breaklines:
 - 3D polylines which describe “edges” or transitions in terrain gradient, derived from ortho photography (OSNI Enhanced DTM product is an example).
- Contours:
 - Equal height ground contours provided as 2D polylines with a height attribute.

Point datasets generally need processing in order to produce breakline or contour line datasets; however these can be of a higher resolution than generally available contour datasets, such as OSI Discovery.

The process of noise mapping calculations involves the assessment of source to receiver propagation paths, which is inherently searching for edges (of buildings, embankments, cuttings etc) to break the direct line of site and provide screening. For this reason experience with breakline products has generally produced efficient noise models.

In general the higher the resolution of the source dataset, the better the quality of the resulting ground model. This conclusion is demonstrated within the quantified accuracy statements within WG-AEN GPG v2 for Toolkits 7, 11 and 12.

7.2.3 Base Model - Buildings

The buildings dataset is an important layer for the development of a 3D noise model. For noise mapping in Ireland, buildings may be identified within the OSI Large Scale vector mapping product by querying the feature codes. Most noise mapping software systems require 2.5D closed vector polygon building objects, this is a 2D vector polygon with a height attribute.

There are typically a number of issues which can arise when preparing buildings datasets.

- Polyline buildings:
 - OSI Large Scale may be delivered in DXF, DWG or NTF formats. In urban areas it common for buildings to be described as a series of vector polylines, rather than a vector polygon, in rural areas the reverse is more common. In both situations it is necessary to undertake processing to produce closed polygon building objects.
- Building polygons split across tiles:
 - Where individual building footprints cross tile boundaries, buildings may not be supplied as a single polygon but rather separate polygon objects split along the tile boundaries.
- Incorrect feature code classifications:
 - Instances can arise where buildings do not have the relevant feature code, or other objects have been attributed with the buildings feature code. These types of issues can be difficult to identify unless the buildings in question are large, or unless manual checking is undertaken against aerial photography.
- Height data:
 - OSI Large Scale is supplied as a 2D dataset, without height data. Buildings need to be 3D objects, and are often set with a single height attribute. The height data may be derived from detailed Lidar datasets, from detailed site surveys, from field surveys of the numbers of storeys or estimated building heights, or by assumption using a default height attribute. WG-AEN GPG v2 Toolkit 15 provides guidance on the impact on accuracy of the various approaches.
- Sound absorption data:

- It is considered unlikely that this information will be available; in this case it is recommended that WG-AEN GPG v2 Toolkit 16 is referenced as a means of determining values to be assigned to the buildings.

7.2.4 Base Model – Topography

For Ireland there are three widely available datasets available which could be utilised for developing the ground cover dataset. These are:

- **OSI Large Scale**
This dataset consists of 1:1,000, 1:2,500 or 1:5,000 scale vector mapping. Areas of acoustically soft ground may be identified and extracted for use in the noise mapping.
- **OSI Digi City**
This dataset consists of 1:15,000 scale raster mapping. Large areas of acoustically soft ground may be identified and carried through into the mapping.
- **CORINE (Co-ordination of Information on the Environment)**
The European Environment Agency's (EEA) CORINE Land Cover 2000 dataset is a European-wide vector land parcel product derived from satellite imagery R2V processing. The CORINE dataset was developed in the framework of the CORINE programme to establish a computerised inventory on land cover. The dataset was used for making environmental policy as well as for others such as regional development and agriculture policies. For noise calculation, the dataset can be used to provide information on the land cover distribution. The various classes of land cover need to be reviewed and a value, or spectrum, of acoustic ground absorption assigned to each as an attribute.

In addition to these, there is also the guidance provided within WG-AEN GPG v2 Toolkit 13.

It is recommended that all available sources are investigated, and tests undertaken within the noise mapping software to assess the relative complexity of the datasets, the impact on processing time, and any difference in calculated noise level which occurs through using the different products.

7.2.5 Base Model - Barriers

The WG-AEN GPG v2 has quantified accuracy statements for WG-AEN GPG v2 Toolkits for road traffic and railway noise calculations. The importance of correctly identifying the height attributes of potential screening objects in the vicinity of road and railway corridors is clearly stated within the WG-AEN GPG v2 Toolkits and the recommendations for data quality, particularly the edges of cuttings and the tops of barriers.

The inclusion of noise barriers within the models not only influences the calculation results, but they are also relevant within the process of noise action planning. It is therefore recommended that the noise model should include noise barrier information where possible, in the vicinity of road, rail and industrial sources within the agglomeration, and in the vicinity of major sources outside the agglomeration.

Within Ireland there is currently no existing data product or record of noise barrier locations. OSI data and orthophotography is not currently of sufficient resolution to enable consistent identification of these features, therefore a field survey is recommended as an appropriate means of capturing barrier data.

WG-AEN GPG v2 Toolkit 14 provides guidance on the means by which barrier heights may be assessed, and WG-AEN GPG v2 Toolkit 16 on setting sound absorption coefficients. They also provide quantified accuracy statements to demonstrate the impact on the uncertainty of the calculated results.

7.2.6 Base Model - Bridges

Bridge objects are required to carry and support 2.5D road and rail emission lines over cuttings or junctions within some of the commercial noise mapping software systems. Bridges are not explicitly identified within OSI data products and therefore bridge datasets may need to be manually created. It is recommended that bridge locations, relative heights and orientations are initially identified from field surveys and aerial photography investigation. This may then be followed by manual ground model checking and bridge structure digitisation in accordance with the dataset specification.

7.2.7 Base Model - Meteorology

Meteorology data is required for the assessment of aircraft, industry, railways and roads when the EC Recommended Interim methods are used. In general, three pieces of meteorology data are required in order to satisfy the data requirements of the methods. These are:

- Wind Direction and Occurrence;
- Air Temperature; and
- Relative Humidity.

As the noise level assessment is undertaken on the basis of a long term annual average, the meteorology data is also required as an annual average, with long term averages required for the three time periods; day, evening and night.

In the absence of data on meteorology it is recommended that WG-AEN GPG v2 Toolkits 17 and 18 are consulted for guidance on setting assumed default values.

7.3 Aircraft Noise Modelling

It is generally the case that the airport operators will be the major source of information required for the assessment of noise from aircraft in flight. In some cases it may be possible to access air traffic control data which provides electronic datasets for the path, flight code and destination of all movements arriving and departing the airport.

In other cases some information may be available from flight logging systems, such as flight code, destination and departure/landing time, whilst other data may be held by airline companies or in secondary datasets, such as aircraft types and mean flight tracks.

The airport should also be able to supply the various location points required for the runway coordinates, and data such as start of roll locations.

For non-major airports located within agglomerations the NMBs will need the cooperation of the airfield operator to undertake the strategic noise mapping. For major airports the airfield operators are the designated NMBs and will need to gather the information required for the strategic noise mapping, and the information required for the post processing and analysis.

For guidance on the application and use of the EC Recommended Interim method, ECAC Doc 29 Interim, it is recommended that the AR-INTERIM-CM⁴⁹ report is reviewed to support the application of the methodology.

7.4 Industrial Noise Modelling

The type of information required for industrial site modelling is determined by the choice of approach. There are three common approaches to modelling the industrial noise emission sources, as discussed within the AR-INTERIM-CM report⁵⁸:

- Format 1: Global Sources;
- Format 2: Zonal Sources; and
- Format 3: Individual Sources.

These approaches have an increasing level of detail and potential accuracy, but also an increasing level of work, time and cost implications. Figures 7.1 to 7.3 are taken from the AR-INTERIM-CM final report to illustrate the differing approaches possible.

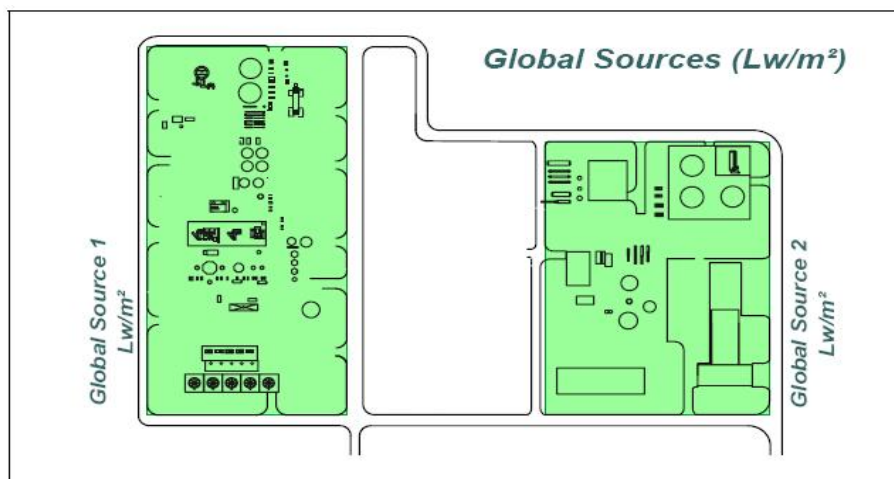


Figure 7.1: Global sources

⁵⁸ "Adaptation and revision of the interim noise computation methods for the purpose of strategic noise mapping", Final Report, 25 March 2003. Available at: http://circa.europa.eu/Public/irc/env/noisedir/library?l=/material_mapping/recommended_computation/reports_interim&vm=detailed&sb=Title [accessed May 2011]

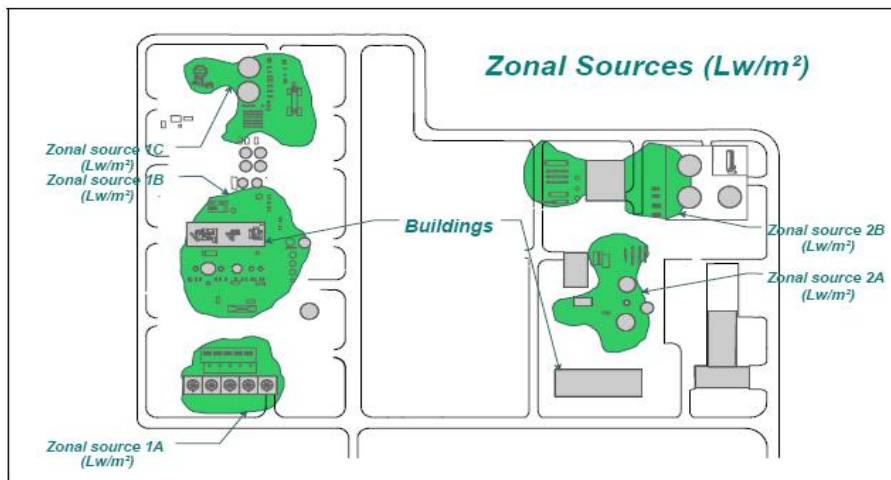


Figure 7.2: Zonal sources

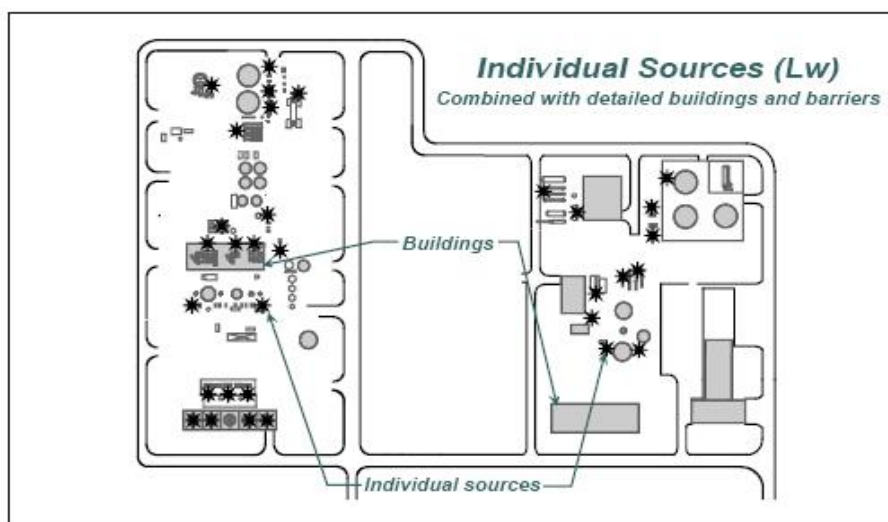


Figure 7.3: Individual sources

It is recommended that the first step is to draw up a list of the industrial sites to be included within the assessment within the agglomeration. With knowledge of the areas to be modelled, the requirements of each of the approaches may be considered alongside the information available for each site.

It is recommended that the guidance within the AR-INTERIM-CM report on modelling industrial noise is considered alongside WG-AEN GPG v2 Toolkit 10 when considering the approach to be used for modelling industrial sites.

7.5 Railway Noise Modelling

The information required for modelling the railway sources is predominantly related to the trains and the track. The noise emitted by railway sources contains a train related component from the engine, exhaust, aerodynamic noise and pantograph, and the noise emitted by the rail/wheel interface. The track related information is commonly held by the infrastructure management section, whilst the train information is often held by the train operations section.

The rail centrelines are to be modelled as the location of the emission, and this is generally midpoint between the two railheads of the line. The rail centrelines may be available from OSI Large Scale, or could be derived from Large Scale which may hold the railhead positions.

Information on physical aspects of the railway line are also required, and assigned as attributes to the rail centreline:

- Bridge/ballast correction; and
- Track type/track support structure.

When these attributes change the rail centreline will need to be segmented at the point of change in attribute.

For each section of rail centreline it is required to assign the train movements which use the track. The number of train movements is required per train type, per time period (day, evening and night) on an annual average basis. For each train type, for each time period, it is also necessary to know the average speed over the section of track, the number of carriages, and whether the brakes are applied.

Some of this information may be available from train timetables, from train network modelling systems, or from trackside train sensing systems. Some of this information, such as the application of brakes, may need to be captured through interviews with train drivers or other personnel.

A key aspect of RMR Interim is that the methodology contains a predefined set of train categories which are based upon the rolling stock commonly in service within the Netherlands. It is not necessarily the case that these train categories equate to the trains in service within Ireland. This leaves the NMB a choice of selecting the predefined train categories which appear to approximate to the trains in service, or of developing a national dataset of train emission categories suitable for use with RMR Interim.

The Defra research project NANR 208 considers the former approach, or selecting train categories to match to in-service rolling stock, and provides guidance on the level of uncertainty which may result from this approach.

AR-INTERIM-CM provides a no-contextual translation of RMR into English, and provides guidance on the application of the methodology for strategic noise mapping, along with a measurement protocol for the development of specific additional train types compatible with RMR Interim.

WG-AEN GPG v2 Toolkit 8 provides information on means of populating train source datasets, and the NANR 208 research project provides quantified accuracy statements and guidance on noise modelling datasets for the EC Recommended RMR Interim method. These resources should be reviewed during the development of the railway source model to guide the development of the datasets.

It is recommended that some form of validation survey is undertaken to provide a record of the correlation between the source models used in the strategic noise mapping and the noise emitted by trains in service on the tracks being modelled.

7.6 Road Traffic Noise Modelling

The information required for the source emission model for road traffic relates to the vehicles using the section of road, and their interaction with the road surface. Road traffic noise contains components from the vehicle, such as engine, exhaust, transmission and aerodynamic noise, plus noise from the tyre/road interface which is determined by the tyre construction and the road surface texture.

The CRTN methodology sets the emission line at 3.5m inset from the nearside carriageway edge, which equates to the centreline in a standard 7.0m wide single carriageway two-way road. The model is built using road centrelines, which should generally be midpoint between the two opposing carriageways for a standard two-way road, or the centre of the carriageway for a one-way road, along with the overall width of the road surface from pavement to pavement. The noise mapping software should then use centreline location and the road width to locate the emission line in the correct location during the calculation. The road centrelines may be available from OSI Large Scale, or could be derived from Large Scale which may hold the locations of the edges of the road.

The road centreline objects are attributed with information on the road surface, texture depth and the vehicle flow parameters. The road centreline object must be split each time one of these attributes changes in order to be compatible with most noise mapping systems.

The road surface data is required for each road section, and may be captured by CPX or statistical pass by measurements, or by visual inspection. WG-AEN GPG v2 Toolkit 5 and NANR 93 provide guidance on the range of methods available, along with quantified accuracy statements associated with the use of each method. The road surface data required for the adapted CRTN method, surface type and texture depth, may be captured using the sand patch test or a laser profilometer.

The road gradient may normally be derived from interfacing the road centrelines with the terrain model.

For each road section, traffic flow data is required for two vehicle categories, light and heavy, for the three time periods; day, evening and night. For each time period, it is also necessary to know the mean vehicle speed (mean of all light and heavy vehicles combined).

WG-AEN GPG v2 Toolkits 2, 3 and 4 and NANR 93 provide guidance on the methods available for determining input data for road traffic flow, average traffic speed and composition of traffic. They also provide quantified data accuracy guidelines to help illustrate the potential impact upon calculation uncertainty associated with the various options.

Traffic flow data may be provided from manual or automated traffic counts, traffic flow models such as the DTO model, or traffic forecasting models. Care needs to be taken in consolidating these various sources, as they may hold data in different formats, including 24 hours, 18 hours, AADT, am peak, pm peak, off peak, weekday, weekend, 7 day etc. It is commonly required to apply factors to flows to provide a common base situation, and undertake linking of traffic flow data to the road centreline geometry.

It is recommended that traffic counts undertaken in the future have regard to the requirements of strategic noise mapping to help prepare the required data in a suitable format, at least in the vehicle categories and time periods required by the calculations.

Traffic speed information may be available from traffic forecasting models, or from journey time databases. In the absence of other speed data it is common practice to use the speed limit of the road section as a basis of setting a default mean vehicle speed. Alternatively it may be possible to drive the network with GPS logging equipment to estimate vehicle speeds.

Further guidance on the modelling of the adapted UK CRTN, and the requirements for the quality of input data should be sought from AR-INTERIM-CM and Defra research study NANR 93⁵⁹.

7.7 Data Capture Through Field Survey

The above sections provide some guidance on the use of the WG-AEN GPG v2 Toolkits to help fill data gaps through the use of assumed default values, it is recommended that where possible data gaps are filled through the undertaking of a field survey to capture data which is likely to provide a lower level of uncertainty than the use of WG-AEN GPG v2 Toolkits.

Where data gaps are identified, steps should be taken to review the importance of the missing data to the overall quality of the assessment. The two Defra funded research studies into uncertainty in noise mapping, NANR 93 and NANR 208⁶⁰, contain report documents which provide guidance and advice on the data requirements for strategic noise mapping for the assessment of noise from roads and railways.

Where missing data is identified as having the potential for a significant impact upon the uncertainty of the assessment, it is recommended that detailed site surveys are undertaken to provide good quality input datasets.

Where the missing datasets have a less significant impact upon the uncertainty of the assessment result it is recommended that simplified observation based field surveys are undertaken to provide input datasets, rather than rely upon the use of WG-AEN GPG v2 Toolkits to provide assumed content.

The type of information which may be captured by field survey could include:

- Noise barriers in the following locations
 - alongside major roads;
 - alongside railways;
 - adjacent to industrial sites; and
 - determine location and relative height.
- Road surface type:

⁵⁹ NANR 93: WG-AEN's Good Practice Guide and the Implications for Acoustic Accuracy, May 2005. Available at: <http://archive.defra.gov.uk/environment/quality/noise/research/wgaen-gpguide/> [accessed May 2011]

⁶⁰ NANR 208 – Noise Modelling, Final Report, May 2007. Available at: <http://archive.defra.gov.uk/environment/quality/noise/research/nanr208/> [accessed May 2011]

- Categories as per the assessment method.
- Building heights:
 - See categories below.
- Additional road and rail information:
 - junctions;
 - bridges;
 - flyovers;
 - underpasses; and
 - tunnels.

In some cases building height data may be available from detailed surveys, or aerial radar or Lidar scans. In the absence of such data the WG-AEN GPG v2 Toolkit 15.2 suggests a default building height of 8m is assumed for all buildings.

A field survey could provide information of a higher quality for the modelling assessment, and either count building stories for each building polygon in the model, or visually estimate the building height within a small range of building height classes, such as:

Category	Modelled height	Range for Estimate
A	8.0	Up to 10m (default)
B	12.0	10 - 14m
C	16.0	14 - 18m
D	20.0	18 – 22m
E	24.0	>22m

Where budgets, manpower or time are in short supply, then the above approach could be focused on the first row of buildings alongside all major roads and railways within the assessment area.

8 Stage 5 – Develop Noise Model Datasets

8.1 General GIS Datasets

Modern large scale, wide area noise mapping projects are increasingly using digital datasets, which are predominantly generated and managed within GIS database environments. Whilst this removes excessive manpower requirements for manual digitisation of the model data into the noise mapping software, it does generate a series of new problems which could adversely affect either the time required for the project, the accuracy of the spatial model within the noise package, or the concluding final accuracy for the results generated.

A review of the typical problems associated with the use of generic GIS datasets within noise modelling is set out below:

- **Lack of Acoustic Intelligence**

The traditional process of a trained acoustician skilled in the use of the calculation methodology, marking up paper plans and digitising this “sampled” data into a noise mapping package are eliminated and extensive coverage areas are now possible by reusing existing GIS data. Unfortunately, this does mean that almost none of the digital data supplied for noise mapping purposes has ever been assessed to determine as to whether it is fit for the purpose of noise mapping.

On the one hand, this can lead to users, without an understanding of the calculation methodology, retaining excessive data accuracy and resolution in the context of the inherent uncertainty within the calculation system, this leads to overly large datasets, and excessive calculation times, for a perceived increase in resolution which does not provide greater accuracy. Conversely, it can also lead to datasets being utilised which do not offer a sufficient level of resolution or accuracy to support properly a reasonable standard of noise assessment.

- **Excessive Data Load**

The resolution of many supplied datasets can be too high within the context of a noise mapping project. The resolution of modern digital cartographic datasets, particularly items such as building outlines, is not necessary within strategic noise mapping projects, so data simplification will help to reduce data volumes within the final model, and subsequently decrease calculation times. Similar issues may well exist with road centreline definitions, barriers, cutting, embankments etc.

- **Fractured Link Data**

Road and rail centrelines datasets can often suffer from fractured link node models, with a series of polylines describing one flow link. To simplify the model, reduce errors, and increase calculation speeds, concatenation of the links should often be investigated.

- **Traffic Flow Direction**
It often proves difficult to gain access to digital datasets accurately describing road flow direction, which is required for correct identification of one way roads.
- **Gradient Correction**
The correct assessment of gradient often requires the “draping” of the road/rail centreline onto the underlying digital terrain model (DTM). This process should always be managed, rather than left to automatic interpretation during the calculation runs as small links within polylines can result in localised excess gradient.
- **Road/Rail Structure Geometry**
Cuttings, embankments and flyovers can be constructed from the linear polyline features received from the OSI load. This enables complex 3D geometry to be constructed simply in order to deal accurately with road structures. Bridges can also be automatically generated from road axis data, even using 3 D road polyline objects.
- **Ground Height Definitions**
Ground and model object height definitions can be managed in a variety of different formats, relative, absolute, single point, 3D polylines, TIN, meshes.

8.2 Base Model - Digital Ground Model

An accurate ground model is important in developing an effective noise model. It is necessary for the determination of the (1) bare ground surface and (2) the assessment of relative building heights, especially within detailed urban areas.

The key components of an optimised Digital Ground Model for noise modelling are:

- As a series of equal height contour lines;
- 3D polylines to describe the edges of features such as cuttings and embankments which would act as screens to sound propagation; and
- Bridges to carry road and rail emission lines over cuttings or junctions.

These elements need to be economically described within the dataset, with a minimum of redundant nodes, and provide a degree of spatial accuracy which impacts upon the acoustic accuracy of the results at or below a level equivalent to the other datasets.

Some types of data optimisation pre-processing steps which could be normally carried out are:

- Line smoothing - this uses an algorithm to remove redundant node information (within a tolerance of say 0.5 or 1m horizontal displacement). This can be an important factor for improving model performance without loss of overall model accuracy and hence enabling the production of effective noise models.
- Editing of the ground contour model in the agglomerations often needs to have been carried out – this requires editing/removal of spurious contours and/or adding key bridge features. This process concentrates on acoustically

important features which are not well defined by the available contour data. These include bridge overpass, underpasses and cuttings located on/near principal road and rail routes.

8.3 Base Model - Buildings

In addition to the ground model, the buildings layer is one of the most important layers necessary for the development of an accurate and effective noise model. There are a number of issues relevant to noise modelling which can typically arise within buildings datasets. These aspects are discussed below:

8.3.1 Building Height

Building height attribution can present issues such as:

- Lack of real building height data;
- Zero height buildings;
- Excessively high buildings; and
- Inconsistencies in building heights along terraces.

8.3.2 High Number of Building Polygons

In complex datasets the individual construction of each building unit as a unique polygon object has many beneficial uses for address based, or population based analysis. Within noise modelling, it is not necessary to have information regarding the connecting walls within blocks of building, or terraces of house, as this is redundant information as far as the noise propagation is concerned, and will thus extend the calculation time without providing benefit to the results obtained.

8.3.3 Building Objects Located on Road or Rail Features

Extensive previous work with OSI Largescale, OS LandLine and OS MasterMap suggests that there can often be issues with objects in the buildings layer being located across the road or rail emission lines, and broken road and rail centrelines which do not extend below bridges.

Checks are often required when developing a buildings layer to identify and correct features such as those below which often find themselves in the buildings theme:

- Footbridges between buildings;
- Footbridges over rivers;
- Footbridges over roads and railways;
- Electricity pylons; and
- Elevated road signs.

Although these represent a small number of objects, the presence of these features can introduce noticeable error into the final noise maps, but caution does need to be exercised, as sometime buildings do correctly straddle road or railway emission lines, so they cannot all be removed without due consideration.

8.4 Base Model – Topography

There are several potential sources for ground cover information which may be applicable:

- The CORINE data set, a 1:100,000 scale European-wide digital land cover product derived from Landsat TM imagery. The minimum size of a CORINE land parcel is 25 hectares;
- The vegetation database contained within the OSI large-scale vector product. Vegetation depiction is more detailed than that of the CORINE data set with boundaries accurate to +/- 0.4m, a minimum area of 0.1 hectares, a minimum width of 5m and a vegetation type indicator in the form of spatially associated symbology; and
- Generation of a new land cover data set from aerial photography.

Recent experience with OSI Largescale and OS MasterMap derived datasets has raised issues regarding the complexity of the raw dataset in the context of noise propagation modelling. Test calculations have also indicated that the simplified CORINE dataset can be used within agglomerations with very little change in calculated noise level.

8.5 Base Model - Barriers

The WG-AEN GPG v2 presents quantified accuracy statements for road traffic noise calculations. One of the key outcomes was an understanding of the importance of correctly identifying the height attributes of potential screening objects in the vicinity of the road corridor, particularly the edges of cuttings, or the tops of barriers.

It should also be noted that the inclusion of noise barriers within the model will not just influence the calculated results, but also be relevant within the process of noise action planning. As such a fit for purpose noise model would normally need to have noise barrier information suitable for the calculation of road, rail, industry and port noise within the agglomerations, and in the vicinity of major roads and railways outside agglomerations.

8.6 Noise Source Layer – Aircraft

The assessment of noise from aircraft in flight may be undertaken within the same noise mapping software system used for the road, railway and industrial noise calculations, or may be undertaken using the FAA INM software.

8.6.1 INM Projection System

When using the FAA INM software one of the main areas to be addressed correctly is the re-projection of data from metres in the Irish National Grid to decimal degrees in the WGS84 projection used within INM. All data associated with runway definitions and study centre point need to be translated accurately, along with terrain data, an example of which is shown in Figures 8.1 to 8.3 below.

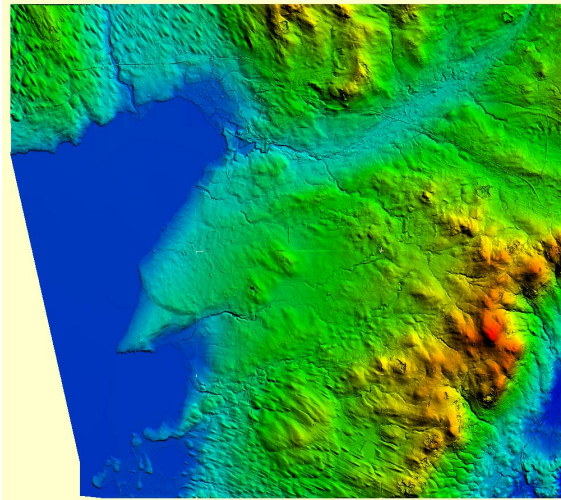


Figure 8.1: Terrain elevation data in Irish Grid

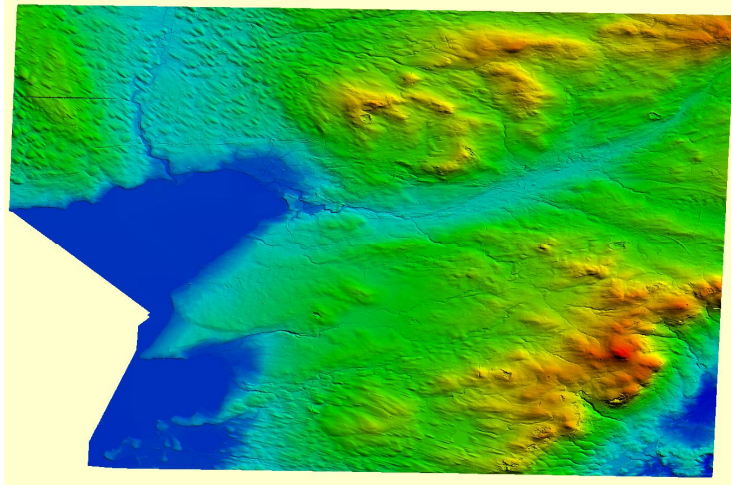


Figure 8.2: Terrain elevation data in WGS84

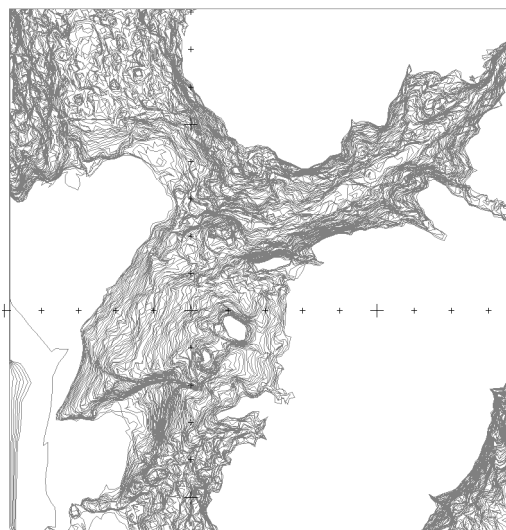


Figure 8.3: INM produced equal height contour lines used within the assessment

8.6.2 Routes and Dispersion

The routes taken by arriving and departing aircraft depend upon many factors including:

- Destination;
- Aircraft Type;
- Operational Characteristics;
- Noise Abatement Tracks / Departure Rules; and
- Runway Usage.

In some cases it is possible to use flight track data directly exported from the airport air traffic control logging system. This is able to provide actual flight routes for all aircraft movements arriving or departing the airfield.

In other cases this information may not be available, in which case it is necessary to set up a series of mean arrival and departure routes for each of the runways in use, along with an estimate of the dispersion around this mean track to consider how the aircraft become spread out from the mean as distance from the airfield increases.

Figure 8.4 illustrates how the modelling of mean tracks and dispersion routes may produce a flight track model.

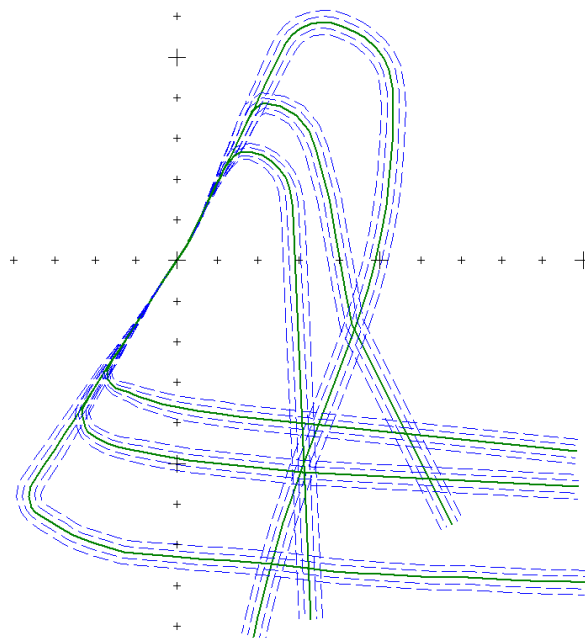


Figure 8.4: Modelled mean flight tracks and dispersion

8.6.3 Assigning Aircraft to Routes

The assigning of aircraft to routes may be handled automatically when such data is logged within the airport systems; however this is not available in all cases, in which case a degree of manual processing is required.

In order to determine the noise emission from the departing aircraft, information on aircraft type is used in addition to the flight profile and the take-off weight, which is generally related to the stage length of the flight i.e. distance to be flown.

In addition to this information, it is also necessary to establish an annual average distribution of arrivals and departures (in the day evening and night periods), across the various runways in use at the airport. This distribution is generally not even as it may be related to weather conditions, prevailing wind and any noise preferential routes or local agreements.

8.6.4 Aircraft Substitutions

The available databases cover the emission data for most major aircraft types, however, they are not exhaustive and therefore the required emission data may not be available for all aircraft which are to be modelled. In these cases it is normal practice to use substitutions of the unknown aircraft with types for which the required emissions data is available. These substitutions may be based upon certification data, engine type or number of seats etc.

The impact of aircraft selection and substitutions upon the uncertainty of the noise contours depends upon the contribution of each aircraft type to the noise contours, and hence the proportion of these aircraft making up the overall movements. In general it is appropriate to undertake an assessment to determine the overall contribution of each aircraft type by determining the noise level for an individual aircraft, combined with its number of movements. It is generally important to ensure that dominant aircraft types are correctly identified, or substituted with caution, the overall impact of some aircraft types with very few movements can be very small in the context of an annual average assessment.

All aircraft matching and substitutions should be documented and set out as part of the project report to be submitted to the EPA.

8.7 Noise Source Layer – Industry/Ports

The strategic noise mapping of industrial sources under the Regulations may be undertaken using a highly detailed approach where each noise source within a site is described, along with all buildings, barriers, topography etc, or may be undertaken in a more simplified manner. WG-AEN GPG v2 provides a number of differing approaches to modelling industrial noise sources.

The information required, and the issues which may be encountered will be determined by the choice of the approach to be adopted. In general the types of issues which may arise include the following factors.

8.7.1 Noise Emission Levels

Sound power levels are required for each of the modelled sources, with any necessary day, evening and night variance considered. Detailed approaches could consider octave band noise sources, whilst more general approaches may only consider overall A-weighted source terms.

8.7.2 Noise Source Location

Detailed point, line or area sources, or generalised emission areas, require accurate location with respect to the 3D ground model

8.7.3 Objects within the Industrial Site

It may often be difficult to gain a current description of the location of relevant buildings, barriers and screens within the industrial site. These items are relevant to both detailed and generalised approaches to assessment.

8.8 Noise Source Layer – Railways

The OSI rail centreline data contains both individual railheads (a pair of parallel polylines per track) and a route centreline (one polyline at the centre of the route corridor, irrespective of how many tracks there are).

There are a number of issues relating to the use of generalised GIS datasets for rail noise sources which are discussed below.

8.8.1 Train Categories

Within the 10 RMR train categories, a view must be made to how rolling stock can be filtered into the existing train categories.

8.8.2 Activation of Brake

The RMR method requires information on the use of brakes, therefore to model this correctly the locations of braking regions must be known.

8.8.3 Bridges and Elevated Tracks

It is known that augmentation of rolling noise levels can occur when trains pass over different types of track or structures such as bridges. This augmentation is also related to the type of locomotive and rolling stock and also the train speed.

8.8.4 Height Attribute

An efficient railway layer will also contain information on the relative height of each rail segment. This is particularly important for railway sections which cross bridge features.

The attribution is normally the result of GIS processing to create and attribute correctly, rail segments which either: (a) traverse a bridge or (b) follow ground contours. Using the output of the cutting process, a manual exercise is typically required to correctly assign attribute values to each of the rail segments.

8.9 Noise Source Layer - Roads

Although the ground model, buildings and ground cover data layers are key components of the noise modelling process, spatially accurate and populated source term information (i.e. road traffic flow and condition data) is crucial to the development of an effective noise map to meet the purposes of the END.

There are a number of issues relating to the use of generalised GIS datasets for road traffic noise sources are discussed below.

8.9.1 Road Traffic Flows

Gaining access to road traffic flow parameters for all the required roads can be problematic. In the absence of such information, default values may be assigned to the input datasets. One potential approach for determining default values could be the approach outlined in the WG AEN GPG v2 Toolkit 2, Tool 5 to assess assumed traffic flow levels using a graduated approach.

8.9.2 Other Road Attributes

In addition to road traffic flow, there are several additional attribute fields which will be important to the effective development of road noise maps within the agglomeration areas and the strategic road corridors. These are:

- Road Direction;
- Road Width;
- Road Surface Type;
- Road Surface Texture Depth;
- Traffic Speed; and
- %HGVs.

8.9.3 Height Attribute

An efficient road layer will also contain information on the relative height of each road segment. This is particularly important for road sections which cross bridge features.

The attribution is normally the result of GIS processing to create and attribute correctly road segments which either: (a) traverse a bridge or (b) follow ground contours. Using the output of the cutting process, a manual exercise is typically required to correctly assign attribute values to each of the road segments.

8.9.4 Geometry

As discussed in WG-AEN GPG v2 available road traffic network models which hold information of vehicle flows and speeds are often based upon a link-node format where nodes may be located in approximately relevant geometrical locations such as junctions, whereas the links are generally straight lines between the nodes, unlike real roads. An example is shown in Figure 8.5 below.

In this situation it is required to match across the traffic flow information from the geometrically inaccurate flow model over onto the geometrically accurate road centreline dataset. This is normally a semi-automated method which may require a high level of manual intervention and checking.

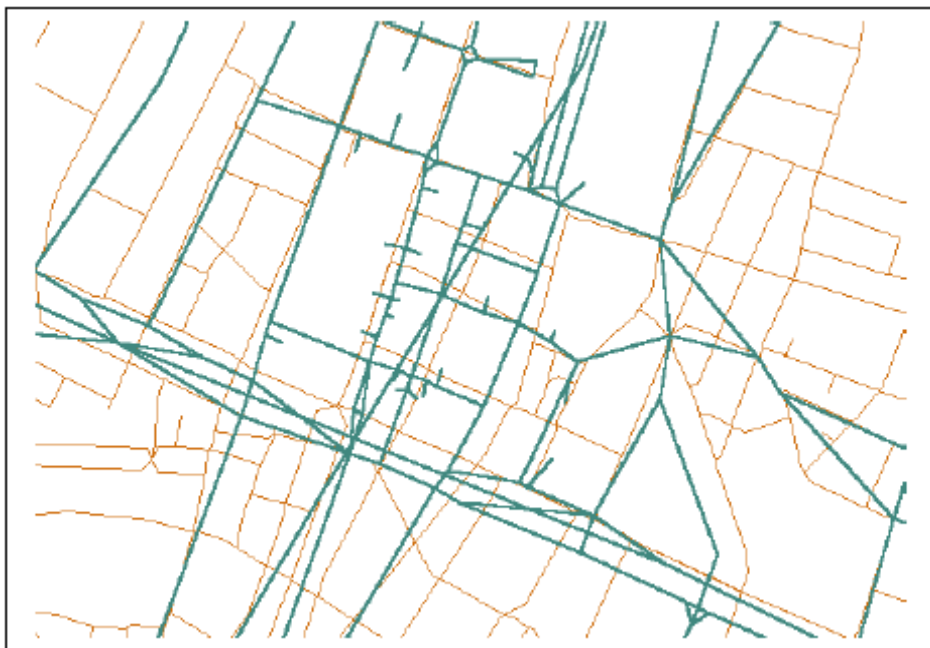


Figure 8.5: An example of an accurate digital road network model (brown) and an inaccurate road traffic network model (green). (*After WG-AEN GPG v2 p19.*)

9 Stage 6 – Noise Level Calculations

The main focus of initial considerations regarding the assessment of noise levels for strategic noise mapping under the Regulations may well centre on the calculations to be undertaken at this stage of the process. As discussed above, experience of large area city and regional noise mapping projects suggests that the data capture, and data processing stages are the most time consuming, costly and labour intensive. The noise calculations at this stage may be more specialised in nature, but when operating a good commercial software solution rely more on machine time for processing, rather than staff time.

Set out below is guidance on some aspects for consideration when considering the purchase of a noise mapping software solution, as well as some issues to be tested and documented whilst using the software for strategic noise mapping.

9.1 Noise Mapping System Requirement Criteria

Whilst it is desirable to allow complete freedom of choice over the noise mapping tool to be used by the noise mapping bodies, it is logical that certain desired functionality and a wish for consistency of quality will result in a restriction over the selection of some software tools. The following is a list of criteria that any selected tool should satisfy in order to be acceptable within the strategic noise mapping process under the Regulations:

- Commercial availability and supported within Ireland;
- Is generally available with an installed user base;
- Documented compliance with CRTN, CRN, RMR, XPS 31-133, ISO9613-2 and ECAC Doc 29 as appropriate, including the relevant adaptations;
- Proven record of use in city sized projects and larger;
- Means of calculating large areas in a seamless coherent manner which avoids discontinuity of results;
- Compatibility with 3D datasets without compromising integrity of height data;
- Utilisation or acceptance of conventional GIS datasets, therefore import/export, batch process proprietary GIS formats and export results data for use in GIS or publish images;
- Scalable, therefore server or GIS based systems to be included; and
- Suitable software should have some or all of these features:
 - Ability to use or interface with personal or server based geodatabase systems;
 - Multi-processor or multi-machine capabilities for parallel processing of calculations;
 - Previous experience with handling geodatasets of over 20km² with more than 250,000 points or objects; and
 - Ability to enable multi-user working on a project.

9.2 Data Management Strategy

As computer processing power has increased rapidly over the past 10 years, the data management aspect of the noise mapping has increasingly overtaken the noise calculations as the primary time and manpower element. As a result, it is considered that such projects can be undertaken as data management/GIS projects with an acoustics component, rather than acoustics projects with a data management/GIS

component. However, in recent large area projects, it has not been uncommon for the work to be seen as acoustics based, and thus high quality data management or best practice GIS techniques have sometimes not been the main focus of the projects. This has led to a variety of approaches to large scale mapping project, but generally following the format shown in Figure 9.1.

The main concern with this approach is the double handling of data within GIS and the noise mapping package. The quality concerns that this creates are then compounded by the fact that there are now two different finalised model datasets, one in the GIS system, and one in the noise package, which are under different control systems, and have different contents. This can lead to difficulties with updating data, quality management and traceability of data manipulation and results.

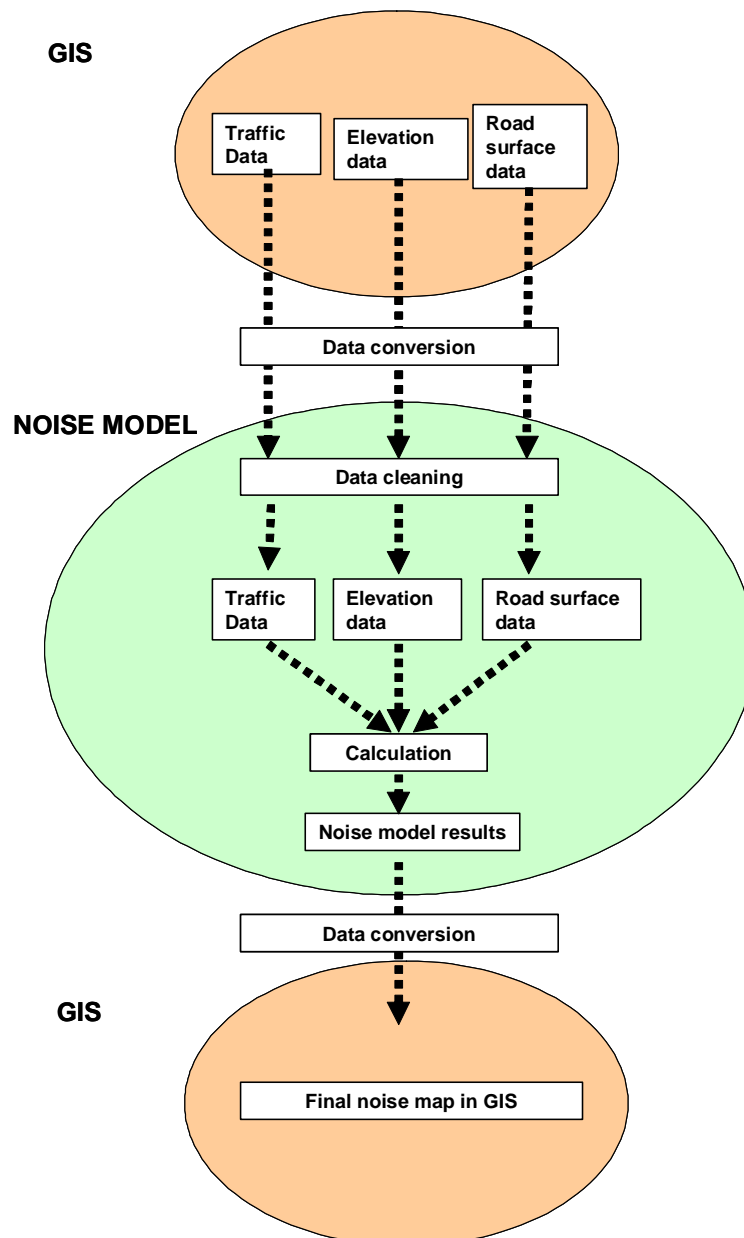


Figure 9.1: Common Approach to GIS Based Noise Mapping

An alternative approach which is becoming increasingly common is to use a central GIS database or 'geodatabase' to deliver model data directly to the acoustics calculation package, which in turn returns the results directly back to the GIS package as shown in Figure 9.2. This can help to eliminate a large amount of time and cost in import/export and data manipulation problems. This approach also combines the skills and people within the acoustics and GIS parts of the project team and helps promote skills transfer and knowledge sharing. It also eliminates multiple stages of data handling, and provides a more robust quality trail and data reliability within the project. All these aspects can combine to help promote quality, whilst reducing time and costs.

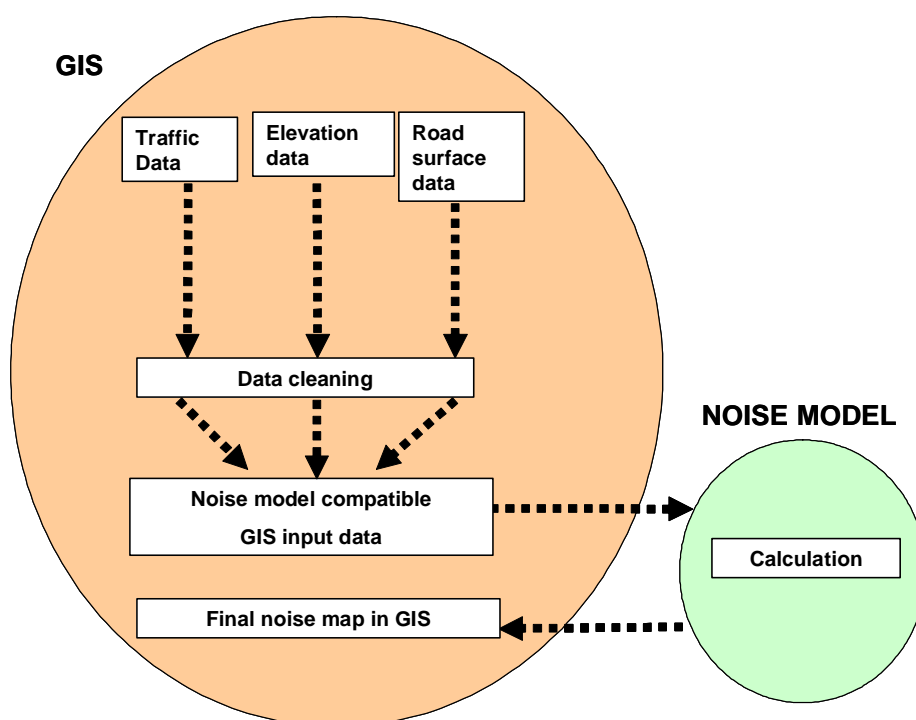


Figure 9.2: Integrated Approaches to GIS Based Noise Modelling

It is currently possible to find commercial noise mapping software solutions which provide workflow in line with both of the above approaches. It is worth considering the general skills of the project team, as well as working practices, locations, data transfer and management strategies, backup requirements and quality assurance methods when making a final selection.

9.3 Model Uncertainty

Noise calculation software brings together the noise model and the noise calculation standard within a 3D calculation environment. Noise calculations are then performed within the 3D environment with tolerances, accuracy and resolution determined by a number of factors.

The Defra funded NANR 93 research project for WG-AEN sets out the first treatment of uncertainty within strategic noise mapping. The model uncertainty is used to

describe the uncertainties introduced into the calculated results due to the method of assessment being used, and the specific details of how this method is transposed into a software tool and configured by the developer and the user.

The main characterisation of model uncertainty is considered to be the responsibility of the owners and developers of the noise models being used, as they are in a position to effect change to the model if uncertainty is identified and quantified.

Within the current noise mapping situation there are probably two main sub-elements to noise mapping uncertainty:

1. The issue of how accurate the prescribed calculation standard is at representing the real world situation, and what uncertainties it introduces due to the (necessary) simplifications made in order to present a solution which is relatively simple to implement, and;
2. The secondary issue of how the documented standard is transposed from a paper document into a 3D noise calculation tool, and how the tool's additional simplifications, efficiency techniques and assumptions introduce further uncertainties into an uncertain methodology in order to create usable real world calculation times.

Figure 9.3 below shows how model uncertainty is introduced into the noise mapping.

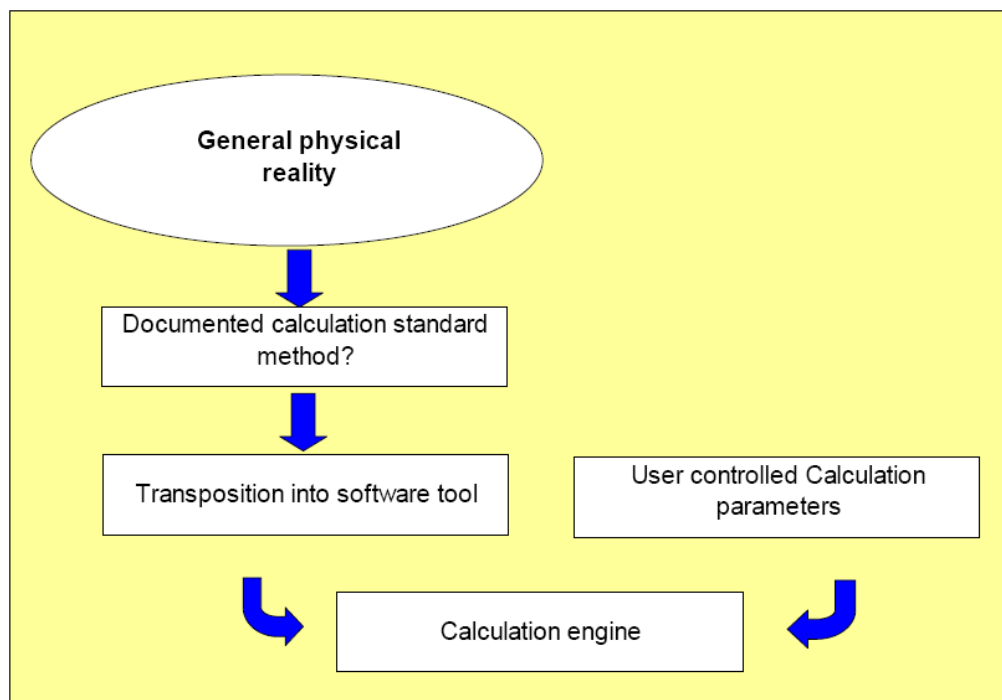


Figure 9.3: Model Uncertainty Flow Chart

The selection of the method of assessment during stage 2 of the mapping process will have an influence upon the uncertainty associated with the calculation method. The choice of noise mapping software will have an influence on the uncertainty introduced on the transposition of the method into the software tool, although such

information is currently hard to uncover as there are few standardised test cases, and no widespread inter-comparison or standardisation of software.

9.4 User Defined Calculation Settings

There are many aspects of the noise calculations which may be controlled by use of the user defined settings. These can range from specifying grid resolution (i.e. grid cell spacing at which noise was calculated) to determining how many reflections should be considered. Other calculation settings can be defined as 'efficiency settings' which aim to simplify aspects of the assessment in order to reduce processing time, these generally aim to provide improvements in processing efficiency, or scalability.

The use of these user controlled calculation parameters may have a significant effect upon the uncertainty associated with the calculated results, and due care and process checks should be included in order to ensure that the settings in use do not introduce unacceptable levels of uncertainty.

Efficiency settings are designed to reduce calculation time by employing different techniques which either reduce the number of calculations required, or reduce the complexity and detail of the calculations. Despite the benefit in reducing calculation time, efficiency settings can introduce uncertainties into the calculated noise levels.

In general efficiency settings are designed to simplify or ignore aspects of the source to receiver propagation path assessment based upon criteria set by the user and the software developer. This introduces a compromise between uncertainty and calculation time. In general, a fast calculation will introduce more uncertainty into the noise levels than a slower calculation.

Some efficiency settings perform better than others both in isolation and in parallel. As a result, it is recommended that investigations are carried out using test areas by the project team to identify the appropriate calculation settings which should be used for the final calculations. These aim to strike a balance between time saving and uncertainty introduced into the noise level results.

9.4.1 Use of Test Calculations

It is recommended that prior to final calculation runs being commenced, that a test area (or areas) of the model are used to investigate the optimal calculation settings to be used. A suitable model area could be 5 x 5 km in area, with a calculation area defined as the central 1 x 1 km area. The test model should be representative of the model as a whole, and provide a range of propagation situations.

It is recommended that the settings associated with the standard are reviewed and set, these include aspects such as search radius for reflections, minimum source to receiver distance, number of reflections etc. These should remain the same throughout the tests.

The settings which the developer suggests may provide efficiency benefits should then be set to their most accurate value, which will normally result in the highest quality calculation taking the longest time. These settings should then be varied one at a time, and the results grids statistically compared with the base case to assess the uncertainty in calculated results.

By running multiple tests, for multiple parameters in a number of settings, it is possible to compare the costs (uncertainty in results) with the benefits (time saving) and select a preferred set of calculation parameters. It is recommended where possible that the 95% confidence interval of the results is kept within 1.0dB of the base case results.

9.5 Calculation Hardware Environment

In addition to defining the appropriate settings for the calculation parameters, the calculation process can be further optimised using a combination of:

- Calculation Tiling;
- Multiple Calculation Servers; and
- Hardware Environment.

All three of these optimisation techniques may be utilised during the calculation of noise levels.

9.5.1 Calculation Tiling

Calculation tiling is a technique which allows one large calculation area and model to be split into smaller areas, which can then be calculated simultaneously on several computers or one by one. Generally it has been found that the smaller the tile size, the faster the calculations will run due to the smaller dataset in process, however this could lead to many hundreds of model tiles.

The tiles would generally be configured with a central calculation area, say 1 x 1 km, plus a buffer of data, say 2 km all around to make a 5 x 5 km model area, to ensure that the tiled results combine in a seamless manner.

Advanced noise mapping software handles this distribution of processing in an automated manner. There are significant advantages of tiling calculations over a single model calculation. These are:

- **Reduced Calculation Times:** By splitting the calculation up into tiles, this allows a noise model to be distributed across multiple calculation servers. Smaller models also process more quickly per grid point than larger models.
- **Calculation Redundancy:** Tiling increases calculation redundancy significantly with respect to a single calculation. In the event of hardware failure only one tile will fail rather than a single large calculation

9.5.2 Multiple Calculation Servers

The use of multiple calculation computers also improves calculation time by allowing automation of calculations, and parallel processing of multiple model tiles. Advanced noise mapping software systems contain tools which can be licensed which will automatically distribute multiple parallel processing jobs across multiple processors, across multiple computers if available.

9.5.3 Hardware Environment

If the computer hardware in use is only expected to be undertaking noise mapping calculations then the hardware environment may also be optimised for calculations based on the requirements of the noise mapping software. This may be achieved by turning off all the unnecessary system services to improve the available physical memory and CPU to the calculation core. Testing across multiple CPU manufacturers and architecture designs may also lead to dramatic differences in processing time not solely related to CPU clock speeds.

9.6 Pre-flight Checks

Prior to the final calculations being commenced, it is recommended that a series of pre-flight checks are undertaken to confirm that the model will be processed without problems.

Final datasets should be loaded into the noise mapping software tool, and a number of single receptor calculations undertaken to confirm that the relevant files load and process without issues.

It can also be useful to undertake a 100m x 100m grid calculation across the model, as this will test any model tiling or automatic distribution of processing across multiple machines, but will also assess 1% of the grid points from the final run, which will help to provide a good indication of likely processing times.

Using current computer hardware, an initial estimate of processing time may be gained by using processing times of around 0.25 seconds per grid point for assessments of road traffic noise in agglomerations, railways, industry and major sources often process more rapidly.

9.7 Post Calculation Checks

Following the completion of the calculation run it is important that checks are carried out to verify that the noise levels produced are in line with expectations. It is recommended that the noise mapping software is used to produce graphical representations of the noise levels, as noise contour maps, in order for any gaps, errors or anomalies to be identified.

Some noise mapping systems also provide output log files which may be reviewed to ensure that all the necessary input datasets were loaded, and that the calculations were processed without errors.

10 Stage 7 – Post Processing and Analysis

After the completion of the noise calculations the noise level results are available as derived datasets from the noise modelling process.

The noise results generated can now be mapped, presented graphically, and used as the basis for supplementary analysis in order to derive the required information for reporting to the Commission.

10.1 Noise Grid Processing

The grids of noise assessment results delivered from the noise mapping software may have a number of aspects which require attention prior to the processing of the various stages of statistical analysis.

Noise results grids may contain:

- Empty grid points or default data values for grid points located inside buildings where an assessment of noise level is not considered appropriate;
- Default data values for grid points located outside the boundary of the area to be mapped; and
- Result values to more than two decimal places.

To prepare the grids of noise results, it is recommended that the results files are verified, and relevant pre-processing undertaken:

- Interpolation of grid values to assign indicated noise levels to points with blank or default values;
- Masking of results grids to the extent of the area to be mapped; and
- Rounding of the results to two decimal places.

These processed noise results grid files may then be used for the following:

- Production of 5dB noise contour bands for graphical mapping of results; and
- Production of reclassified grids into a set of 5dB categories.

The 5dB bands are:

- L_{den} <55, 55 – 59, 60 – 64, 65 – 69, 70 – 74, ≥ 75
- L_{night} <50, 50 – 54, 55 – 59, 60 – 64, 65 – 69, ≥ 70

Note 14: all class boundaries are .00, i.e. 55-59 is actually 55.00 to 59.99. This is in line with the approach of a number of the commercial noise mapping software packages. This may require the use of a database program such as MS Access, MS SQL or MySQL where class boundaries can be programmed. The default behaviour in MS Excel should not be used for this analysis as it rounds at .49 and .50, however the ROUNDDOWN function may be used to apply the class boundaries.

10.2 Area Analysis

The EC recommended reporting mechanism, ENDRM 2007, requires information on the total area, inside and outside agglomerations, (in km²) exposed to L_{den} and L_{night} higher than 55, 65 and 75dB for major roads, major railways and major airports.

The reclassified grid files may be used to calculate these areas as each grid point represents an area of 100 m².

10.3 Dwelling Analysis

The Directive requires information on the total number of dwellings (in hundreds) exposed to L_{den} and L_{night} higher than 55, 65 and 75dB for major roads, major railways and major airports.

It also requires information on the estimated number of people (in hundreds) living in dwellings that are exposed to noise in 5dB bands for the various scenarios mapped. This will require population census data with a specified date.

For these reasons it is necessary to develop a dwellings dataset. Although the Directive refers to “dwelling” in a number of places⁶¹, there is no definition within the Directive.

The recommended approach to developing a residential dwellings dataset is as follows:

- Extract GeoDirectory “Buildings” table;
- Filter out buildings created after the date of the population census being used;
- Filter out derelict, vacant, invalid and under construction buildings;
- Filter out commercial or unknown building use;
- Filter out building groups which do not contain residential dwellings, except for schools and hospitals which should be retained as noise sensitive premises (others may be retained in line with the requirements of the Action Plans); and
- Assess total number of residences per building by summarising the total number of delivery points per building.

The residential dwellings dataset may then be intersected with the reclassified grid files to assign the noise exposure band to each façade of the building, and the most exposed façade identified in line with the recommendations within WG-AEN GPG v2, and the building noise level assigned. The buildings may then be summarised to provide the total numbers of dwellings required.

10.4 Population Analysis

The Directive requires information on the estimated number of people (in hundreds) living in dwellings that are exposed to noise in 5dB bands for major roads, major railways and major airports, and for airports, industry, railways and roads within agglomerations.

The 5dB bands are:

⁶¹ END Article 3 (q), Annex I (1), Annex III, Annex IV (1) and Annex VI (1.5, 1.6) and (2.5, 2.6)

- L_{den} <55, 55 – 59, 60 – 64, 65 – 69, 70 – 74, ≥ 75
- L_{night} <50, 50 – 54, 55 – 59, 60 – 64, 65 – 69, ≥ 70

The recommended approach to developing a population dataset is as follows:

- Utilise Small Area Population Statistics (SAPS) from Central Statistics Office (CSO) census data. The themes required are:
 - Number of persons in private households by type of household; and
 - Number of private households by type of accommodation.
- Attribute CSO data to Ordnance Survey Ireland (OSI) Electoral Divisions (ED).

Note 15: ED level data is suggested due to its availability, however the large variability in the size of ED's mean they are not ideal from a statistical output perspective. Should the relevant information become available for smaller areas, such as statistical output areas, it is recommended that they are used.

Note 16: Joining CSO boundaries to EDs may require manual matching and cleaning of datasets as there is not currently a unique one to one match across between the datasets.

The resulting dataset is ED boundary polygons with population and dwelling numbers attributed.

- This data may then be used to assess the average population per residential property at ED level;
- Intersect the ED level average population per residential property with the residential dwellings location dataset to assign numbers of people to each residential dwelling; and
- Using the assigned noise levels for most exposed façade the population exposure statistics may be assessed.

Further guidance may be issued by the EPA in relation to this, and NMBs should not undertaken population exposure assessment without first consulting with the EPA.

11 Reporting Requirements

11.1 Reporting Mechanism

The Member States within the EC need to submit the results of the strategic noise mapping and action planning to the Commission. As the designated national authority it is the responsibility of the EPA to report the results of the strategic noise mapping and action planning to the Commission⁶².

To this end the EC have published the recommended Electronic Noise Data Reporting Mechanism (ENDRM)⁶³ for reporting under the END, which sets out 11 Data Flow templates covering the Member State (MS) reporting obligations set out in the Directive. The Data Flows cover the first and second round implementations of the END with deadlines ranging from 2005 to 2014.

Information on the extent of designated locations to be mapped during the second round of the Directive, 2012 was submitted to the Commission in December 2008 using Data Flow 5 (DF5). The information reported under DF5 covered the designation of the following:

- Agglomerations $\geq 100,000$ inhabitants;
- Major airports $\geq 50,000$ movements/y
- Major roads ≥ 3 million vehicles/y
- Major railways $\geq 30,000$ trains/y

The information reported to the EC may be updated at any time by the EPA, and thus the NMBs should report to the EPA any changes in information pertinent to this report as the project extents are clarified and confirm approaching the commencement of the strategic noise mapping projects.

The results of the second round of strategic noise mapping are to be submitted to the Commission by 31st December 2012 using Data Flow 8 (DF8). The information to be reported under DF8 covers the following:

- DF8 by 31 December 2012
Strategic noise maps related data as listed in annex VI for major roads, railways, airports and agglomerations concerned by 2nd round.
- Per agglomeration $\geq 100,000$ inhabitants, including:
 - Agglomeration Roads;
 - Agglomeration Rail;
 - Agglomeration Airports; and
 - Agglomeration Industry.

⁶² Article 5 (4)

⁶³ Available at:

http://circa.europa.eu/Public/irc/env/d_2002_49/library?l=/reporting_mechanism/reporting_mechanism&vm=detailed&sb=Title [accessed May 2011]

- Per major airport $\geq 50,000$ movements/y.
- For overall major roads ≥ 3 millions vehicles/y.
- For overall major railways $\geq 30,000$ trains/y.

Appendix F includes extracts from the ENDRM which sets out the reporting requirements under DF8 for major roads, whilst Appendix G includes extracts of DF8 for agglomerations.

Appendix H contains an extract from the ENDRM which describes the supplementary summary reports required under DF8.

The latest version of the reporting templates should be used. They may be accessed from the EIONET Reporting Obligations Database (ROD) website⁶⁴, or provided by the EPA on request.

11.2 Information to be Sent to the EPA

The Regulations allow for some scope by the NMBs to select the method of assessment to be used for the noise mapping⁶⁵, as well as the use of supplementary noise indicators in addition to the required assessment of L_{den} and L_{night} ⁶⁶. The Regulations require the NMBs to seek prior approval from the EPA on the choice of method of assessment, the use of supplementary noise indicators, and the data used to undertake the strategic noise mapping⁶⁷. In these regards the NMB should submit a proposal to the EPA for approval no later than 31st December 2011.

The noise mapping bodies are to have made strategic noise maps by 30 June 2012, in respect of the calendar year 2011⁶⁸. The NMBs are to submit the following to the EPA by 31 July 2012⁶⁹:

- Results of the strategic noise mapping, in an electronic format to be agreed with the EPA;
- Draft Strategic Noise Mapping Report, see Appendix E; and
- Supplementary Report, not exceeding 10 pages in length, see ENDRM 2007 section 6.1 and Appendix H.

The designated noise mapping bodies for the agglomerations are to liaise and submit a single consolidated set of strategic noise mapping results, a single consolidated Draft Strategic Noise Mapping Report and a single consolidated short Supplementary Report, not exceeding 10 pages in length, to the EPA covering the whole of the agglomeration.

⁶⁴ Available at: <http://rod.eionet.europa.eu/> [Accessed July 2011]

⁶⁵ Article 9

⁶⁶ Article 8 (3)

⁶⁷ Article 8 (2)

⁶⁸ Article 10 (2)

⁶⁹ Article 10 (6)

11.3 Information to the Public

Within the context of the Regulations, and the Directive, the strategic noise maps are to serve as a public statement of the extent to which environmental noise currently affects the area covered by the maps, and to provide the basis of evidence for the development of noise action plans.

To this end information for the public on strategic noise maps, should be clear and comprehensible, and include a summary setting out the most important points⁷⁰.

Dissemination to the public should be via any appropriate means, including through the use of available information technologies⁷¹, and should be in accordance with relevant Regulations, see Note 17. The results of the strategic noise mapping should be made available to the public within one month of the date they are finalised⁷².

Note 17: On dissemination, the Directive states that it should be in “accordance with relevant Community legislation, in particular Council Directive 90/313/EEC of 7 June 1990 on the freedom of access to information on the environment”, which has subsequently been repealed and replaced by Directive 2003/4/EC of 28 January 2003 on public access to environmental information.

The Regulations quote the European Communities Act 1972 (Access to Information on the Environment) Regulations 1998 (S.I. No. 125 of 1998), which have subsequently been revoked and replaced by European Communities (Access to Information on the Environment) Regulations 2007, S.I. No. 133 of 2007, which transpose Directive 2003/4/EC, and which have an accompanying guidance document from the DEHLG⁷³.

It is recommended that the 2007 Regulations are followed, using the DEHLG guidance note as a point of reference.

European Commission Working Group Assessment of Exposure to Noise (WG-AEN) have developed a Position Paper on “*Presenting Noise Mapping Information to the Public*”, March 2008⁷⁴. This provides clear guidance, advice and examples of best practice on how to publish noise mapping information. One important aspect which the position paper covers is the need for suitable supporting information and explanation alongside the noise mapping results in order for the relevance and context of the results to be conveyed.

It is currently the view of the EPA that noise mapping results which are presented in line with the recommendations within Appendix J of this Guidance, and which take into consideration the WG-AEN Position Paper, and meet the requirements of S.I. No. 133 of 2007, will have achieved current best practice.

⁷⁰ Article 12 (2)

⁷¹ Article 12 (1)

⁷² Article 12 (3)

⁷³ Available from: <http://www.environ.ie/en/Legislation/Environment/Miscellaneous/> [accessed May 2011]

⁷⁴ Available from: http://circa.europa.eu/Public/irc/env/noise_map/library?l=/wg-aen_001_2008doc/_EN_1.0_&a=d [accessed May 2011]

11.4 Revision

The Regulations introduce a continuing obligation on noise mapping bodies to review and, where necessary, revise each strategic noise map every 5 years, or sooner where requested by the EPA⁷⁵, or when a material change in environmental noise in the area concerned triggers a revision of the relevant noise action plan⁷⁶. The EPA “Guidance Note for Noise Action Planning”, July 2009, suggests that a noise action plan should be revised due to a material change if *“it is known, or thought likely, that greater than 10% of the exposed population within the area of an action plan have experienced a change in the prevailing noise situation of greater than 3dB L_{den} or L_{night} ”*.

Therefore, Noise Mapping Bodies who undertook strategic noise mapping for the first round in 2007 have an obligation to undertake a review of the strategic noise maps and, where necessary, revise them. For the basis of this review of Round 1 strategic noise maps ahead of Round 2, the NMBs should consider that a revision of the strategic noise maps is required if it is known, or thought likely, that greater than 10% of the exposed population within the area of an action plan have experienced a change in the prevailing noise situation of greater than 1dB(A) L_{den} or L_{night} .

It is recommended that the review comprises consideration of the following aspects:

- Has there been a significant increase or decrease in traffic volumes (25% = 1dB) on any individual road?
- Have there been any significant new infrastructure developments? E.g. bridges, bypasses or runways;
- Have there been any significant new developments? E.g. regeneration or housing developments;
- Have additional road or railway segments come into the “major” category due to the change in traffic flows or flow thresholds?
- Have any major policy decisions caused a noise impact which should be shown in revised maps? E.g. noise action plan measures;
- Have there been any significant changes to the vehicle fleet? i.e. cars, %HGVs, rail or tram vehicles, aircraft.
- Have noise emissions from industrial sites within agglomerations altered?

This process has the potential to conclude that a revision of the strategic noise maps is not required in certain areas; therefore no further work needs to be undertaken for that location and the Round 1 noise level results may be published as the Round 2 noise level results. It should be noted that the EPA does not consider this to be a likely outcome in many cases, there may be a number of reasons for this including:

- The change in flow threshold from 6 million to 3 million vehicles between the first and second rounds will significantly change the network of major roads to be mapped, up to 7 times greater road length in the case of the NRA;
- A number of the National roads mapped by the NRA during the first round have been de-nationalised since 2007 and the NRA expects many of these to have changed significantly in traffic flow;

⁷⁵ Article 10 (5)

⁷⁶ Article 11 (7)

- The change in flow threshold from 60,000 to 30,000 trains between the first and second rounds will significantly change the network of major railways to be mapped.

The review and its outcome should be documented within the report on strategic noise mapping, see Appendix E.

When revision of the strategic noise maps are deemed necessary for any of the above reasons, the revised strategic noise maps should be re-published and re-submitted to the EPA in line with the approach set out above.

Appendix A: Glossary of Acoustic and Technical Terms

Term	Definition
Agglomeration	Major Continuous Urban Area as set out within the Regulations
Attribute Data	A trait, quality, or property describing a geographical feature, e.g. vehicle flow or building height
Attributing (Data)	The linking of attribute data to spatial geometric data
CRN	The Calculation of Railway Noise 1995. The railway prediction methodology published by the UK Department of Transport.
CRTN	The Calculation of Road Traffic Noise 1988. The road traffic prediction methodology published by the UK Department of Transport.
Data	Data comprises information required to generate the outputs specified, and the results specified
dB	Decibel
DEM	Digital Elevation Model
DSM	Digital Surface Model
DTM	Digital Terrain Model
DVD	Digital Versatile Disk
EC	European Commission
END	Environmental Noise Directive (2002/49/EC)
ESRI	Environmental Systems Research Institute
GIS	Geographic Information System
INM	Integrated Noise Model
Irish National Grid (ING)	The official spatial referencing system of Ireland
ISO	International Standards Organisation
Metadata	Descriptive information summarising data
NA	Not Applicable
Noise Bands	Areas lying between contours of the following levels (dB): L_{den} <55, 55 – 59, 60 – 64, 65 – 69, 70 – 74, ≥75 L_d <55, 55 – 59, 60 – 64, 65 – 69, 70 – 74, ≥75 L_e <55, 55 – 59, 60 – 64, 65 – 69, 70 – 74, ≥75 L_n <45, 45-49, 50 – 54, 55 – 59, 60 – 64, 65 – 69, ≥70 Notes: 1) It is recommended that class boundaries be at .00, e.g. 55 to 59 is actually 55.00 to 59.99 2) The assessment and reporting of the 45 – 49dB band for L_{night} is optional under the Regulations
Noise Levels	Free-field values of L_{den} , L_d , L_e , L_n , and $L_{A10,18h}$ at a height of 4m above local ground level
Noise Level - L_d -	L_d (or L_{day}) = $L_{Aeq,12h}$ (07:00 to 19:00)

Term	Definition
Daytime	
Noise Level - L_e - Evening	L_e (or L_{evening}) = $L_{\text{Aeq},4h}$ (19:00 to 23:00)
Noise Level - L_n - Night	L_n (or L_{night}) = $L_{\text{Aeq},8h}$ (23:00 to 07:00)
Noise Level - L_{den} - Day/Evening/Night	A combination of L_d , L_e and L_n as follows: $L_{\text{den}} = 10 * \log \frac{1}{24} \{ 12 * 10^{((L_{\text{day}})/10)} + 4 * 10^{((L_{\text{evening}}+5)/10)} + 8 * 10^{((L_{\text{night}}+10)/10)} \}$
Noise Level - $L_{A10,18h}$	$L_{A10,18h} = L_{A10,18h}$ (06:00 to 24:00)
Noise Mapping (Input) Data	Two broad categories: (1) Spatial (e.g. road centre lines, building outlines). (2) Attribute (e.g. vehicle flow, building height – assigned to specific spatial data)
Noise Mapping Software	Computer program that calculates required noise levels based on relevant input data
Noise Model	All the input data collated and held within a computer program to enable noise levels to be calculated.
Noise Model File	The (proprietary software specific) project file(s) comprising the noise model
Output Data	The noise outputs generated by the noise model
OSI	Ordnance Survey for Ireland
Processing Data	Any form of manipulation, correction, adjustment factoring, correcting, or other adjustment of data to make it fit for purpose. (Includes operations sometimes referred to as 'cleaning' of data)
QA	Quality Assurance
RMR	The railway noise calculation method published in the Netherlands in 'Reken- en Meetvoorschrift Railverkeerslawaaai '96, Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 20 November 1996'.
Spatial (Input) Data	Information about the location, shape, and relationships among geographic features, for example road centre lines and buildings.
WG - AEN	Working Group – Assessment of Exposure to Noise
XPS 31-133	The French road traffic noise calculation method published in 'NMPB-Routes-96 (SETRA-CERTULCPC-CSTB)', referred to in 'Arrêté du 5 mai 1995 relatif au bruit des infrastructures routières, Journal Officiel du 10 mai 1995, Article 6' and in the French standard 'XPS 31-133'.

Appendix B: Bibliography and References

Legislation

European Communities (Access to Information on the Environment) Regulations 2007, (S.I. No. 133 of 2007).

European Communities (Noise Emission by Equipment for Use Outdoors) (Amendment) Regulations 2006, (S.I. No. 241 of 2006).

Environmental Noise Regulations 2006, (S.I. No. 140 of 2006).

Protection of the Environment Act, 2003.

Waste Management Acts 1996 to 2003.

European Commission (2003). Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information. OJ L 41, 14/02/2003, Luxembourg 2003.

European Commission (2002). Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise. OJ L 189, 18/07/2002, Luxembourg 2002.

First Schedule to the Air Pollution Act 1987 (Marketing, Sale and Distribution of Fuels) Regulations 1998 (S.I. No. 118 of 1998)

European Commission (1996). Council Directive 96/61/EC concerning integrated pollution prevention and control. OJ L 257, 10/10/96, Luxembourg 1996.

Irish Publications

Department of the Environment, Heritage and Local Government, *European Communities (Access to Information on the Environment) Regulations 2007 (S.I. No. 133 of 2007) - Guidance for Public Authorities and others in relation to implementation of the Regulations*, 2007.

National Roads Authority, *Environmental Impact Assessment of National Road Schemes – A Practical Guide*, 2005.

National Roads Authority, *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*, Revision 1, October 2004.

EPA Publications

Environmental Protection Agency, *Guidance Note for Noise Action Planning for the first round of the Environmental Noise Regulations 2006*, July 2009.

Environmental Protection Agency, *Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)*, 2003.

EC Publications

European Commission Working Group Assessment of Exposure to Noise (WG-AEN), *Position Paper, Presenting Noise Mapping Information to the Public*, March 2008.

European Commission, *Reporting Mechanism proposed for the reporting under the Environmental Noise Directive 2002/49/EC - Overview*, October 2007.

European Commission, *Reporting Mechanism proposed for reporting under the Environmental Noise Directive 2002/49/EC - Handbook (including Data Specifications)*, October 2007.

European Commission Working Group Assessment of Exposure to Noise (WG-AEN), *Position Paper, Good Practice Guide for Strategic Noise Mapping and the Production of Associated Data on Noise Exposure*, Version 2, 13th August 2007.

Official Journal of the European Union (OJEU) 6 August 2003, Commission Recommendation 2003/613/EC.

EC Contract B4-3040/2001/329750/MAR/C1 “Adaptation and revision of the interim noise computation methods for the purpose of strategic noise mapping”.

BS, ISO Standards and Miscellaneous Guidance Documents

ISO 1996. Acoustics - *Description and Measurement of Environmental Noise*:-
International Standards Organisation, Geneva (2003-2007)
 Part 1 - Basic quantities and assessment procedures; and
 Part 2 – Determination of environmental noise levels.

ISO 1996. Acoustics - *Description and Measurement of Environmental Noise*:-
International Standards Organisation, Geneva (1982 – 1987)
 Part 1 - Basic quantities and procedures;
 Part 2 - Acquisition of data pertinent to land use; and
 Part 3 - Application to noise limits.

ISO 1996, Acoustics - *Description and Measurement of Environmental Noise*:- Part 2
- Acquisition of data pertinent to land use, Amendment 1 (1998-09-15).

ISO 9613 Acoustics - *Attenuation of sound during propagation outdoors;*
 Part 1: 1993 Calculation of the absorption of sound by the atmosphere;
 Part 2: 1996 General method of calculation.

Department of Transport publication, ‘*Calculation of Road Traffic Noise*’, HMSO, 1988
ISBN 0115508473.

Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping, P
G Abbott and P M Nelson, PR/SE/451/02.

Department for Environment, Food and Rural Affairs, *METHOD FOR CONVERTING
THE UK ROAD TRAFFIC NOISE INDEX $L_{A10,18h}$ TO THE EU NOISE INDICES
FOR ROAD NOISE MAPPING*, st/05/91/AGG04442, 24th January 2006.

Reken- en Meetvoorschrift Railverkeerslawaaï '96, Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 20 November 1996.

ECAC.CEAC Doc. 29 *'Report on Standard Method of Computing Noise Contours around Civil Airports'*, 1997.

General Texts/References

Dublin City Council Noise Maps

Web Links to Other Related Information

Accessed October 2008

WG-AEN	http://ec.europa.eu/environment/noise/mapping.htm
DG Environment	http://ec.europa.eu/environment/noise/directive.htm
HARMONOISE	http://www.harmonoise.org/why.asp
IMAGINE	http://www.imagine-project.org/

Appendix C: Extract from S.I. No. 118 of 1998

The Environmental Noise Regulations 2006 (S.I. No. 140 of 2006), define the agglomerations of Cork and Dublin with reference to the Air Pollution Act, 1987 (Marketing, Sale and Distribution of Fuels) Regulations, 1998, (S.I. No. 118 of 1998).

Section 4 of this Guidance discusses the definition of the areas to be mapped for the agglomerations of Cork and Dublin. Presented here is an extract from the Air Pollution Act, 1987 (Marketing, Sale and Distribution of Fuels) Regulations, 1998 to clarify the areas to be mapped.

Agglomeration of Cork

The Environmental Noise Regulations 2006 (S.I. No. 140 of 2006), define the “agglomeration of Cork” as:

- The restricted area of Cork as specified in the First Schedule to the Air Pollution Act 1987 (Marketing, Sale and Distribution of Fuels) Regulations 1998 (S.I. No. 118 of 1998).

The restricted area of Cork under the Air Pollution Act 1987 (Marketing, Sale and Distribution of Fuels) Regulations 1998 is defined as follows:

- The county borough of Cork; and
- The included areas of the administrative county of Cork
 - 1. The District Electoral Divisions of:
 - Ballincollig;
 - Douglas;
 - Inishkenny;
 - Lehenagh; and
 - Rathcooney.
 - 2. That part of the District Electoral Divisions of Bishopstown and St. Mary's not within the county borough of Cork.

These included areas of the administrative county of Cork are to be included with the county borough of Cork within the “agglomeration of Cork” as defined in the Environmental Noise Regulations 2006.

Agglomeration of Dublin

The Environmental Noise Regulations 2006 (S.I. No. 140 of 2006), define the “agglomeration of Dublin” as:

- The county borough of Dublin;
- The administrative county of Fingal;
- The administrative county of South Dublin; and
- The administrative county of Dun Laoghaire/Rathdown other than those areas excluded in the First Schedule to the Air Pollution Act 1987 (Marketing, Sale and Distribution of Fuels) Regulations 1998 (S.I. No. 118 of 1998).

The excluded areas of Dún Laoghaire-Rathdown under the Air Pollution Act 1987 (Marketing, Sale and Distribution of Fuels) Regulations 1998 are as follows:

1. The District Electoral Division of Tibradden.
2. That part of the District Electoral Division of Glencullen situated west of an imaginary line drawn as follows:

Commencing at the junction of Slate Cabin Lane and Woodside Road, thence in a south-easterly direction and proceeding along Woodside Road and Ballyedmonduff Road to the county boundary at Glencullen Bridge.

These excluded areas are not included within the “agglomeration of Dublin” as defined in the Environmental Noise Regulations 2006.

Appendix D: Example of Conceptual Data Model for Strategic Noise Mapping

In support of the discussion within Section 6 of this guidance, regarding the development of a data specification, below is an example of a first stage conceptual model of the datasets required for noise mapping using the EC Recommended Interim Methods, namely RMR Interim, ISO 9613 Interim and ECAC Doc 29 Interim, and the adapted UK CRTN method.

Input Requirements for 3D Model Environment

The 3D model environment is required for all noise sources, road, railway, industry or aircraft, and for all areas within agglomeration model areas and near major sources.

Table D.1: Pathway data – defines the environment within which propagation occurs

Attribute	Spatial reference method	Object structure	Elevation type	Reference feature	Height Attribute method	Unit of measurement
Ground Model Spot Heights	Vector	2.5D/3D Points	Absolute	Ground Height	Constant per object	Metre (m)
Ground Model Contour Lines	Vector	2.5D Polylines	Absolute	Ground Height	Constant per object	Metre (m)
Ground Model Break line (including top and bottom embankments)	Vector	3D Polylines	Absolute	Ground Height	Height per vertex	Metre (m)
Ground Cover	Vector	2D Polygons	NA	NA	NA	NA
Building	Vector	2.5D Polygons	Relative	Roof height	Constant per object	Metre (m)
Bridges	Vector	3D Polygons	Absolute	NA	Height per vertex	Metre (m)
Barriers Including noise barriers, retaining walls, stone walls	Vector	2.5D/3D Polylines	Relative or absolute	Barrier height	Constant per object or height per vertex	Metre (m)
Meteorology Wind Direction	Vector	NA	NA	NA	NA	NA
Meteorology Wind speed	NA	NA	NA	NA	NA	m/s
Meteorology Air Temperature	NA	NA	NA	NA	NA	Celsius
Meteorology Relative humidity	NA	NA	NA	NA	NA	%
Meteorology Mean occurrences of favourable conditions in the daytime, evening and night period respectively	NA	NA	NA	NA	NA	p_{day} , p_{evening} , p_{night}
Meteorology local meteorological constant, per period	NA	NA	NA	NA	NA	C_0

Input Requirements for Assessment of Aircraft Noise to ECAC Doc 29 Interim

Tables D.2 and D.3 present a logical model for the source input datasets required to carry out noise mapping using the ECAC Doc 29 Interim methodology.

For each airport to be assessed the following information is typically required per runway:

Table D.2: Airport source data – defines the position of noise sources

Attribute		Spatial reference method	Object structure	Elevation type	Reference feature	Attribute method	Unit of measurement	Range
Runway width		NA	NA	NA	NA	NA	Meters	NA
Runway centre point	Location	NA	NA	NA	NA	NA	Meters or Lat / long	NA
	Elevation	NA	NA	Relative	NA	Constant per object	Metres	NA
Runway end points	Location	NA	NA	NA	NA	NA	Meters or Lat / long	NA
	Elevation	NA	NA	Relative	NA	Constant per object	Metres	NA
Start of roll		NA	NA	NA	NA	NA	Meters or Lat / long	NA
Approach threshold coordinates		NA	NA	NA	NA	NA	Meters or Lat / long	NA
Glide slopes		NA	NA	NA	NA	NA	Degrees	NA
Threshold crossing height		NA	NA	NA	NA	NA	Meters	NA
Route definitions		Vector	Polyline	NA	NA	Constant per object	Metres or Lat / long	NA

For each aircraft to be assessed the following information is typically required per aircraft movement:

Table D.3: Aircraft source data – defines the characteristics of noise sources

Attribute	Spatial reference method	Object structure	Elevation type	Reference feature	Attribute method	Unit of measurement	Range
Number of movements	NA	NA	NA	NA	NA	Per aircraft type	NA
Arrival time	NA	NA	NA	Exit runway onto taxiway	NA	Local time	NA
Aircraft source	NA	NA	NA	Airport code of flight take off	NA	NA	NA
Departure time	NA	NA	NA	Start of roll	NA	Local time	NA
Aircraft destination	NA	NA	NA	Airport code of flight destination	NA	NA	NA
Take off weight	NA	NA	NA	NA	NA	kg	NA
Runway	NA	NA	NA	Runway code	NA	Per movement	NA
Aircraft type	NA	NA	NA	ICAO code	NA	Per movement	NA
Engine and airframe variant	NA	NA	NA	NA	NA	Per movement	NA

Input Requirements for Assessment of Industrial Noise to ISO 9613 Interim

Tables D.4 presents a logical model for the source input datasets required to carry out noise mapping using the ISO 9613 Interim methodology.

Table D.4: Source data – defines the position and characteristics of noise sources

Attribute		Spatial reference method	Object structure	Elevation type	Reference feature	Attribute method	Unit of measurement	Range
Ground type		NA	NA	NA	NA	NA	Hard, soft, mixed	NA
Point source	Location	NA	NA	NA	NA	NA	Metres	NA
	Height	NA	NA	Relative	NA	Constant per object	Metres	NA
Line source	Location	NA	NA	NA	NA	NA	Metres	NA
	Height	NA	NA	Relative	NA	Constant per object	Metres	NA
	Length	Vector	Polyline	NA	NA	Constant per object	Metres	NA
Area source	Location	NA	NA	NA	NA	NA	Metres	NA
	Height	NA	NA	Relative	NA	Constant per object	Metres	NA
	Area	Vector	Polygon	NA	NA	Constant per object	Metres square	NA
Mixed source	Acoustic centre	NA	NA	NA	NA	NA	NA	NA
	Height	NA	NA	Relative	NA	Constant per object	Meters	NA
	Source distribution	Vector	Polyline and Polygon	NA	NA	NA	NA	NA
Directivity		NA	NA	NA	NA	NA	Degree	NA
Sound Power Level (SWL) as overall dB(A) or spectrum per octave or third octave band		NA	NA	NA	NA	NA	dB	NA
Operational Period		NA	NA	NA	NA	NA	Second	NA
Mean Frequency		NA	NA	NA	NA	NA	Hz	NA

Input Requirements for Assessment of Railway Noise to RMR Interim

Tables D.5 presents a logical model for the source input datasets required to carry out noise mapping using the RMR Interim methodology.

Table D.5: Source data – defines the position and characteristics of noise sources

Attribute	Spatial reference method	Object structure	Elevation type	Reference feature	Attribute method	Unit of measurement	Range
Rail centre line geometry	Vector	Polylines	NA	NA	NA	Metre (m)	NA
Train flow per category	NA	NA	NA	NA	NA	NA	NA
Track type/track support structure	NA	NA	NA	NA	NA	NA	NA
Locomotive/carriage type in categories	NA	NA	NA	NA	NA	NA	NA
Speed per category	NA	NA	NA	NA	NA	Km/h	*20-230 km/h
Brake gear activation	NA	NA	NA	NA	NA	NA	NA
Number of carriages	NA	NA	NA	NA	NA	Unit	*1-50 units
Bridge/ballast correction	NA	NA	NA	NA	NA	NA	NA

* Range displayed in the standard.

Input Requirements for Assessment of Road Traffic Noise to adapted UK CRTN

Tables D.6 presents a logical model for the source input datasets required to carry out noise mapping using the adapted UK CRTN methodology.

Table D.6: Source data – defines the position and characteristics of the noise sources

Attribute	Spatial reference method	Object structure	Unit of measurement
Road centreline geometry or carriageway centreline geometry	Vector	Polylines	NA
Road width	NA	NA	M
Light vehicle flow along centreline - day - evening - night	NA	NA	Vehicles/h
Heavy vehicle flow along centreline - day - evening - night	NA	NA	Percentage (%)
Mean traffic speed - day - evening - night	NA	NA	Km/h
Gradient of centreline	NA	NA	Up, down or flat
Surface type	NA	NA	Impervious bituminous, Pervious macadam, Cement concrete.
Surface Texture Depth	NA	NA	mm
Direction of flow	NA	NA	With or against direction of digitisation
Road classifications	NA	NA	Major or non-major and motorway, A, B, C or unclassified

*Range displays in the standard

Input Requirements for Population Exposure, Post Processing and Analysis

The post processing datasets are required for all noise sources, road, railway, industry or aircraft, and for areas within agglomeration model areas and near major sources.

Table D.7: Post processing data – defines the location of population and noise levels

Attribute	Spatial reference method	Object structure	Elevation type	Reference feature	Height Attribute method	Unit of measurement
Building	Vector	2.5D Polygons	Relative	Roof height	Constant per object	Metre (m)
Residential and noise sensitive dwellings	Vector	2D Points	NA	NA	NA	NA
Population statistics per ED	NA	NA	NA	NA	NA	People
Electoral Divisions	Vector	Polygon	NA	NA	NA	NA
Noise level results	Vector	3D Points	Relative	Receptor height	Constant per object	dB
GeoDirectory	NA	NA	NA	Buildings table	NA	NA
CSO SAPS	NA	NA	NA	Persons in private households by type of household, and number of private households by type of accommodation	NA	NA

Appendix E: Guidelines on the Information to be contained in report on Strategic Noise Mapping

The report on Strategic Noise Mapping must at least include information to address the requirements of Annex IV of the Directive (see Box 2 and Section 2 of this guidance), and provide the information required for the Supplementary Report for DF4 (and DF8) of the ENDRM 2007. In addition the Strategic Noise Mapping Report should include information on the noise mapping process and any known issues or limitations encountered during the assessment of noise levels. In addition, the NMB shall prepare a summary of the Strategic Noise Mapping Report (not exceeding 10 pages in length) which meets the requirements of the ENDRM 2007 Supplementary Report content.

The following is a possible framework setting out the information to be contained within a strategic noise mapping report. Any items not specifically mentioned in this framework, but which are mentioned in the main body of the guidance document, the Regulations or Directive are still to be included.

Executive Summary

Table of Contents

1. Introduction

- 1.1 Background
- 1.2 Noise and Effects of Noise
- 1.3 Purpose and Scope of the END Directive
- 1.2 Purpose and Scope of the Regulations
- 1.4 Roles and Responsibilities of designated bodies
- 1.5 Key Phases
 - Identification of areas required to be mapped.
 - Preparation of strategic noise maps
 - Publication of extent of noise impact
 - Development of the noise action plans.
 - Implementation of the plans (5 year time scale).

2. Overview of Strategic Noise Mapping Process

- 2.1 Project review
 - Roles and responsibilities of parties undertaking the mapping
 - Project timetable etc
- 2.2 Process overview
 - Description of technical stages of project

3. Review of First Round Maps (if applicable)

- 3.1 Developments since the 1st round

4. Define Areas to be Mapped

- 4.1 Requirements of Directive
- 4.2 Requirements of Regulations
- 4.3 Approach to Definition of Mapping Extents
- 4.4 Maps and Statistics Describing Area to be Mapped
- 4.5 Approach to Definition of Model Extents including buffer
- 4.6 Maps and Statistics Describing Area to be Modelled

5. Define Noise Calculation Method

- 4.1 Requirements of Directive
- 4.2 Requirements of Regulations
- 4.3 Factors influencing selection of assessment method
- 4.4 Confirmation of method of assessment along with any required adaptations

5. Develop Dataset Specification

- 5.1 Input Data Requirements of Calculation Method – Conceptual Model
- 5.2 Data specification requirements of noise mapping software – Logical model
- 5.3 Data specification requirements of GIS – Physical model
- 5.4 Data specification for noise mapping – Database design

6. Produce Datasets

- 6.1 Identify data sources
- 6.3 Identify gaps, anomalies and uncertainties
- 6.4 Field survey work to reduce data gaps

7. Develop Noise Model Datasets

- 7.1 Develop input datasets to meet specification
 - Document data manipulation required
- 7.2 Document use of WG-AEN GPG v2 Toolkits and assumptions to fill data gaps
- 7.3 Document data checks and QA

8. Noise Level Calculations

- 8.1 Documentation of noise mapping software system
 - Software specification
 - Calculation settings
 - Use of efficiency settings

8.2 Approach to calculations

- Test calculations
- Any validation against measurements
- Use of multiple client, or tiling of model, and how model was split into sections

8.3 Results of noise calculations

9. Post Processing and Analysis

9.1 Post processing of noise level results

- Document any interpolation or manipulation of results required
 - Such as receptors within buildings
 - Any edge matching issues with tiles of results
 - Calculation of L_{den} from L_d , L_e and L_n
- Document means of generating 5dB noise level bands
- Document means of generating 5dB noise level band contours, if applicable

9.2 Area exposure assessment

- Document approach to area analysis
- Results of area analysis

9.3 Dwellings exposure assessment

- Document development of dwellings location dataset
- Document approach to dwellings analysis
- Results of dwellings analysis

9.4 Population exposure assessment

- Document development of population distribution dataset
- Document approach to population exposure analysis
- Results of population exposure assessment

10. Summary and Conclusions

Appendix A:

Glossary of acoustic and technical terms

Appendix B:

Bibliography and references

Appendix C:

Strategic noise map(s) – See Appendix J for recommended colour scheme for display of noise level bands.

Appendix F: Extract from ENDRM section 5.2 Reporting Major Road Information

5.2.5 Data Flow 4 (and 8) – Noise Mapping Results (page 45 of RM2007 HandBook.doc)

Name	Data Flow 4 (and 8), Statistical data - Major Roads
Reporting Naming Convention	<CountryCode>_<Reporting Entity Unique Code>_DF4_MRoad (or <CountryCode>_<Reporting Entity Unique Code>_DF8_MRoad for the second implementation and thereafter)
Short Description	The Major Roads, Data Flow 4 (and 8) table allows Member States to provide noise map related information and statistics for their major road network as defined in Data Flow 1 (and 5).
Methodology for obtaining data	<p>European Parliament and Council Directive 2002/49/EC, relating to the assessment and management of environmental noise requires data and reports from Member States to be supplied to the European Commission.</p> <p>In Data Flow 4 (and 8), Member States must report strategic noise map related data. This data specification details the table structure for Member States to supply this information. For major roads, one single set of results data is required for each reporting region. The table detailed in this specification must contain details of the associated written report, which must be supplied electronically with the submission.</p> <p>The table must be supplied with supporting xml metadata compliant with the current European Environment Agency, Dublin Core Metadata Element Set (http://cr.eionet.europa.eu/dcmes.jsp).</p>

Columns in table:

Field Name	Field Definition	Methodology	Data Specification
Reporting Entity Unique Code	A single character Unique code assigned by the Member State to each Reporting Entity.	The same code as defined in DF0_MRoad	Datatype: string Minimum size: 1 Maximum size: 1 Minimum value: a Maximum value: z
Numbers Exposed to Lden 55-59	The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to values of Lden between 55-59 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 60-64	The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to values of Lden between 60-64 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lden 65-69	The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to values of Lden between 65-69 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 70-74	The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to values of Lden between 70-74 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden >75	The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to values of Lden >75 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 55-59 with Special Insulation	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation that are exposed to values of Lden between 55-59 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 60-64 with Special Insulation	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation that are exposed to values of Lden between 60-64 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 65-69 with Special Insulation	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation that are exposed to values of Lden between 65-69 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lden 70-74 with Special Insulation	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation that are exposed to values of Lden between 70-74 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden >75 with Special Insulation	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation that are exposed to values of Lden >75 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 55-59 with a Quiet Façade	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden between 55-59 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 60-64 with a Quiet Façade	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden between 60-64 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 65-69 with a Quiet Façade	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden between 65-69 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 70-74 with a Quiet Façade	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden between 70-74 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lden >75 with a Quiet Façade	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden >75 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 50-54	The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to values of Lnight between 50-54 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 55-59	The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to values of Lnight between 55-59 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 60-64	The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to values of Lnight between 60-64 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 65-69	The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to values of Lnight between 65-69 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight >70	The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to values of Lnight >70 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 50-54 with Special Insulation	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 50-54 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lnight 55-59 with Special Insulation	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 55-59 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 60-64 with Special Insulation	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 60-64 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 65-69 with Special Insulation	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 65-69 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight >70 with Special Insulation	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation, that are exposed to values of Lnight >70 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 50-54 with a Quiet Façade	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 50-54 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 55-59 with a Quiet Façade	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 55-59 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Night 60-64 with a Quiet Façade	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation, that are exposed to values of Night between 60-64 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Night 65-69 with a Quiet Façade	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation, that are exposed to values of Night between 65-69 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Night >70 with a Quiet Façade	Where available, the estimated total number of people (in hundreds) living outside agglomerations in dwellings that have special insulation, that are exposed to values of Night >70 dB(A), 4 m above the ground and on the most exposed façade.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Area exposed to Lden > 55 (including agglomerations)	The estimated total area (in km ²) exposed to values of Lden higher than 55 dB. The area must include agglomerations.		Minimum size: 0 Datatype: float Unit: km ²
Area exposed to Lden > 65 (including agglomerations)	The estimated total area (in km ²) exposed to values of Lden higher than 65 dB. The area must include agglomerations.		Minimum size: 0 Datatype: float Unit: km ²
Area exposed to Lden > 75 (including agglomerations)	The estimated total area (in km ²) exposed to values of Lden higher than 75 dB. The area must include agglomerations.		Minimum size: 0 Datatype: float Unit: km ²
Numbers exposed to Lden > 55 (including agglomerations)	The estimated total number of people (in hundreds) exposed to values of Lden higher than 55 dB. The number of people must include agglomerations.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers exposed to Lden > 65 (including agglomerations)	The estimated total number of people (in hundreds) exposed to values of Lden higher than 65 dB. The number of people must include agglomerations.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers exposed to Lden > 75 (including agglomerations)	The estimated total number of people (in hundreds) exposed to values of Lden higher than 75 dB. The number of people must include agglomerations.	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Dwellings exposed to Lden > 55 (including agglomerations)	The estimated total number of dwellings (in hundreds) exposed to values of Lden higher than 55 dB. The number of dwellings must include agglomerations.	The number of dwellings, in hundreds and rounded to the nearest hundred (for example 77,598 in this case is equivalent to 776 hundred).	Datatype: integer Unit: hundreds
Dwellings exposed to Lden > 65 (including agglomerations)	The estimated total number of dwellings (in hundreds) exposed to values of Lden higher than 65 dB. The number of dwellings must include agglomerations.	The number of dwellings, in hundreds and rounded to the nearest hundred (for example 77,598 in this case is equivalent to 776 hundred).	Datatype: integer Unit: hundreds
Dwellings exposed to Lden > 75 (including agglomerations)	The estimated total number of dwellings (in hundreds) exposed to values of Lden higher than 75 dB. The number of dwellings must include agglomerations.	The number of dwellings, in hundreds and rounded to the nearest hundred (for example 77,598 in this case is equivalent to 776 hundred).	Datatype: integer Unit: hundreds
Reference to Maps	The map title, the author/publisher and date of production.	An electronic copy of the Data Flow 4 (and 8) maps for Major Roads must be supplied electronically with the submission to the European Commission using the naming convention, '<Country Code>_<Reporting Entity Unique Code>_DF4_MRoad_map'.	Datatype: string Minimum size: 1 Maximum size: 255
Computation and measurement methods report details	The full name of the report, the author/publisher and date of production.	An electronic copy of the Data Flow 4 (and 8) report detailing limit values for Major Roads must be supplied electronically with the submission to the European Commission using the naming convention, '<Country Code>_<Reporting Entity Unique Code>_DF4_MRoad'.	Datatype: string Minimum size: 1 Maximum size: 255

Appendix G: Extract from ENDRM section 5.5 Reporting Agglomeration Information

5.5.9. Data Flow 4 (and 8) – Noise Mapping Results: Road (page 124 of RM2007 HandBook.doc)

Name	Data Flow 4 (and 8), Statistical data - Agglomeration Roads
Reporting Naming Convention	<CountryCode>_<Reporting Entity Unique Code>_DF4_Agg_Road (or <CountryCode>_<Reporting Entity Unique Code>_DF8_Agg_Road for the second implementation and thereafter)
Short Description	The Agglomeration Roads, Data Flow 4 (and 8) table allows Member States to provide noise map related information and statistics for noise from roads inside agglomerations as defined in Data Flow 1 (and 5).
Methodology for obtaining data	<p>European Parliament and Council Directive 2002/49/EC, relating to the assessment and management of environmental noise requires data and reports from Member States to be supplied to the European Commission.</p> <p>In Data Flow 4 (and 8), Member States must report strategic noise map related data. For Agglomerations, there are five tables that allow the information required by Data Flow 4 (and 8) to be reported. For Agglomeration roads, one single set of results data is required for each Agglomeration. The table detailed in this specification must contain details of the associated written report, which must be supplied electronically with the submission.</p> <p>The table must be supplied with supporting xml metadata compliant with the current European Environment Agency, Dublin Core Metadata Element Set (http://cr.eionet.europa.eu/dcmes.jsp).</p>

Columns in table:

Field Name	Field Definition	Methodology	Data Specification
Unique Agglomeration ID	Unique Agglomeration ID assigned by the reporting entity to each agglomeration.	The same code as defined in DF1_Agg (or DF5_Agg)	Datatype: string Minimum size: 6 Maximum size: 14
Numbers Exposed to Lden 55-59	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lden between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 60-64	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lden between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lden 65-69	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lden between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 70-74	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lden between 70-74 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden >75	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lden >75 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 55-59 from Major Source	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lden from a Major Source between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 60-64 from Major Source	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lden from a Major Source between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 65-69 from Major Source	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lden from a Major Source between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 70-74 from Major Source	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lden from a Major Source between 70-74 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lden >75 from Major Source	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lden from a Major Source >75 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 55-59 with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation that are exposed to values of Lden between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 60-64 with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation that are exposed to values of Lden between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 65-69 with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation that are exposed to values of Lden between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 70-74 with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation that are exposed to values of Lden between 70-74 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden >75 with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation that are exposed to values of Lden >75 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lden 55-59 from Major Source with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation that are exposed to values of Lden from a Major Source between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 60-64 from Major Source with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation that are exposed to values of Lden from a Major Source between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 65-69 from Major Source with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation that are exposed to values of Lden from a Major Source between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 70-74 from Major Source with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation that are exposed to values of Lden from a Major Source between 70-74 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden >75 from Major Source with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation that are exposed to values of Lden from a Major Source >75 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 55-59 with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lden 60-64 with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 65-69 with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 70-74 with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden between 70-74 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden >75 with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden >75 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 55-59 from Major Source with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden from a Major Source between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 60-64 from Major Source with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden from a Major Source between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lden 65-69 from Major Source with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden from a Major Source between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden 70-74 from Major Source with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden from a Major Source between 70-74 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lden >75 from Major Source with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have a quiet façade, that are exposed to values of Lden from a Major Source >75 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 50-54	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lnight between 50-54 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 55-59	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lnight between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 60-64	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lnight between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lnight 65-69	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lnight between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight >70	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lnight >70 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 50-54 from Major Source	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lnight from a Major Source between 50-54 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 55-59 from Major Source	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lnight from a Major Source between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 60-64 from Major Source	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lnight from a Major Source between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 65-69 from Major Source	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lnight from a Major Source between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight >70 from Major Source	The estimated total number of people (in hundreds) living in agglomerations in dwellings that are exposed to values of Lnight from a Major Source >70 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lnight 50-54 with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 50-54 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 55-59 with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 60-64 with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 65-69 with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight >70 with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight >70 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 50-54 from Major Source with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight from a Major Source between 50-54 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lnight 55-59 from Major Source with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight from a Major Source between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 60-64 from Major Source with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight from a Major Source between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 65-69 from Major Source with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight from a Major Source between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight >70 from Major Source with Special Insulation	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight from a Major Source >70 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 50-54 with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 50-54 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 55-59 with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lnight 60-64 with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 65-69 with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight >70 with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight >70 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 50-54 from Major Source with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight from a Major Source between 50-54 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 55-59 from Major Source with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight from a Major Source between 55-59 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight 60-64 from Major Source with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight from a Major Source between 60-64 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds

Numbers Exposed to Lnight 65-69 from Major Source with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight from a Major Source between 65-69 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Numbers Exposed to Lnight >70 from Major Source with a Quiet Façade	Where available, The estimated total number of people (in hundreds) living in agglomerations in dwellings that have special insulation, that are exposed to values of Lnight from a Major Source >70 dB(A), 4 m above the ground and on the most exposed façade	The number of people, in hundreds and rounded to the nearest hundred (for example 159,432 in this case is equivalent to 1594 hundred).	Datatype: integer Unit: hundreds
Computation and measurement methods report details	The full name of the report, the author/publisher and date of production.	An electronic copy of the Data Flow 4 (and 8) report detailing computation and measurement methods for Agglomeration Roads must be supplied electronically with the submission to the European Commission using the naming convention, '<Country Code>_<Reporting Entity Unique Code>_DF4_Agg_Road'.	Datatype: string Minimum size: 1 Maximum size: 255

Appendix H: Extract from ENDRM Section 6.1 Reporting of Supplementary Information

A single Supplementary Report should be submitted for each type of noise source (Major Roads, Major Rail, Major Airport and Agglomerations) within each of the geographical areas defined in Data Flow 0.

The reports should be submitted in Microsoft Word document (.doc) format. The file should be named in accordance with the naming convention defined in the relevant data specification.

Further details of the content required within each of the Supplementary Reports is provided below.

6.1.2 Data Flow 4 (and 8), Statistical Data - Supplementary Report

The Supplementary Report associated with Data Flow 4 (and 8) should provide information regarding the computation and measurement methodologies used to generate the statistics being reported in this Data Flow. The opportunity to provide supporting information regarding the robustness of the results also exists within this report. Issues that should be reported include:

- Confirmation of the definition of the time periods used for Day, Evening and Night;
- Stating whether the results have been derived from computation or measurement;
- The computation methods used;
- If national computation methods have been used that have had to be adapted, as described in paragraph 2.1 of Annex II, information regarding the adaptation should be provided, and should include, as required in Art 6(2), a demonstration that the results are equivalent to the results that would be obtained with the methods set out in paragraph 2.2 of Annex II of the END;
- If measurements have been used, the measurement method should be defined and it should be stated whether it has been adapted in accordance with Annex II, paragraph 3 of the END;
- The contour maps required by paragraph 2.7 of Annex VI; and
- For Agglomerations, an explanation of the extent of the sources incorporated in the mapping should be given for roads, railways, airports and industry.

The following issues may also be covered in this report. The provision of this information will enable an understanding to be gained of the robustness of the results.

- If Interim methods have been used, information about any adaptations to the methods;
- For calculation methods, the software used to carry out the calculations and the version of the software;
- For calculation methods, information regarding the input datasets used in the noise models and the methodologies employed to derive the input datasets;
- For calculation methods, information regarding the extent to which the WG-AEN GPG v2 Toolkits has been used to determine the input data and the likely accuracy of the result. Information may also include estimates of the error and uncertainty of the results;

- For calculation methods, information on the extent to which the noise level results have been validated, and
- The datasets and methodology used to derive the population exposure statistics.

Appendix I: Extract from ENDRM Section 6.2 Reporting of Metadata

Information submitted to the EC within the ENDRM will take the form of data tables, written reports and spatial (GIS) datasets. This information will be submitted electronically to the EC and will therefore need to be accompanied with appropriate metadata to support data management. Due to the different types of data to be submitted, 2 different metadata specifications will be required.

- Data Flow tables such as Excel spreadsheets and Supplementary Reports in Word format should be supported with metadata complying with the EEA Reportnet Metadata Specification.
- Spatial datasets such as a shapefile should be supported with metadata complying with the EEA GIS metadata specifications.

Further details of these metadata standards and their application are set out below.

6.2.1 Reportnet Metadata Specification

The metadata specifications used within the Reportnet system comprise a simple profile of elements based around the widely used Dublin Core Metadata Specification. The specification supports the Reportnet system by enabling information aspects such as the originating organisation, the document's drafting language and creation date to be recorded.

The Reportnet Metadata Specifications can be viewed at <http://cr.eionet.europa.eu/dcmes.jsp>

6.2.2 Geospatial Metadata Specification

Spatial datasets require a different metadata profile to support the technical information associated with geographical data. Besides information on the supplying organisation name, contact person name, telephone, email address, url of the organisation responsible for the delivered geospatial data further technical information should also be provided.

This should include the original title of the dataset, a short abstract about the content of the data and a version number. It is also valuable to know if the data is free to be used by anyone or if there are any constraints. Please provide the terms of use or a hyperlink if they are published on the internet. It is also important to provide information about the scale of the data in the delivery (e.g. 1:100 000) and/or geographic accuracy (e.g. 25 m). Information on datum and projection parameters should also be provided here if not already included in the data format.

Information about datum and projection is essential for combining the different national deliveries into a European dataset. This information is sometimes embedded in the file format, e.g. as a .prj file as part of the shapefile format. If the datum and projection information is not embedded in the file format it should be provided as part of the metadata.

Information for national experts coordinating national geospatial data deliveries is available at <http://www.eionet.europa.eu/gis/nationaldeliveries>

A metadata checklist which sets out the minimum specification for metadata reported by Member States for national geospatial data deliveries is available at <http://www.eionet.europa.eu/gis/nationaldeliveries/natdelmetadata.rtf>

The EEA's full metadata specification for spatial datasets and tools to support the management of metadata are available at

<http://www.eionet.europa.eu/gis/geographicinformationstandards.html>

Further guidelines on the use of GIS including technical standards and specifications can be referenced from the EEA Guide to Geographical data and Maps, which is available at

<http://www.eionet.europa.eu/gis>

A summary of the metadata specification which are required to be used with particular ENDRM Data Flows are set out in the table below.

Data Flow File/Dataset	Report File Type	Metadata Specification to be used
DF0 Dataset	Spatial dataset (e.g. .shp)	GIS Metadata
DF1 (and 5) Table <ul style="list-style-type: none"> • M Road (Optional) • M Rail (Optional) and • M Airports 	Tabular (e.g. .xls)	Reportnet
DF1 (and 5) Dataset <ul style="list-style-type: none"> • M Road (Optional) • M Rail (Optional) and • Agglomerations 	Spatial dataset (e.g. .shp)	GIS Metadata
DF2 Table	Tabular (e.g. .xls)	Reportnet
DF3 Table	Tabular (e.g. .xls)	Reportnet
DF3 Supplementary Report	Document (e.g. .doc)	Reportnet
DF4 (and 8) Table	Tabular (e.g. .xls)	Reportnet
DF4 (and 8) Supplementary Report	Document (e.g. .doc)	Reportnet
DF6 (and 9) Table	Tabular (e.g. .xls)	Reportnet
DF6 (and 9) Supplementary Summary Report	Document (e.g. .doc)	Reportnet
DF7 (and 10) Table	Tabular (e.g. .xls)	Reportnet
DF7 (and 10) Supplementary Summary Report	Document (e.g. .doc)	Reportnet

Appendix J: Recommended Colour Scheme for Presentation of Noise Level Bands

The colour bands below are recommended for use in the production of noise level contour maps. The colour bands are based upon those set out within ISO 1996-2 (1987). Furthermore, it is recommended that the colour bands are made semi-transparent such that the base mapping below remains partly visible such that orientation and location remains possible.

Table J-1: Recommended noise Level Bands for Maps of L_{den}












Noise zone dB	Colour	Code	Red	Green	Blue
< 55	Transparent				
55 to 59	Orange 	# FF 66 00	255	102	0
60 to 64	Cinnabar 	# FF 33 33	255	51	51
65 to 69	Carmine 	# 99 00 33	153	0	51
70 to 74	Lilac red 	# AD 9A D6	173	154	214
≥75	Blue 	# 00 00 FF	0	0	255

Table J-2: Recommended Noise Level Bands for Maps of L_{night}

Noise zone dB	Colour	Code	Red	Green	Blue
<45	Transparent				
45 to 49	Yellow 	# FF FF 00	255	255	0
50 to 54	Ochre 	# FF C7 4A	255	199	74
55 to 59	Orange 	# FF 66 00	255	102	0
60 to 64	Cinnabar 	# FF 33 33	255	51	51
65 to 69	Carmine 	# 99 00 33	153	0	51
≥70	Lilac red 	# AD 9A D6	173	154	214

Notes:

1. It is recommended that class boundaries be at .00, e.g. 55 to 59 is actually 55.00 to 59.99;
2. The assessment and mapping of L_{night} values in the 45 to 49dB band is optional under the Regulations; if results are not available, or are chosen not to be mapped, below 50dB L_{night} , the maps should show levels <50dB as transparent.