



Guidance Note for Strategic Noise Mapping

For the
Environmental Noise Regulations 2006

Version 2

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**Revised Section 10: Stage 7 – Post Processing and
Analysis – for Round 2 Implementation**

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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 Reporting Requirements

As mentioned within the EPA Guidance the precise content of the reports to be submitted to the EC and EEA are not yet finalised. The EPA is awaiting publication of the Handbook for the revised EEA Reportnet Reporting Mechanism which is expected in May 2012, prior to finalising the reporting requirements for the noise mapping bodies.

10.2 Requirements of the Directive

Annex VI of the END requires that “the estimated number of **people** living in dwellings” exposed to various noise levels “4 m above the ground on the **most exposed façade**” is provided for various scenarios.

For this reason it is necessary to more clearly define the terms “people”, “dwellings”, and “most exposed façade”.

For the purposes of the statistics required by Annex VI, persons (or people) can be defined as “human” beings, thus being consistent with the scope of the END defined in Article 2, paragraph 1. They are members of “the public” as defined in Article 3 (v) as “one or more natural or legal persons and, in accordance with national legislation or practice, their associations, organisations or groups”.

The term “population” is not referred to in the END, and is only a convenient means of referring to the exposure assessment, which as noted above is for “the estimated number of people living in dwellings”. It should be noted that the estimation of the number of people living in dwellings does not directly assess the exposure of people, as individuals move around; rather the exposure assessment is carried out upon the building/dwelling in which people normally reside. In the assessment there is no attempt to reflect the temporal dimension of the movement of population in this exposure assessment.

The CSO defines dwellings as “any building or structure, permanent or temporary created or used for private or communal human habitation or part of such a structure (e.g an apartment)”. CSO divides dwellings into “Private Dwellings” which can include houses, bungalows, flats, apartments, bedsits, houseboats, mobile homes and caravans; and “Non-private Dwellings” which can include educational establishments, prisons, hotels, boarding houses, hospice, campsite, hostel and civilian ships.

Importantly, the use of “dwellings” within the END indicates that vacant or unoccupied dwellings should be included within the assessment of exposure of dwellings, but not within the assessment of exposure of people if the dwellings are known to be vacant, as this is contra to the phrasing used, e.g. “how many persons in the above categories live in dwellings that have” and “The estimated total number of people (in hundreds) living in dwellings”. For this reason the revised approach set out below will provide two approaches to identifying dwellings, one including vacant

dwellings, to be used in the dwelling exposure assessment, and the other which excludes them, for use in the assessment of numbers of people living in dwellings.

The term “building” as used by CSO is not referred to directly in the context of the exposure assessments required by Annex VI. A building may contain zero, one or more individual dwellings. Residential buildings can therefore be considered to be those buildings containing one or more individual “Private dwellings”. Noise-sensitive buildings may be considered those buildings which contain “Non-private dwellings”, or which have uses which the competent authority deems to be noise sensitive, such as libraries etc.

The façades of a dwelling shall consist of all externally facing walls. Annex I, 1 defines the L_{den} using the stated formula, and in which: “the incident sound is considered, which means that no account is taken of the sound that is reflected at **the façade of the dwelling under consideration**”. This indicates that the subsequent references to façade indicate **the façade of the dwelling under consideration**. Which would be consistent with Annex III regarding dose-response relationships: “dwellings with a quiet façade as defined in Annex VI”.

Regarding the most exposed façade Annex I, 1 states: “the most exposed façade; for this purpose, the most exposed façade will be the external wall facing onto and nearest to the specific noise source; for other purposes other choices may be made”. Subsequent practical experience has demonstrated that selection of the most exposed façade based upon distance may lead to contradictory situations. For this reason a revised definition is proposed: “the most exposed façade will be the external wall of the dwelling exposed to the highest value of L_{den}/L_{night} from the specific noise source under consideration (e.g. road traffic).” The proposed definition is also more consistent with the existing definition of quiet façade.

Regarding quiet façade, Annex VI, 1.5 states: “a quiet façade, meaning the façade of a dwelling at which the value of L_{den} four metres above the ground and two metres in front of the façade, for the noise emitted from a specific source, is more than 20 dB lower than at the façade having the highest value of L_{den} .” This makes determination of the presence of a quiet façade more complex as it necessary to determine the noise exposure at a different distance from the façade of the dwelling than for the most exposed façade. As the reporting of quiet facades is optional, it is not currently proposed to determine the presence of quiet facades.

10.3 Relevant Input Datasets

Given the above definitions the input datasets required to undertake the required assessments may be identified.

Central Statistics Office

CSO publish statistical information on population based upon Census returns. The most recent Census was held on 10 April 2011, and the preliminary information is currently available, with the final information currently expected to be available at the end of March 2012. The information available on population is issued according to various political boundaries, namely Province or County, Province County or City, Regional Authority, Constituency or Electoral Division. Data is not made available at Census Output Area level; rather these are merged up to the Electoral Division (ED) level which provides for the highest level of resolution available to the location of the population. There are approximately 3750 ED covering Ireland.

In order to provide an accurate spatial location for the population within each ED it is necessary to have an up to date map of ED areas which matches the ED codes within the population exposure statistics report. At present the readily available ED

boundary dataset does not match the population statistics spreadsheet, which will introduce errors into the geocoding of the population statistics. CSO have provided the EPA with an ED dataset which has the population data already assigned with the PERSONS_2011 attribute containing the total number of people per ED.

Proposal: When the 2011 Census data is finalised by CSO, the EPA will request a finalised dataset for ED areas with the population data already assigned by CSO. This will provide the most detailed population distribution data direct from source, assigned to a consistent ED dataset and provide a reference for the exposure assessment.

With the number of people per ED area provided by CSO, it is now necessary to establish which buildings contain dwellings, and the total number of people living within those dwellings.

GeoDirectory

The GeoDirectory data products are developed by OSi and An Post to provide a single point location object for each building in Ireland. The complete dataset is available with the "GeoAddress Locator" product, and each point location has a number of attributes which may be useful in identifying both vacant and occupied dwellings, for both CSO style private and non-private use categories.

GeoDirectory is updated quarterly. The most recent updates were published as:

- Q4 2010 on 27th Jan 2011;
- Q1 2011 on 8th April 2011;
- Q2 2011 on 25th July 2011;
- Q3 2011 on 24th October 2011;
- Q4 2011 during January 2012; and
- Q1 2012 is expected during April 2012.

Ideally, all the source datasets used as the basis of the assessment would be related to the same date in time, with all data correct and relevant as of that date, in order to minimise temporal mismatches between the datasets.

Proposal: Discussions with GeoDirectory have led to the conclusion that the dataset released from Q2 2011 release from 25th July 2011 provides the closest match to the Census date of 10th April 2011, it is therefore proposed to use this version of the dataset for the assessment of exposure.

As GeoDirectory provides a location point for each building, it is necessary to undertake a filter procedure in order to identify the two location datasets required for the assessment, namely:

- Point locations for buildings containing dwellings, and
- Point locations for buildings containing occupied dwellings.

The highest level of resolution within GeoDirectory is within the ADDRESS_POINTS table, which has a many-to-one link to the BUILDINGS table i.e. there can be many address points within one building, and one building may contain one or many address delivery points.

The number of linked address points is provided by the RESIDENTIAL_DELIVERY_POINTS and COMMERCIAL_DELIVERY_POINTS attributes within the BUILDINGS table. The RESIDENTIAL_DELIVERY_POINTS have a blank entry in the ORGANISATION attribute within the ADDRESS_POINTS

table, whereas the COMMERCIAL_DELIVERY_POINTS have an entry in the ORGANISATION attribute within the ADDRESS_POINTS table. The ADDRESS_POINTS table also has a VACANT attribute for each of the entries, whether they are commercial or residential.

As the noise level assessment is undertaken at the façade of the building object, it is appropriate to work from the BUILDINGS table as it provides the information relevant for the assessment, i.e. the number of residential delivery points within the building, and has the advantage that there should only be one single BUILDINGS_ID per building in OSi Large Scale.

In order to produce a location dataset of “RESIDENTIAL_BUILDINGS”, the following filters should be applied to the GeoDirectory BUILDINGS table:

- BUILDING_USE – filter out all C (commercial) and U (unknown);
- DERELICT – filter out all Y (yes);
- INVALID – filter out all Y (yes);
- UNDER_CONSTRUCTION – filter out all Y (yes) entries; and
- RESIDENTIAL_DELIVERY_POINTS – filter out all 0 (zero) entries, as they do not have any residential delivery points.

The resultant dataset contains the location points for all residential buildings, whilst the RESIDENTIAL_DELIVERY_POINTS attribute provides the total number of residential dwellings within each building.

In order to create a location dataset of “OCCUPIED_RESIDENTIAL_BUILDINGS” a two step process needs to be undertaken. First it is necessary to determine the number of occupied residential delivery points within each building. For each BUILDING_ID within the “RESIDENTIAL_BUILDINGS” dataset, the ADDRESS_POINTS table should be queried, and the entries with blank ORGANISATION attributes and N in the VACANT attribute summed per building and the total value per BUILDING_ID assigned to the new OCCUPIED_RESIDENTIAL_DELIVERY_POINTS attribute within the “RESIDENTIAL_BUILDINGS” dataset.

The “OCCUPIED_RESIDENTIAL_BUILDINGS” dataset should then be created by running the following filter on the “RESIDENTIAL_BUILDINGS” dataset:

- OCCUPIED_RESIDENTIAL_DELIVERY_POINTS > 0 (zero)

The resultant dataset contains the location points for all occupied residential buildings, whilst the OCCUPIED_RESIDENTIAL_DELIVERY_POINTS attribute provides the total number of occupied residential dwellings within each building.

Proposal: GeoDirectory BUILDINGS and ADDRESS_POINTS tables are to be processed as described to produce two location datasets of “RESIDENTIAL_BUILDINGS” and OCCUPIED_RESIDENTIAL_BUILDINGS”.

OSi Large Scale

The GeoDirectory data product is stated as being sourced initially from the OSi Large Scale Map Database, with geocoding validated against OSi Large Scale maps by An Post staff.

OSi Large Scale is made up of three data products which have different scales and update cycles, but the same object layers. OSi Large Scale is produced in three different scales:

- 1:1,000 scale in urban areas;
- 1:2,500 scale in suburban and periurban areas; and
- 1:5,000 scale in rural areas.

Licensees are delivered updates on a rolling cycle:

- 1:1,000 scale is updated annually for each licensee
- 1:2,500 scale is updated every 3 years for each licensee
- 1:5,000 scale is updated every 5 yearly for each licensee

In addition to these aspects, the process of polygonising the Large Scale vector datasets is currently incomplete. In some areas Large Scale is made up of polygon objects, in other areas the vector product continues to be a CAD-style line dataset.

Within the areas of noise mapping it is necessary to have building polygon objects in order to successfully undertake the noise calculations. Detached, semi-detached and terrace properties should have each unit described as a separate polygon i.e. a semi-detached building is two adjoining polygon objects, a row of terrace properties is a series of adjoining polygon objects. The areas of noise mapping may encompass urban, suburban, periurban and rural locations, therefore it may be necessary to use a collection of different Large Scale data products at 1:1000, 1:2500 and 1:5000 to cover the entire mapping area.

Ideally all the building footprints would be available as individual building polygons, and spatial GIS processing tools could then connect the GeoDirectory building points to the Large Scale building footprints. At present it is thought that to achieve a building footprint dataset of this type of national coverage would require significant processing and data preparation along with an appropriate quality assurance procedure.

Within Large Scale the building footprints are thought to be described within the following layers:

- INN_WALLS – Inner walls of buildings
- SOLID – Outline of solid buildings
- PECK – Outline of pecked buildings
- DW_HOUSE – Outline of dwellings
- BLD_ANTIQ
- BLD_COASTL
- BUILDINGS
- MBARRACKS
- MBUILDINGS

For consistency with Census and GeoDirectory it is recommended that the most recent OSi Large Scale datasets should be used:

- 1:1,000 data should be less than 12 months old as of 31st March 2012;
- 1:2,500 data should be less than 3 years old as of 31st March 2012; and
- 1:5,000 data should be less than 5 years old as of 31st March 2012.

Note: the 31st March was chosen to relate to the expected publication data of 2011 Census data.

From the source datasets the above layers should be extracted from Large Scale and merged into a LARGE_SCALE_BUILDINGS dataset. This dataset may then be clipped to the mapping extents, and should be checked and processed to ensure that all building objects are polygons.

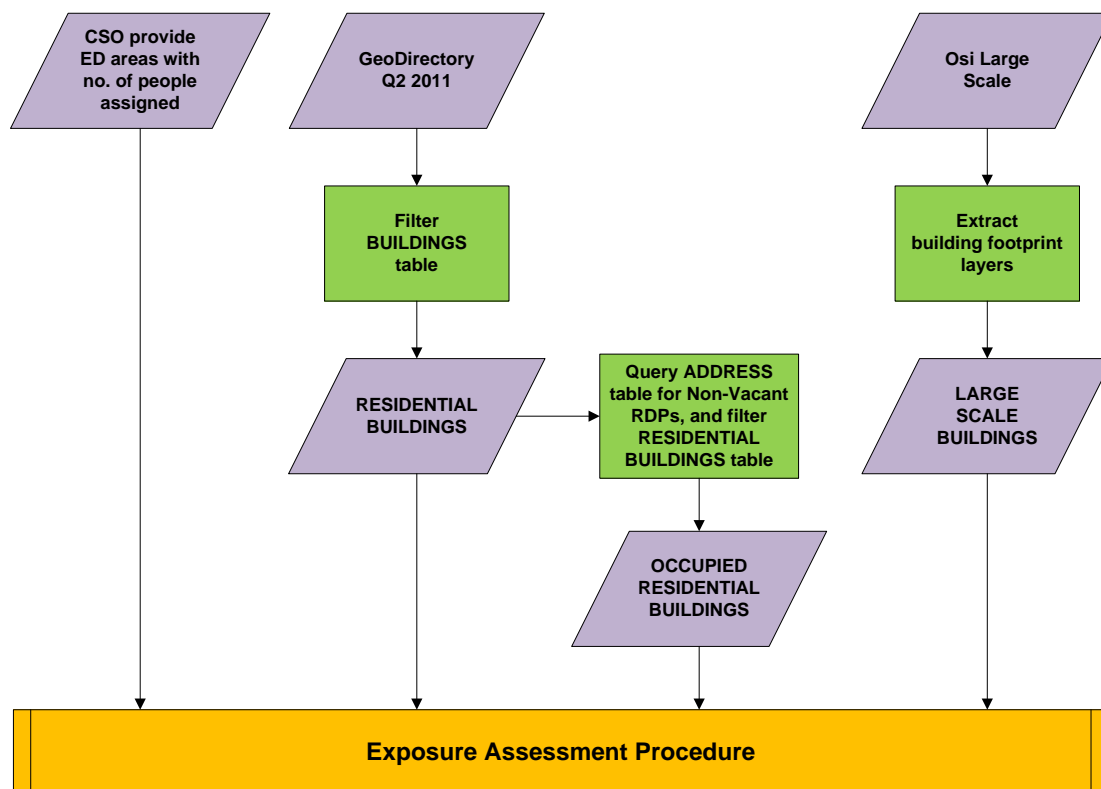


Figure 10.1: Summary of input dataset processing

10.4 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 to produce a “seamless” results grid;
- Rounding of the results to two decimal places; and
- Masking of the seamless results grids to the extent of the area to be mapped.

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 reclassified grids are produced by assigning each point to a classification based upon the 5dB band in which the noise level resides.

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: 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.

10.5 Area Analysis

The EC recommended reporting mechanism, ENDRM 2012 DF8, requires information on the total area, inside and outside agglomerations, (in km²) exposed to L_{den} 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 10m interval grid point is at the centre of an area 10m by 10m, therefore each grid point represents 100 m². This approach avoids the secondary processing required to produce equal noise level contours based upon an interpolation between the grid points, and therefore avoid introducing any further uncertainty into the results.

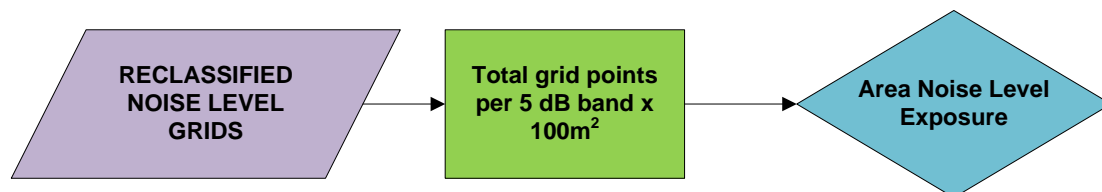


Figure 10.2: Summary of area analysis

10.6 Assessment Datasets

With the relevant input datasets prepared, they can be processed together to produce the datasets required for the assessment.

1) Average number of people per residential delivery point, per ED

The CSO ED boundary polygon dataset with 2011 Census data assigned to each ED area, should be loaded in GIS with the OCCUPIED_RESIDENTIAL_BUILDINGS point data derived from GeoDirectory.

A spatial query should be run to count the total number of OCCUPIED_RESIDENTIAL_DELIVERY_POINTS assigned to building points inside each ED area polygon. This total should be assigned as an attribute to the ED area polygon.

For each ED area polygon the average number of people per residential delivery point is then calculated by dividing the total PERSONS_2011 for the ED, by the

total OCCUPIED_RESIDENTIAL_DELIVERY_POINTS for the ED. This average is then assigned as a new AVERAGE_PERSONS_PER_ORDP attribute on the ED area polygon.

2) Number of people per occupied residential building

For each of the OCCUPIED_RESIDENTIAL_BUILDINGS points the total number of people per building can be calculated from the AVERAGE_PERSONS_PER_ORDP assigned to the ED area, within which the building is located, multiplied by the total number of OCCUPIED_RESIDENTIAL_DELIVERY_POINTS for the building point. This total can then be assigned as a new PERSONS_PER_BUILDING attribute to the building point.

3) Finalising “RESIDENTIAL_BUILDINGS” dataset

The OCCUPIED_RESIDENTIAL_BUILDINGS dataset now contains an attribute for the total number of persons per building. It is a subset of the RESIDENTIAL_BUILDINGS dataset.

The PERSONS_PER_BUILDING attribute should be copied across to the equivalent building point within the RESIDENTIAL_BUILDINGS dataset. All RESIDENTIAL_BUILDINGS with a blank PERSONS_PER_BUILDING attribute should have it set to 0 (zero).

The RESIDENTIAL_BUILDINGS dataset is then ready to use in the remainder of the assessment.

4) Noise exposure level per building

Façade noise level calculations

Where noise level calculations have been carried out for façade receptors around buildings, they should be used as the source dataset for noise exposure for each building.

If the façade receptor points are at a distance of 0.1m from the building façade (as recommended by WG-AEN GPG v2) then the building polygon may be buffered by 0.2m and a spatial search undertaken inside the resulting polygon to find the highest and lowest noise level figures from the calculation point. These highest and lowest noise levels may then be assigned to the building polygon as attributes.

Grid noise level calculations

Where only 10m grids of noise levels have been calculated, or where buildings were absent from the noise assessment model but are available within the OSi Large Scale data, it will be necessary to generate building façade receptor locations, and assign noise levels to these points based upon interpolation from the grid of noise levels.

The façade receptor point should be created on the external building facades in the following manner:

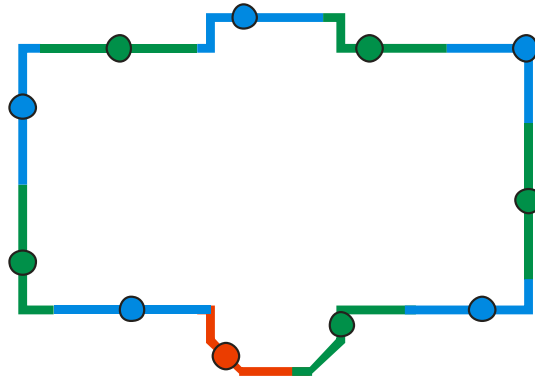


Figure 10.3: Assignment of receptor points to building facades

- a) Façades are split up every 5 m from start position on with a receiver position placed at half distance (blue/green).
- b) The remaining section gets its receiver point in its middle (red).

Note: there are other means of generating façade receptor points which may be acceptable. This approach is presented one being straightforward to implement in GIS.

At each façade receptor point the noise level should be determined by interpolation from the 10m grid noise levels nearby. The highest and lowest noise levels for each building polygon may then be identified and assigned to the building polygon as attributes.

5) Linking “RESIDENTIAL_BUILDINGS” datasets to building footprints

The RESIDENTIAL_BUILDINGS datasets and the LARGE_SCALE_BUILDINGS footprints can be linked using a spatial query to identify the “RESIDENTIAL_BUILDINGS” points within each of the footprint feature of the “LARGE_SCALE_BUILDINGS” dataset. The GeoDirectory “BUILDING_ID” table can then be assigned to the footprint polygons within dataset “LARGE_SCALE_BUILDINGS”.

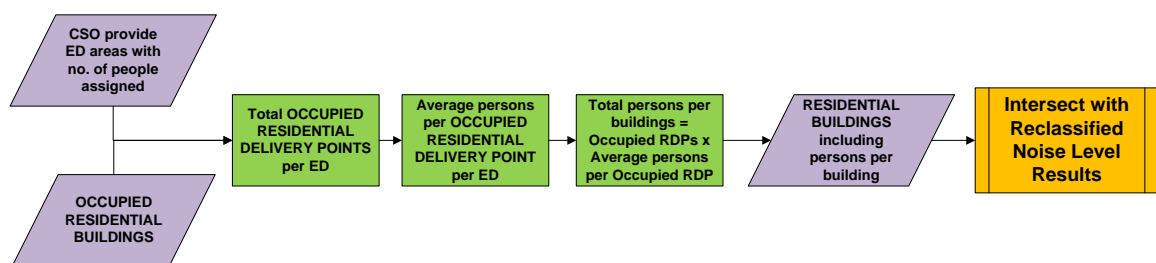


Figure 10.4: Distribution of persons in dwellings

10.7 Assessment of Noise level Exposure

After joining the dataset “RESIDENTIAL_BUILDINGS” with the footprints dataset “LARGE_SCALE_BUILDINGS”, the highest and lowest noise levels assigned to each of the Large Scale footprint polygons may be copied across an attribute tables onto the dataset “RESIDENTIAL_BUILDINGS_POINTS”.

The total number of features within dataset “RESIDENTIAL_DELIVERY_POINTS” per noise level band then be calculated using the highest noise level per building to determine the total number of dwellings within each noise level band.

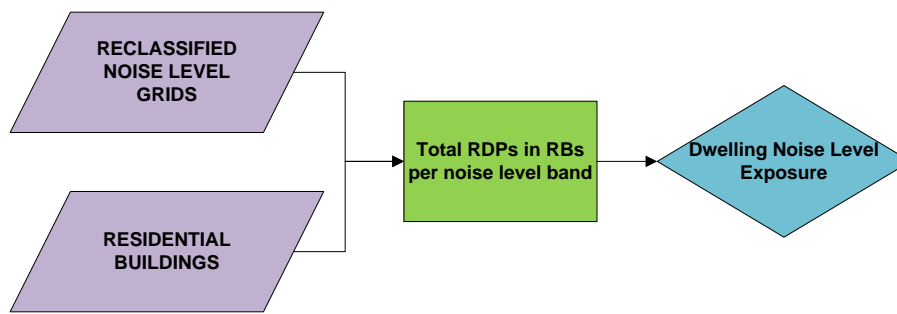


Figure 10.5: Summary of dwelling analysis

The PERSONS_PER_BUILDING = 0 (zero) buildings can then be filtered out of the dataset, and the total number of persons per building summed per noise level band, using the highest noise level per building, to determine the total number of people exposed within each noise level band.

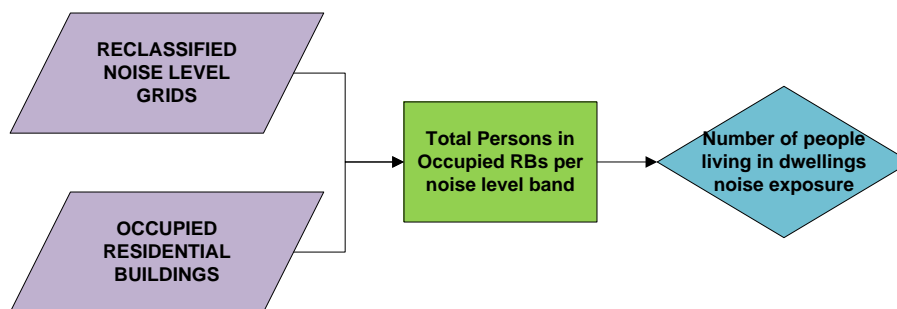


Figure 10.6: Summary of persons in dwellings analysis

The 5dB bands to be used 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: 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.