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IDENTIFYING NOISE ACTION PLAN PRIORITY LOCATIONS IN IRELAND

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ABSTRACT

The Environmental Protection Agency (EPA) in Ireland published a guidance note for noise action planning in 2009, to support the Local Authorities designated as Action Planning Authorities (APAs) under the Environmental Noise Regulations (ENR). An update to the guidance note was published in June 2018, in support of the Round 3 noise action plans (NAPs). Ahead of the Round 4 NAPs, the EPA extensively revised the draft guidance note; aligning with the 2018 Regulations, implementing the revisions to the Environmental Noise Directive (END), including Annex II (CNOSSOS-EU as amended) and Annex III (harmful effects). The noise action plans are to be drawn up on the basis of the results of the strategic noise mapping. As there are no statutory noise limit values in Ireland, the EPA developed other relevant criteria for identifying priorities, and the most important areas, exposed to road and railway noise to be addressed within the NAPs. The paper provides an overview of the methodology developed to identify priority important areas (PIA) to be assessed by APAs during implementation of the Round 4 NAPs. The methodology uses a combination of GIS analysis, and localised decision making within the APA to provide a nationally consistent, and locally responsive approach.

Keywords: *environmental noise, action plan, priority actions, noise planning, environmental noise directive*

1. INTRODUCTION

Environmental noise is the second biggest environmental cause of health problems in the EU, after air pollution (the fine particulate matter in air), according to the World Health Organisation (WHO), and the European Environment Agency (EEA). Prolonged exposure to noise can lead to serious illnesses including: cardiovascular diseases; reduced cognitive performance in children; severe annoyance, which is a form of stress; and sleep disturbance.

The Environmental Noise Directive (END) is the main pan-European regulatory framework established to manage environmental noise, through harmonised procedures to assess levels of noise exposure, assess the impact on human health, and prepare noise action plans. The END is transposed into Irish law through the European Communities (Environmental Noise) Regulations 2018 (amended) (the Regulations) [1].

The Environmental Protection Agency (EPA) is the designated national authority for the purposes of the Regulations and is to exercise general supervision over the functions and actions of noise mapping bodies and action planning authorities, and to provide guidance or advice, where necessary.

The EPA has developed guidance for strategic noise mapping in 2009, 2011 and fully revised for Round 4 using the CNOSSOS-EU assessment methods between 2022 and 2024 [2]. The EPA also developed guidance on noise action planning published in July 2009 [3], with updated sections published for round 3 in June 2018 [4]. The guidance was revised for Round 4 and the draft guidance was issued to the Action Planning Authorities (APA) in December 2024 [5].

As there are no statutory noise limit values in Ireland, the EPA developed other relevant criteria for identifying priorities, and the most important areas, exposed to road and railway noise to be addressed within the noise action plans (NAPs).

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The 2009 guidance on noise action planning recommended the use of a noise score matrix to help Action Planning Authorities (APAs) identify priority locations. During the revision of the NAP guidance for Round 4 the matrix approach was reviewed and a revised methodology developed to identify priority important areas (PIAs) to be assessed by APAs during implementation of the Round 4 NAPs.

2. REQUIREMENTS

The Regulations defines an “action plan” as a plan designed for the purpose of managing noise issues and their effects, including noise reduction if necessary. Local Authorities are designated as Action Planning Authorities (APA) under the Regulations, and have a statutory responsibility to make noise action plans, consult with the public, and report to the EPA on all action taken under each action plan in the previous 12 months.

The aims and objectives of the Directive state that the adoption of action plans, based upon noise-mapping results, should be concerned with:

“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.”

Under the Regulations, Action Planning Authorities (APAs) are to determine the measures to be included within the noise action plans, and:

“Each action plan or revision of an action plan shall address priorities which—

- (i) *may be identified on the basis of exceedances of any relevant noise limit value or other relevant criteria established by the Agency in accordance with subparagraph (3), and*
- (ii) *shall, in the first instance, address the most important area or areas, as the case may be, established by strategic noise mapping.”*

The noise actions plans are to be drawn up on the basis of the results of the strategic noise mapping of major roads, major railways, major airports and agglomerations as defined in the Regulations, which has previously been completed by the designated Noise Mapping Bodies (NMBs). The strategic noise maps provide graphical and statistical data on the exposure of people, dwellings and areas to noise.

The Regulations require that “priorities” and “the most important area or areas” are to be addressed.

Additionally, the EPA recommended that noise action plans have regard to Policy Objective 65 from the National Planning Framework 2040, which states:

“Promote the pro-active management of noise where it is likely to have significant adverse impacts on health and quality of life and support the aims of the Environmental Noise Regulations through national planning guidance and Noise Action Plans.”

In May 2021 the EU launched the Zero Pollution Action Plan (ZPAP) with a vision for 2050 that air, water and soil pollution is reduced to levels no longer harmful to health and natural ecosystems. The targets set to be achieved by 2030 include *“reducing the share of people chronically disturbed by transport noise by 30%”*, compared to 2017. In support of ZPAP, the EU PHENOMENA project was undertaken to identify cost-effective noise mitigation measures which may help competent authorities to achieve noise reductions across large parts of the exposed population.

The previous version of the EPA guidance notes on noise action planning, from 2009 to 2018, focused noise mitigation measures on locations exposed to high levels of noise, however in the context of the ZPAP it was determined that a different approach would be required to help support APAs actions to reduce the overall health effects of environmental noise. The aim of the revised approach recommends the identification of Priority Important Areas (PIAs). This approach is to support the aspirations of ZPAP by providing for noise reductions to larger numbers of exposed residents.

3. RATIONALE

The objective of the Regulations is to:

“avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise”. Where environmental noise is *“unwanted or harmful outdoor sound created by human activities”*.

The results of the strategic noise mapping provide information on the assessed noise levels at all noise sensitive properties within the assessment area, along with an estimate of the number of inhabitants.

The NMBs *“shall calculate the harmful effects in accordance with the Second Schedule”* of the Regulations. Meanwhile, the APAs *“shall estimate the expected reduction in the harmful effects of noise exposure to the population as a result of the mitigation measures contained in their Noise Action Plans”*. The Second Schedule of the Regulations sets out a mandatory assessment of the harmful





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effects of environmental noise using the dose-response relationships set out in Commission Directive (EU) 2020/367 [6] and transposed under S.I. 663/2021 [7], replacing Annex III of the END.

The European Commission, on its Environmental Noise Directive webpage, outlines that the harmful effects assessment methods in *'Annex III of the Environmental Noise Directive describes the methods for calculating the burden of disease caused by exposure to specific noise levels. The methods include dose-effect relations for a set of health endpoints such as cardiovascular disease, annoyance and sleep disturbance. Annex III was revised in 2020 following the latest scientific review of the health effects of noise that is being performed by the WHO.'* Box 2 'Impact of the Guidelines at EU level' in the joint WHO and EEA briefing [9] provides details on the where Annex III originated from and its links to WHO guidelines [10]. The results of the strategic noise mapping, including the harmful effects, may then be used to identify important areas [IAs] where long term noise exposure to noise from transport infrastructure is likely to produce negative health effects on the exposed population. This would be all areas exposed above the outdoor noise levels set out within WHO guidelines [10-12].

The main purpose of the WHO guidelines is to provide recommendations for protecting human health from exposure to environmental noise originating from various sources. They provide public health advice underpinned by evidence, which is essential to drive policy action that will help to protect communities from the adverse effects of noise. The WHO ENG 2018 guidelines reviewed the pertinent literature in order to incorporate significant research undertaken in the area of environmental noise and health since the *Community Noise Guidelines* (1999) [11] and *Night Noise Guidelines for Europe* (2011) [12] were issued. The significant health impacts of noise are most likely to be underestimated, with WHO evidence demonstrating effects from noise levels below the thresholds that countries report against under the Environmental Noise Directive.

The WHO Environmental Noise Guidelines (ENG 2018) formulated recommendations based on the available evidence, and exposure values based on a relevant risk increase of adverse health effects. Thus, the 2018 guideline values define an exposure level at which effects certainly occur. Furthermore, the WHO developed dose-response relationships for the assessment of health effects due to chronic long-term exposure to environmental noise from roads, railways and aircraft. These dose-response relationships have subsequently been adopted by the EU as Annex III of the END as set out in the Second Schedule of

the Regulations, which sets out methodologies to be used for the assessment of three harmful effects:

- Ischaemic heart disease due to road traffic noise, and
- High annoyance and high sleep disturbance due to road, railway and aircraft noise.

The WHO definition of health is *"a state of complete mental, physical and social well-being"*. In addition, noise annoyance in this field means a feeling of displeasure, nuisance, disturbance or irritation caused by a specific sound, and in the context of the WHO guidelines and END it refers to long-term (chronic) noise annoyance, rather than just a temporary irritation. The WHO acknowledge that there are uncertainties in the quantification of health impacts from a range of factors, including: in their own recommendations; the modelling of noise exposure; transferability of exposure response functions to locations beyond where they were studied. However, they concluded that the recommended values provide an acceptable estimate of the average response to certain noise levels in Europe.

4. OVERVIEW OF METHODOLOGY

Following consultation with the NMBs and APAs the EPA developed relevant criteria for action plan priorities, recommended as a three-step approach to identify one or more of these priorities due to exposure to noise from roads and railways:

- **Step 1: Important Areas (IA)** – these are locations exposed to environmental noise which may be harmful to human health, such as high annoyance, above the relevant thresholds with reference to the WHO 2018 guidelines on road and railway noise;
- **Step 2: Most Important Areas (MIA)** – these locations are a sub-set of Important Areas where the health effects are highest, typically through a product of noise exposure levels and the number of people exposed to noise;
- **Step 3: Priority Important Areas (PIA)** – where appropriate and relevant to the individual local authority between 5 and 10 MIAs, or groups of similarly affected MIAs, which are identified by the APAs as those which will be addressed during the implementation of the Noise Action Plan (NAP).





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5. IDENTIFYING MOST IMPORTANT AREAS (MIAs) – ROADS AND RAILWAYS

The END requires that:

*“The measures within the plans are at the discretion of the competent authorities, but should notably **address priorities** which may be identified by the **exceeding of any relevant limit value or by other criteria** chosen by the Member States and **apply in particular to the most important areas** as established by strategic noise mapping.”*

As there are no statutory noise limit values in Ireland, the EPA has developed other relevant criteria for identifying priorities, and the most important areas, exposed to road and railway noise to be addressed within the noise action plans.

While the below method sounds complex, it can be automated in a few steps within modern GIS (geographical information system) software, resulting in a graphical map which effectively shows the relative number of people highly annoyed due to noise, as shown in Figure 1 below.

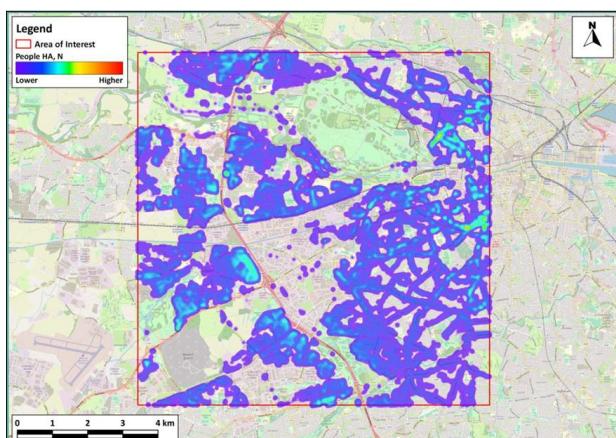


Figure 1. Heat map of density of people highly annoyed due to road traffic noise above 53 dB L_{den}

The results of the strategic noise mapping include noise levels calculated around the facades of noise sensitive buildings, and an estimate of the number of dwellings and people in dwellings within each residential building.

The assignment of population to the calculated noise levels is set out within Annex II of the END (CNOSSOS-EU) and provides building level statistics across the assessment area. Following the method in Annex II of the END, the harmful effects due to noise may also be statistically assessed at the centre point of each building location. For example, the number of people highly annoyed, due to road traffic noise.

It is important to note that this is a statistical approach across the whole population covered by the noise maps and should not be considered to be an accurate assessment of the possible health effects at any specific building. The WHO recommended dose-response curves were derived from meta-analysis of a large number of studies and are considered representative across the overall population within the study.

The point dataset of the number of people highly annoyed is then interpolated to generate a raster heatmap, using a quadratic weighted circular neighbourhood around each point. The heatmap process only includes important areas above the WHO guideline levels, and is generated on a 100 metre radius, which generates 100 m² raster cells.

From the heatmap it is then possible to identify the most important areas (MIAs), which are those IAs with the largest concentration of people highly annoyed due to noise. This aims to identify locations where noise mitigation measures may have a positive effect on the quality of life for a large number of people. Using a criterion of 15 or more people highly annoyed per 100 m², the MIAs (delineated as polygons) for an example area are shown in Figure 2 below.

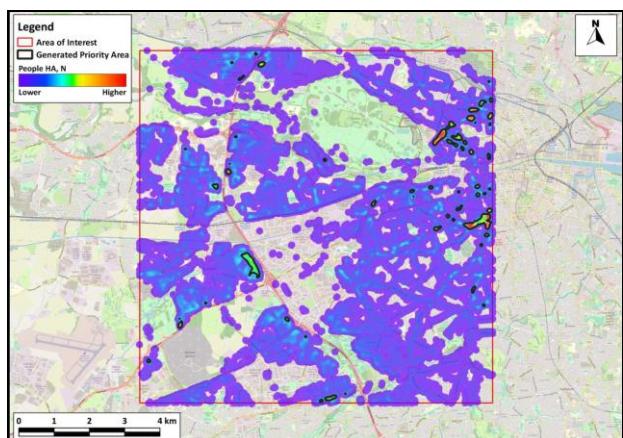


Figure 2. Most Important Areas (MIAs) highlighted (15 people per 100 m² criterion)

The criterion of 15 or more people per 100 m² has been found to be appropriate in the main urban areas within agglomerations. For edge of urban, or rural, locations it may be found that very few MIAs are identified based on this criterion. In this situation it is recommended that the criterion is reduced to 10, or even 7.5, in order to ideally identify at least 15 to 20 MIAs within the region covered by strategic noise mapping.





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The recommended process aims to identify areas with high levels of health impact, due to both noise exposure levels and population density. This is designed to support aims of the EU Zero Pollution Action Plan and provide noise reduction, and associated reductions in health effects, for groups of the population.

It is accepted that this may result in some locations with similar or even higher noise exposure levels and lower levels of population density not being identified as MIAs. It is within the discretion of the APAs to identify specific locations with ongoing noise problems as MIAs, or PIAs, if the automated process does not identify them, but this alternative method of designating PIAs must be backed up with well-grounded evidence in order that comparisons can be made at a Regional/National Level.

6. IDENTIFYING PRIORITY IMPORTANT AREAS (PIAs) – ROADS AND RAILWAYS

The recommended process described in Section 5.2 above is expected to identify a range of most important areas (MIAs), and there are likely to be more identified than it would be possible to address within the current noise action plan lifecycle. It is therefore the task of each Local Authority to select their Priority Important Areas (PIAs), informed by the list of most important areas.

The MIAs are described as areas within the map, and the GIS may be used to develop a series of statistics about each of these MIAs, for example:

- Noise source identifying the Most Important Area, i.e., railways or roads
- Area (m²)
- Total population
- Number of people highly annoyed (HA)
- Number of people highly sleep disturbed (HSD)
- Population increased risk to ischaemic heart disease (IHD)
- Number of dwellings
- Population noise exposure above END threshold values:
 - road traffic noise exposure in 5 dB bands (L_{den} 55 - >75 dB, L_{night} 50 - >70 dB)
 - railway noise exposure in 5 dB bands (L_{den} 55 - >75 dB, L_{night} 50 - >70 dB).

When considering the selection of PIAs to address under the action plan, it is recommended that the APAs consider the following aspects for each of the MIAs:

- Number of people exposed to noise, and the health effects

- Level of noise exposure
- Potential for grouping adjacent MIAs into a larger PIA
- The main source of transport noise
- Competent body to carry out any proposed mitigation measures
- History of complaints
- Planned road maintenance and resurfacing programme
- Planned speed or traffic calming measures
- Planned nearby developments
- Existing noise reduction measures
- Proposed noise reduction measures
- Options available for noise reduction measures, if available

Based upon all the information available, where necessary, it is recommended that APAs identify at least 5 and up to 10 Priority Important Areas (PIAs) which will be included within the noise action plan, with a plan to undertake an assessment of noise mitigation measures for each PIA within the life cycle of the noise action plan (e.g.: 2024-2028, 2028-33, 2033-38).

The selection of the PIAs from the MIAs is be documented within the NAP, including a rationale for each PIA selected. The PIAs selected within Limerick Agglomeration are shown in Figure 3, which illustrates how adjacent MIAs exposed to the same source have been clustered into a single PIA.

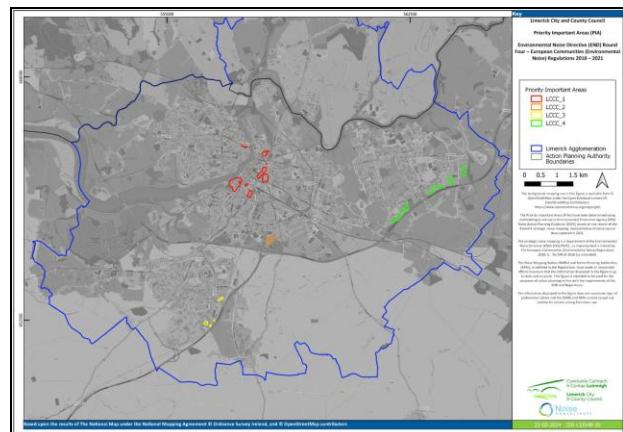


Figure 3. Limerick Agglomeration –Priority Important Areas (PIAs) - LCCC_1: Limerick City; LCCC_2: John Carew Park; LCCC_3: Ballycummin; LCCC_4: Monaleen/Castle Troy





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7. ASSESSMENT OF NOISE MITIGATION MEASURES

Following adoption of the NAP, for each of the Priority Important Areas, an assessment of cost-effective noise mitigation measures is undertaken during implementation of the NAP. It is recommended that this assessment includes:

- noise monitoring to confirm exposure levels;
- noise modelling calculations of practical noise mitigation measures, and
- cost-benefit analysis based on estimated costs of implementing and maintaining mitigation works, and monetised benefit to health of noise reduction.

It is recommended that the most cost-effective noise mitigation measures, or combination of measures, are proposed to the relevant departments, organisations and fund holders to be incorporated within their future work plans as robust proposals for cost-effective noise mitigation measures.

8. CONCLUSIONS

The Environmental Protection Agency in Ireland is to exercise general supervision over the functions and actions of noise mapping bodies and action planning authorities, and to provide guidance or advice, where necessary.

The EPA has developed a revised draft guidance note on noise action planning for Round 4 of the END implementation.

As there are no statutory noise limit values in Ireland, the EPA developed other relevant criteria for identifying priorities, and the most important areas, exposed to road and railway noise to be addressed within the noise action plans.

The recommended approach identifies Important Areas (IA) as areas exposed above the relevant thresholds with reference to the WHO 2018 guidelines on road and railway noise.

The recommended approach then identifies Most Important Areas (MIA) on the basis of interpolating a building point dataset of the number of people highly annoyed to generate a raster heatmap, using a quadratic weighted circular neighbourhood around each point.

From the heatmap it is then possible to identify the most important areas (MIAs), which are those IAs with the largest concentration of people highly annoyed due to noise. This aims to identify locations where noise mitigation measures may have a positive effect on the quality of life for a large number of people. Using a criterion of 15 or more people highly annoyed per 100 m².

The criterion of 15 or more people per 100 m² has been found to be appropriate in the main urban areas within agglomerations. For edge of urban, or rural, locations it may be found that very few MIAs are identified based on this criterion. In this situation it is recommended that the criterion is reduced to 10, or even 7.5, in order to ideally identify at least 15 to 20 MIAs within the region covered by strategic noise mapping.

The Action Planning Authorities should then propose 5 to 10 MIAs to be the Priority Important Areas (PIA) to be assessed during the implementation of the noise action. The recommended approach to assessment of each PIA includes noise monitoring, review of noise mitigation measures, and cost-benefit assessment, with the aim to develop robust proposals for cost-effective noise mitigation measures. The recommended process aims to identify areas with high levels of health impact, due to both noise exposure levels and population density. This is designed to support aims of the EU Zero Pollution Action Plan and provide noise reduction, and associated reductions in health effects, for groups of the population.

In late 2024, a number of pilot acoustic design studies were undertaken to look at validating some of the identified PIAs. It is hoped that any lessons learned from these initial pilot studies can be shared with other APAs in 2025.

9. ACKNOWLEDGMENTS

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