Cambridge NECAAP

Noise Model and Mitigation Assessment

Greater Cambridge Planning Service

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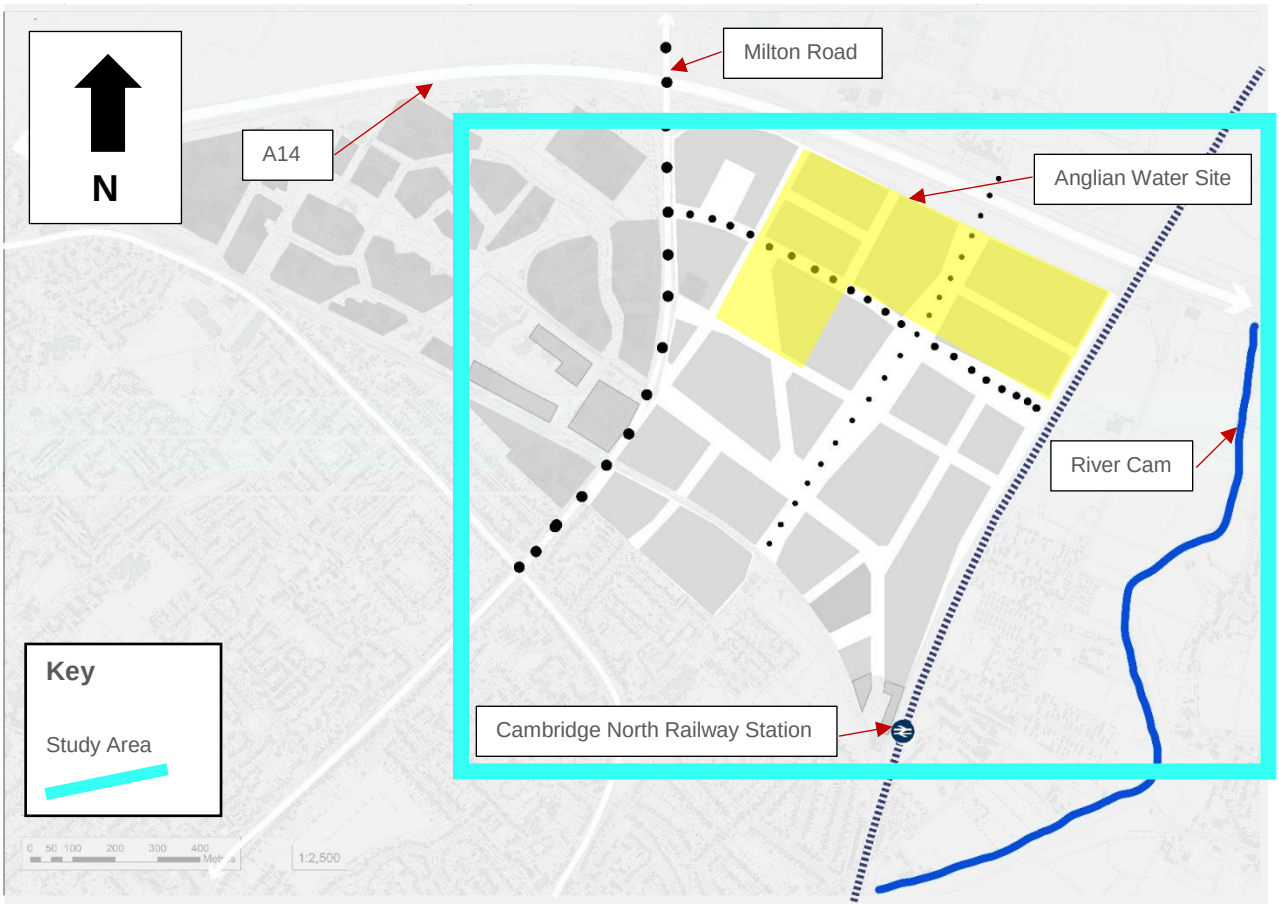
1. Introduction

The Greater Cambridge Planning Service has plans to develop a new residential area on the site of the old Anglian Water Sewage Works and beyond, west of the new Cambridge North Station and south of the A14. They have prepared the North East Cambridge Area Action Plan (NECAAP) to identify the key issues, challenges and opportunities facing the area and sets out the different ways these could be responded to.

The proposed site is located between the Ely to Cambridge Railway Line and Milton Road, but not including Cambridge Regional College. At the northern edge of the site area is the A14 trunk road, with the southern edge on or near to the guided busway. There are concerns that noise from the A14, and the railway line, could be a constraint on the site. The study area is shown in Figure 1-1, on a plan that was provided by the Greater Cambridge Planning Service.

The scope of work was to generate a series of noise contour maps without detailed commentary. These noise contour maps demonstrate the extent of noise from existing roads and the railway at this site, plus a series of potential noise mitigation options, using a 3D noise model of the area. This report provides these results, as well as some more context and legislation to enable the comparison of mitigation scenarios and against guidance on acceptable noise limits.

Figure 1-1 - Study Area



2. Guidance on Acceptable Noise Levels

The following section includes the guidance that can be used to interpret the noise contour maps that have been provided in Sections 4 and 5.

2.1. National Planning Policy Framework

The National Planning Policy Framework (NPPF) was published in March 2012 and updated in February 2019. The document defines the national policy toward developments that are sensitive to noise and vibration. Specifically, on the subject of noise, paragraphs 170, 180 and 182 state that:

- *"170. Planning policies and decisions should contribute to and enhance the natural and local environment by:*

  (e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;"
- *"180. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

  (a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

  (b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason;"
- *"182. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."*

The NPPF refers to the Noise Policy Statement for England, discussed in the subsequent section.

2.2. Noise Policy Statement for England

The long-term vision of Government noise policy is set out in the Noise Policy Statement for England (NPSE) published in March 2010. Through effective management and control of environmental noise within the context of Government policy on sustainable development, the NPSE aims to:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise other adverse impacts on health and quality of life; and
- Contribute to improvements to health and quality of life, where possible.

The Explanatory Note to the NPSE assists in the definition of significant adverse and adverse with reference to No Observed Effect Level (NOEL), Lowest Observed Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect Level (SOAEL) values:

- NOEL: the level of noise exposure below which no effect at all on health or quality of life can be detected.
- LOAEL: the level of noise exposure above which adverse effects on health and quality of life can be detected.
- SOAEL: The level of noise exposure above which significant adverse effects on health and quality of life occur.

The Government policy and guidance do not state values for the NOEL, LOAEL and SOAEL, rather, it considers that they are different for different noise sources, for different receptors and at different times and should be defined on a strategic or project basis taking into account the specific features of that area, source or project.

2.3. Planning Practice: Noise

Planning Practice Guidance (PPG) for Noise was published in March 2014 and updated in July 2019. It provides advice on how planning can manage potential noise impacts in new development. It states that:

> *"Noise needs to be considered when development may create additional noise, or would be sensitive to the prevailing acoustic environment (including any anticipated changes to that environment from activities that are permitted but not yet commenced). When preparing plans, or taking decisions about new development, there may also be opportunities to make improvements to the acoustic environment. Good acoustic design should be considered early in the planning process to ensure that the most appropriate and cost-effective solutions are identified from the outset."*

It also states that *"it is important to look at noise in the context of the wider characteristics of a development proposal, its likely users and its surroundings, as these can have an important effect on whether noise is likely to pose a concern"'*

The guidance also advises that *'*

> *"Plan-making and decision making need to take account of the acoustic environment and in doing so consider:*
>
> *•whether or not a significant adverse effect is occurring or likely to occur;*
>
> *•whether or not an adverse effect is occurring or likely to occur; and*
>
> *•whether or not a good standard of amenity can be achieved"*

It then refers to the NPSE and states that the aim is to identify where the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) falls in relation to the SOAEL, LOAEL and NOEL. The guidance then provides the definitions of the observed effect levels, in line with the definitions from the Explanatory Note to the NPSE.

The guidance presents a table, which is reproduced in Table 2-1. The implication of the final line of the table is that only the *"present and very disruptive"* outcomes are unacceptable and should be prevented. All other outcomes (i.e. all other lines in the table) can be acceptable, depending upon the specific circumstances and factors such as the practicalities of mitigation.

Table 2-1 - Summary of noise exposure hierarchy (from PPG)

Response	Examples of outcomes	Increasing effect level	Action
No Observed Effect Level			
Not present	No effect	No observed effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life	No observed adverse effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life	Observed adverse effect	Mitigate and reduce to a minimum

Response	Examples of outcomes	Increasing effect level	Action
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion, where there is no alternative ventilation, having to keep windows closed most of the time because of noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area	Significant observed adverse effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable observed adverse effect	Prevent

2.4. Professional Practice Guidance: Planning and Noise – New Residential Development

The primary goal of the Professional Practice Guidance on Planning and Noise (ProPG): Planning and Noise (2017) is to assist the delivery of sustainable development by promoting good health and well-being through the effective management of noise. It seeks to do this through encouraging a good acoustic design process in and around proposed new residential development having regard to national policy on planning and noise.

ProPG advocates a two-stage risk-based approach to encourage early consideration of potential noise issues. This strategy accelerates straightforward decision making for lower risk sites and assists in proper consideration of noise issues in higher risk sites.

The stages are broken down into the following:

- Stage 1 – an initial noise risk assessment of the proposed development site; and
- Stage 2 – a systematic consideration of four key elements.

The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:

- Element 1 – demonstrating a “Good Acoustic Design Process”;
- Element 2 – observing internal “Noise Level Guidelines”;
- Element 3 – undertaking an “External Amenity Area Noise Assessment”; and
- Element 4 – consideration of “Other Relevant Issues”.

The ProPG document also provides detail on practical considerations for decision makers, acoustic design principles and expands on the latest research behind noise limits and dealing with night-time noise events.

At Stage 1, the initial noise risk is assessed by comparing the unmitigated (measured or predicted) noise levels against the values in Figure 1 of the document, “Initial Site Noise Risk Assessment”, ranging from low to negligible risk below around daytime 55dB $L_{Aeq, 16hr}$ and night time 45dB $L_{Aeq, 8hr}$, where a site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed. As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed. Where noise levels are around 60dB or higher, it is recommended that a Stage 2 assessment is carried out.

The ProPG Supplementary Document 2, ‘Good Acoustic Design’: May 2017, has been created in reference to ‘Element 1’ of Stage 2. It states that *“a good acoustic design will be one that continues to minimise noise impacts and to avoid significant noise effects for the lifetime of the development or as long as is practicable taking into account other economic, environmental and social impacts. Ideally new development should also help to mitigate any existing adverse impacts elsewhere, for example by acting as a barrier between noisy infrastructure and any existing noise-sensitive uses that do not benefit from incorporated mitigation.”*

The document provides a hierarchy of noise management measures that are reproduced below:

i. Maximising the spatial separation of noise source(s) and receptor(s).

ii. Investigating the necessity and feasibility of reducing existing noise levels and relocating existing noise sources.

iii. Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise.

iv. Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.

v. Using the layout of the scheme to reduce noise propagation across the site.

vi. Using the orientation of buildings to reduce the noise exposure of noise-sensitive rooms.

vii. Using the building envelope to mitigate noise to acceptable levels.

This leads to the consideration of space at the site, the location and orientation of rooms and buildings, barrier blocks close to the source of noise, the use of balconies and podiums, noise barriers, bunds and mounds, construction materials and the ventilation and cooling design of the residential buildings on the site.

2.5. World Health Organization Environmental Noise Guidelines 2018

The main purpose of the World Health Organization (WHO) Environmental Noise Guidelines is to provide recommendations for protecting human health from exposure to environmental noise originating from various sources, namely transportation (road traffic, railway and aircraft) noise, wind turbine noise and leisure noise.

For road traffic noise, the WHO Environmental Noise Guidelines strongly recommend that the average noise exposure at a property is reduced to below 53dB L_{den}, with night noise exposure reduced below 45dB $L_{Aeq,\ 8hr}$. Road traffic noise above these levels are associated with adverse health effects, and adverse effects on sleep, respectively.

For railway noise, the WHO Environmental Noise Guidelines strongly recommend that the average noise exposure at a property is reduced to below 54dB L_{den}, with night noise exposure reduced below 44dB $L_{Aeq,\ 8hr}$. Railway noise above these levels are associated with adverse health effects, and adverse effects on sleep, respectively.

The values in the guidelines are those where adverse effects are confirmed to have occurred rather defining the point at which those adverse effects begin to occur.

The document also strongly recommends that policymakers introduce suitable measures where road traffic noise exceeds these guideline values. At the time of writing no changes to policy have been made as a result of the WHO Environmental Noise Guidelines.

2.6. BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings is a code of practice for acoustic design of buildings. For dwellings, the standard provides guidance on internal ambient noise levels as shown in Table 2-2. These criteria should be achieved inside the dwellings under normal background ventilation conditions.

These values are also used in the Acoustics Ventilation and Overheating: Residential Design Guide that has been prepared by the Association of Noise Consultant's Acoustics, Ventilation and Overheating Group, and released in January 2020. This guidance also references ProPG.

Table 2-2 - Internal ambient noise levels

Activity	Location	Daytime 0700-2300	Night-time 2300-0700
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping / resting	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$ 45 dB $L_{Amax,F}$*

**More than 10 times per night. Individual noise events (for example passing cars) can cause sleep disturbance. WHO community noise guidelines recommend that peak noise in bedrooms should not exceed 45 dB $L_{Amax,F}$ more than 10 to 15 times per night, which is a threshold below which the effects of individual noise events on sleep can be regarded as negligible. This threshold is therefore associated with LOAEL.*

Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels listed in Table 2-2 may *be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal levels start to exceed the internal target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable".*

Paragraph 7.7.3.2 of BS8233:2014 indicates that in external amenity spaces (balconies or play areas should also be considered) it is desirable that the steady noise levels should not exceed 50 dB $L_{Aeq,T}$, and 55 dB $L_{Aeq,T}$ should be regarded as an upper guideline value. The paragraph continues to state the following:

> *"… it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."*

Where the BS8233 outdoor noise level aim of 55 dB $L_{Aeq,16hour}$ can be achieved, this will ensure that outdoor noise levels will be below the Lowest Observed Adverse Effect Level in terms of the PPG. Values above this are not necessarily unacceptable but indicate that mitigation should be considered where reasonably practical. Where such levels are exceeded, the PPG states the following:

> *"The impact may be partially off-set if the residents of those dwellings have access to:*
>
> - *a relatively quiet facade (containing windows to habitable rooms) as part of their dwelling, and/or;*
> - *a relatively quiet external amenity space for their sole use, (e.g. a garden or balcony). Although the existence of a garden or balcony is generally desirable, the intended benefits will be reduced with increasing noise exposure and could be such that significant adverse effects occur, and/or;*
> - *a relatively quiet, protected, nearby external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings, and/or;*
> - *a relatively quiet, protected, external publicly accessible amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance)."*

2.7. Design Manual for Roads and Bridges, LA 111: Noise and Vibration 2019

This document issued by Highways England sets out the requirements for noise and vibration assessments to be completed for road projects, and states that the LOAEL and SOAEL threshold levels shown in Table 2-3 (Table 3.49.1 of the document) that should be used for all noise sensitive receptors.

For comparison with the predicted noise maps, the $L_{A10,18hr}$ façade levels can be converted to $L_{Aeq,\ 16hr}$ free field by subtracting 5dB.

Table 2-3 - Operational noise LOAELs and SOAELs for all receptors

Time Period	LOAEL	SOAEL
Day (06:00-24:00)	55dB $L_{A10,18hr}$ facade	68dB $L_{A10,18hr}$ facade
Night (00:00-06:00)	40dB $L_{Aeq,\ 8hr}$, outside (free-field)	55dB $L_{Aeq,\ 8hr}$, outside (free-field)

These values were based on the Noise Insulation Regulations, and previous versions of the WHO Guidelines, the WHO Guidelines for Community Noise:1999 and the WHO Night Noise Guidelines for Europe: 2009.

2.8. Summary of Guidance

The summary table below provides the indicative noise threshold values that can be used in this assessment to determine a low risk of adverse effect. In areas that exceed these values, additional measures, such as additional mitigation, the orientation of buildings and rooms, ventilation design and building construction may need to be considered.

Table 2-4 - Summary of Threshold Values

Metric	Noise Threshold Road Traffic	Noise Threshold Railway
Night Time (23:00 to 07:00) $L_{Aeq, 8hr}$	45dB	44dB
Daytime (07:00 to 23:00) $L_{Aeq, 16hr}$	50dB	50dB
Day, evening and night (24hr hours with penalties for evening and night), L_{den}	53dB	54dB

3. Methodology

This investigation of noise in the area has been carried out using a 3D noise model of the site. All noise modelling has been carried out using 'Noisemap 5' software, which implements the calculation methodology from both 'Calculation of Road Traffic Noise, DfT,1988 (CRTN)' and 'Calculation of Railway Noise, DfT, 1995 (CRN)', plus amendments (2004 and 2007).

3.1. The Origins of the Noise Model

3.1.1. Road Traffic Noise Model

The 'A14 Cambridge to Huntingdon' Scheme will open fully this year (2020). With approval from Highways England, the model for this assessment has been based on the latest A14 Scheme model.

Following the DCO in 2016, additional work has been carried out on the A14 Scheme, both prior to and throughout the construction phase, to ensure that any proposed alterations to the Scheme do not result in a material change in noise at any noise sensitive property. The model incorporates the latest 'design year' 2035 traffic flows on the A14 and associated local traffic. This includes the reclassification of the offline sections of the A14 from 'Expressway' to 'Motorway'; introduced in 2018.

The model was originally created using 3D drawings of the A14 Scheme's height and alignment, for both the mainline and junctions, as well as existing ground height information beyond the edge of the A14 Scheme.

In addition, the scheme includes the A14 Scheme mitigation; environmental noise barriers and low noise road surfacing. Figure 3-1, taken from the A14 Scheme DCO 2016 document 'HE-A14-EX-197', shows the location of this mitigation, where the very low noise surfacing has a correction in the noise model of -5.4dB.

Beyond the A14 Scheme, going east, the pavement on the A14 beyond Milton Road is modelled as a low noise surface with a correction of -2.5dB. The assumptions for all scenarios are included in Section 3.4.

Figure 3-1 - Noise Mitigation included in the A14 Scheme

3.1.2. Railway Noise Model

The railway noise model used the road traffic noise model as a base, with the level of detail for the topography and screening the same as before.

The information about train movements was taken from the national rail timetable, and aligned with correction factors for each service, as provided in CRN. This information has been provided in Table 5-2 on page 81.

3.2. Noise Contour Maps

The results of the assessment are shown in the noise contour maps from Section 4 and Section 5, with each colour representing a different range of predicted values, as referenced in the key.

The noise contour maps showing night time ($L_{Aeq, 8hr}$) noise levels, are the lowest predicted noise levels, with daytime ($L_{Aeq, 16hr}$) in the middle and the combined day, evening and night (L_{den}) being the highest noise levels.

In addition, the quietest noise levels will be at 1.5m above ground level, where ground absorption and screening are more effective.

3.3. Mitigation Measures

The A14 at this location already includes low noise surfacing, as discussed in Section 3.1. This assessment will consider additional mitigation to reduce noise in the development area from road traffic noise, in the form of environmental noise barriers, earth-bunds and/or barrier accommodation blocks.

These mitigation options have been assessed to give an early indication of the likely initial suitability of the site for new residential development from a noise perspective and the extent of the potential acoustic issues at the site. The mitigation suggestions in this report assume that the measures suggested are possible, buildable, safe and built on land that is owned by the developer. Further investigations by other specialists, such as structural engineers and landscape architects would be required before any option is finalised.

3.3.1. Environmental Noise Barriers

Environmental Noise Barriers can take many forms, including timber, recycled plastic, clear acrylic, concrete, steel, aluminium barriers, and even those that encourage green planting. The common factor between all barriers are that they are built with no gaps or spaces, and that they are made from a material that is dense enough to significantly reduce the sound going through it.

The reasons for choosing a type of barrier will be based upon space requirements, durability and cost, and whether the barrier can be designed to fit the desired aesthetics of the development area. They are typically 2m to 4m tall but can be as much as 5m tall.

Environmental noise barriers are very effective close to a road, as long as the top of the barrier cuts the line of site from the road to the receptor, but there are limited benefits beyond around 200m from the road.

Environmental noise barriers can be acoustically reflective or absorptive, and this determines the finish on the side of the barrier fronting the road. Absorptive noise barriers are used when there is a requirement to avoid reflections from the barrier, which could cause a noise increase within noise sensitive areas on the opposite side of the road.

3.3.2. Earth Bunds

Earth-bunds or mounds are acoustically absorptive in nature, as they are formed using materials such as soil. Due to the slopes on either side of the bund, they take up more space than noise barriers, and if slopes are built too steep, they won't be stable. Landscape architects have advised that, for this assessment, a minimum unsupported slope gradient of 1:3 should be used, in order to maximise the development area and ensure a sturdy slope. For example, a 3m high bund would be at least 18m wide.

3.3.3. Barrier Accommodation Blocks

The final option is to build barrier blocks of accommodation. These are tall blocks of flats with habitable rooms at the back of the property, away from the road or railway. These act like large noise barriers and are effective at reducing noise for properties behind the first block.

The other buildings on the site will also act as screening within the development site, but this has not been considered.

3.4. Modelling Assumptions

The following table provides the assumptions used to create all noise contour maps.

Table 3-1 - General Assumptions

Name	Assumption	Description
Ground type	Soft ground	It has been assumed that most of the ground around the road and railway is soft and absorptive, such as grass.
Grid Size	25m	The noise contour maps have been created using a 25m grid of calculation points.
Cut off distance	2000m	The predictions only include sources of noise (roads or railways) within 2km of the prediction point.
Height above Ground	The contours have been calculated at ground height/garden level, first floor, second floor and fifth floor as required.	The calculation heights that are required have been provided by the Greater Cambridge Planning Service, based on the ground floor ear height being 1.5m above ground, and there is 2.5m between each floor. i.e. 1st floor is at 4m, 2nd floor is at 6.5m and 5th floor is at 15m.
Metrics used	$L_{Aeq, 8hr}$, $L_{Aeq, 16hr}$ and L_{den}	These metrics were used for all scenarios.
Calculation Area	Shown in Figure 1-1	The water treatment works and surround, including Milton Road.
Buildings within the NECAAP Area	The development area is largely free of buildings.	The site is on a former water treatment works, and so offers no screening from the A14 or railway.
Environmental Noise Barriers	All noise barriers have been modelled as reflective regardless of their composition. This includes the A14 Scheme noise barriers that are absorptive.	This is an assessment to model noise mitigation measures that could reduce noise within the development area. However, if barriers are shown to reflect sound back across the A14 to a noise sensitive area, an absorptive barrier should be considered.

3.4.1. Road Noise Assumptions

In addition to the general assumptions given in Table 3-1 the road traffic noise maps have been created using the following assumptions.

Table 3-2 - Road Traffic Noise Modelling Assumptions

Name	Assumption	Description
Traffic year modelled	2035	This is the design year for the A14 Cambridge to Huntingdon Scheme.
Traffic flow	The traffic used in this assessment does not include any traffic from the development.	This assessment is only showing the future baseline noise levels on the land parcel that will be developed.
Road layout information	The latest A14 scheme used	The model was based on the A14 scheme, including road height, earthworks, barriers and surfacing.

3.5. Railway Assumptions

In addition to the general assumptions given in Table 3-1, the railway noise maps have been created using the following assumptions. The Greater Cambridge Planning Service requested these contours at ground and first floor height, and only for the 'no mitigation' scenario.

Table 3-3 - Railway Noise Modelling Assumptions

Name	Assumption	Description
Rail service year modelled	Late 2019	Current rail services, as future services are unknown.
Train Speed	125kph	Near to the site, the trains will be well past Cambridge North Station.
Freight Trains	Freight Trains have not been included.	Freight Trains are not regular, and although noise levels are high when they pass-by, their impact on overall levels is minimal.

3.5.1. Prediction of Metrics

For the road traffic noise assessment, the night time $L_{Aeq,\ 8hr}$ and L_{den} metrics were calculated by the noise modelling software using "TRL Method 3", based on the predicted daytime $L_{A10,18hr}$ noise level. L_{den} is the equivalent continuous noise level over a whole 24-hour period, but with noise in the evening (19:00 to 23:00) increased by 5 dB (A) and noise at night (23:00 to 07:00) increased by 10 dB (A) to reflect the greater noise-sensitivity of people at those times. This approach assumes that the diurnal traffic pattern is typical for the roads in the study area. The daytime $L_{Aeq,\ 16hr}$ was also calculated from the $L_{A10,18hr}$, using a simple conversion factor.

For the railway noise assessment, the night time $L_{Aeq,\ 8hr}$ and daytime $L_{Aeq,\ 16hr}$ were predicted, and then converted to L_{den}.

3.5.2. Assumptions for Wind Direction

In both the road traffic noise modelling (CRTN:1988) and railway noise modelling (CRN:1995), it is assumed that the noise propagation conditions are consistent with the wind direction being from the nearest part of any road or railway, to the calculation point, parallel to the road.

In CRTN, when measuring noise from roads that can be compared with predictions, the wind speed at the calculation point must be no greater than 10m/s.

3.6. Comparison with Defra Strategic Noise Maps

Every five years, Defra publish a series of strategic noise maps; developed as part of implementing the Environmental Noise Directive. The latest maps were released in 2019.

These strategic noise contour maps include major road and rail sources. These maps are used by transport authorities to identify and prioritise local action on noise.

The Defra strategic maps only include major roads and railways, where major roads were only included if they had a bi-directional flow of 3 million vehicle passages, or more, per year and railways were only included where the rail route had a flow of 30,000 vehicles, or more, per year.

The accuracy of the traffic or mapping data that is used to create these strategic maps is not explicitly stated, and it is not clear whether these maps take into consideration road surfacing corrections. The prediction height for these maps is also not clearly stated.

The Environmental Noise Directive, Implementation of Round 1 Noise Action Plans: Progress Report from January 2014 states that:

> *"It should be noted that the noise maps are produced by bringing together a range of input data including traffic flow, composition, surface topography and other factors. The mapping is strategic and was designed to provide an overall indication of the noise exposure rather than a precisely accurate value at a particular location. The results should therefore be treated with a degree of caution."*

There are clear differences between the strategic maps and what has been predicted in this report, and this is likely to be due to the differences in input data used and any changes related to the A14 Scheme.

For the purposes of this assessment the strategic maps are considered to be indicative only, and the rest of the report will consider the noise models created for this assessment only.

4. Road Traffic Noise

This section provides the details and the results of each mitigation scenario.

There were four main mitigation scenarios that were modelled, as provided in Table 4-1. The calculation heights that are required by the Greater Cambridge Planning Service are also provided.

Table 4-1 - Road Traffic Noise Mitigation Scenarios and Prediction Height

Mitigation Scenario	Mitigation Options	Prediction Heights (Above Ground)
No Mitigation	None	Ground Floor (1.5m) 2nd Floor (6.5m) 5th Floor (15.0m)
1) Roadside Barrier	a) 2m high b) 4m high c) 5m high	Ground Floor (1.5m) 2nd Floor (6.5m) 5th Floor (15.0m)
2) Combination Bund and Barrier – 3m high bund	a) With 3m high barrier b) With 4m high barrier	Ground Floor (1.5m)
3) Combination Bund and Barrier – Road height bund (3m-6m above ground)	a) With 3m high barrier b) With 4m high barrier	Ground Floor (1.5m)
4) Barrier Apartment Block	a) 4 Storeys High b) 8 Storeys High c) 4 Storeys High with a 4m Roadside Barrier	Ground Floor (1.5m)

4.1. Road Traffic Noise Modelling Results

4.1.1. No Mitigation – Road Traffic Noise

In this prediction scenario, the noise model calculated road traffic noise levels within the study area without any mitigation in place beyond the measures incorporated into the A14 Cambridge to Huntingdon Scheme.

- The night time $L_{Aeq, 8hr}$ noise contours are shown from Figure 4-1 to Figure 4-3,
- The daytime $L_{Aeq, 16hr}$ noise contours are shown from Figure 4-4 to Figure 4-6, and
- The day, evening and night, L_{den}, contours are shown from Figure 4-7 to Figure 4-9.

Figure 4-1 - No Mitigation – Night Time $L_{Aeq, 8hr}$ – Ground Floor

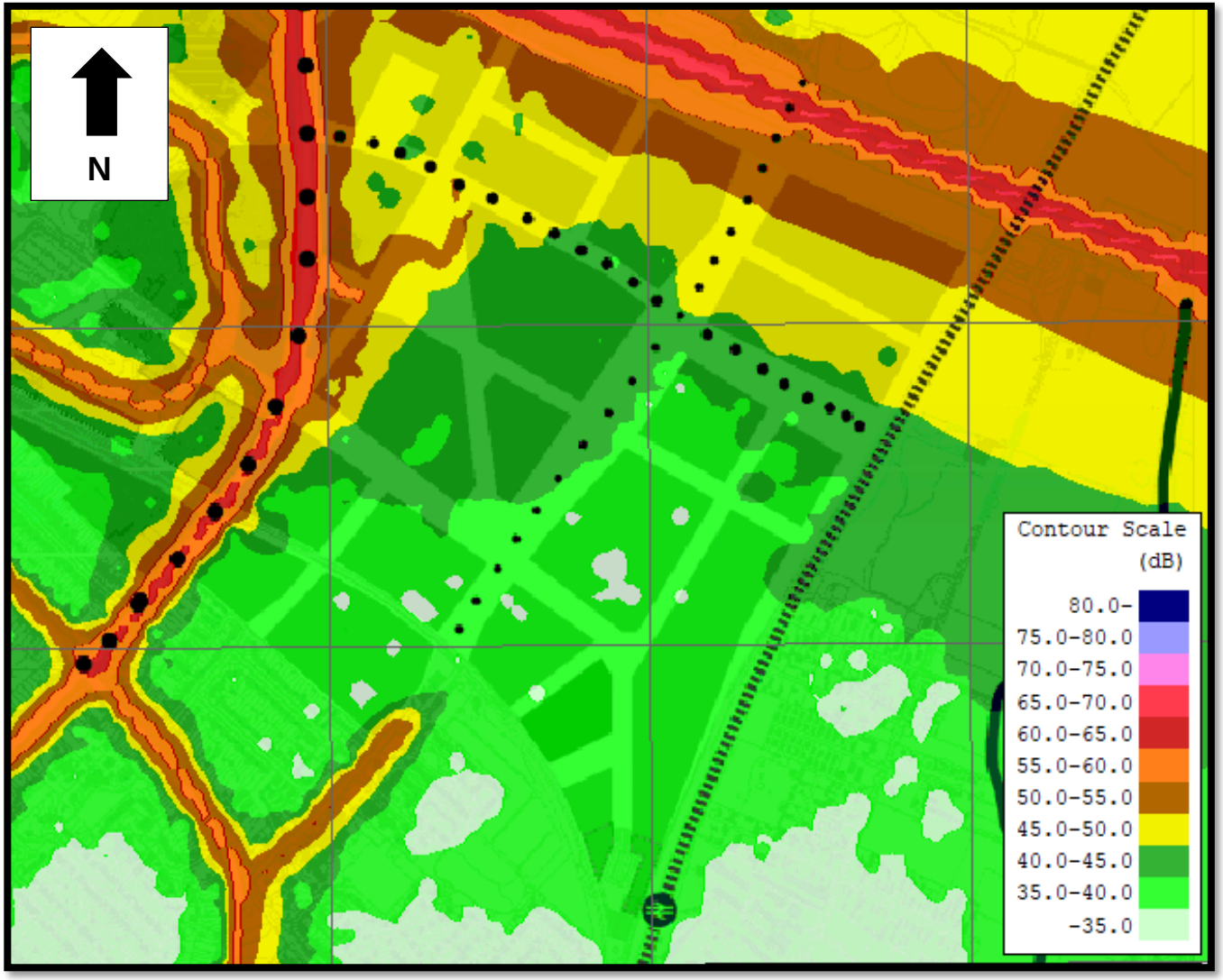


Figure 4-2 - No Mitigation – Night Time $L_{Aeq, 8hr}$ – Second Floor

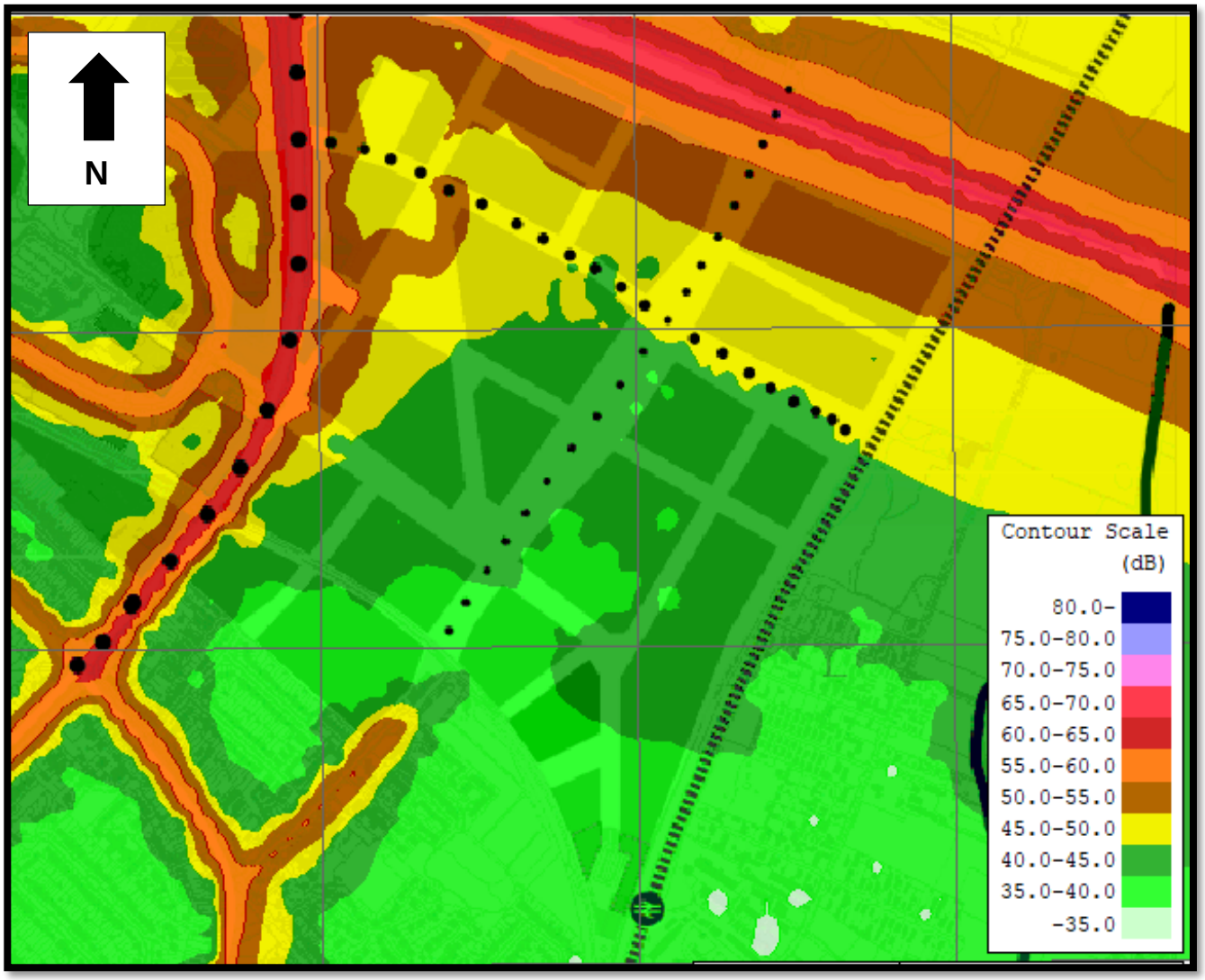


Figure 4-3 - No Mitigation – Night Time $L_{Aeq, 8hr}$ – Fifth Floor

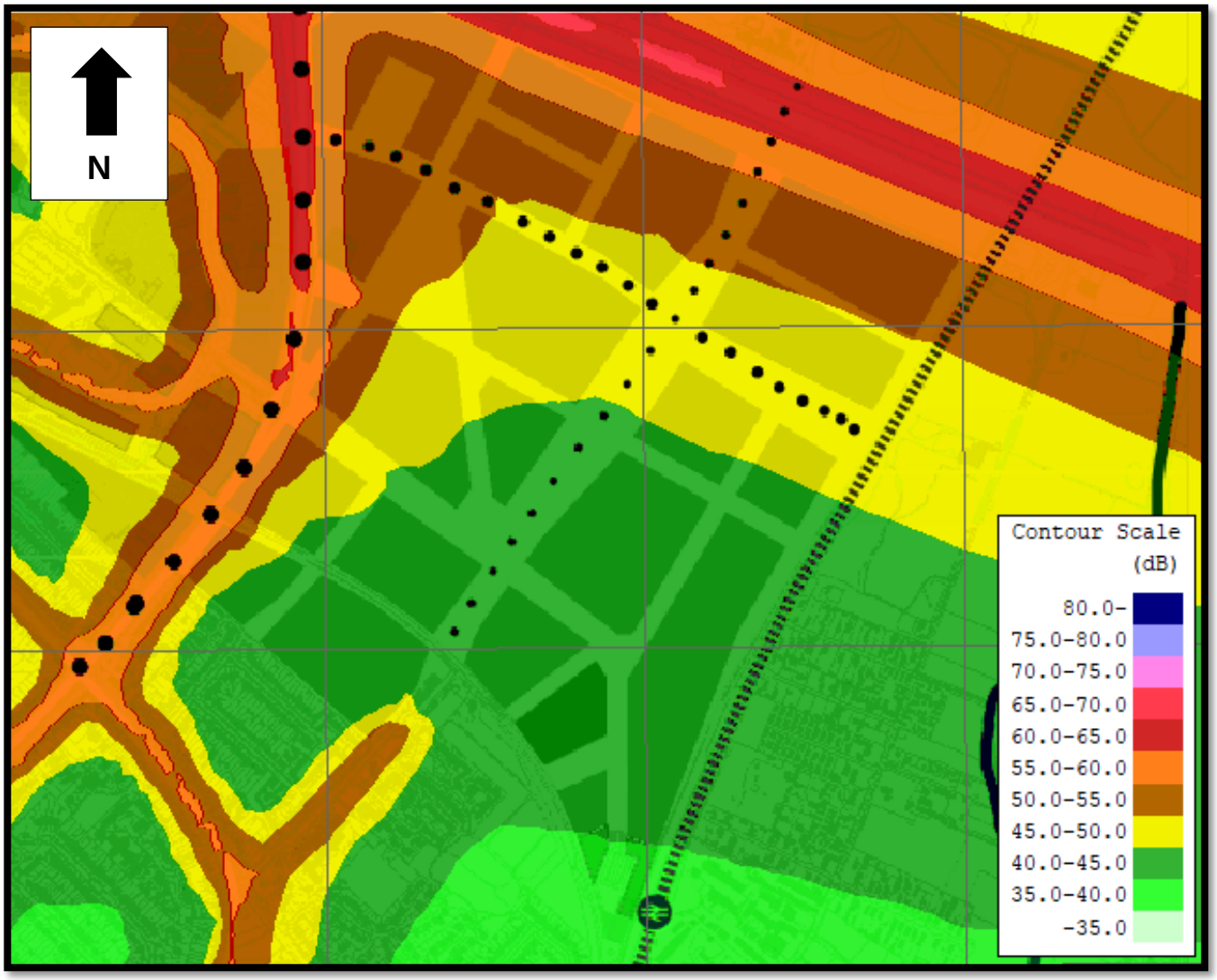


Figure 4-4 - No Mitigation – Daytime $L_{Aeq, 16hr}$ – Ground Floor

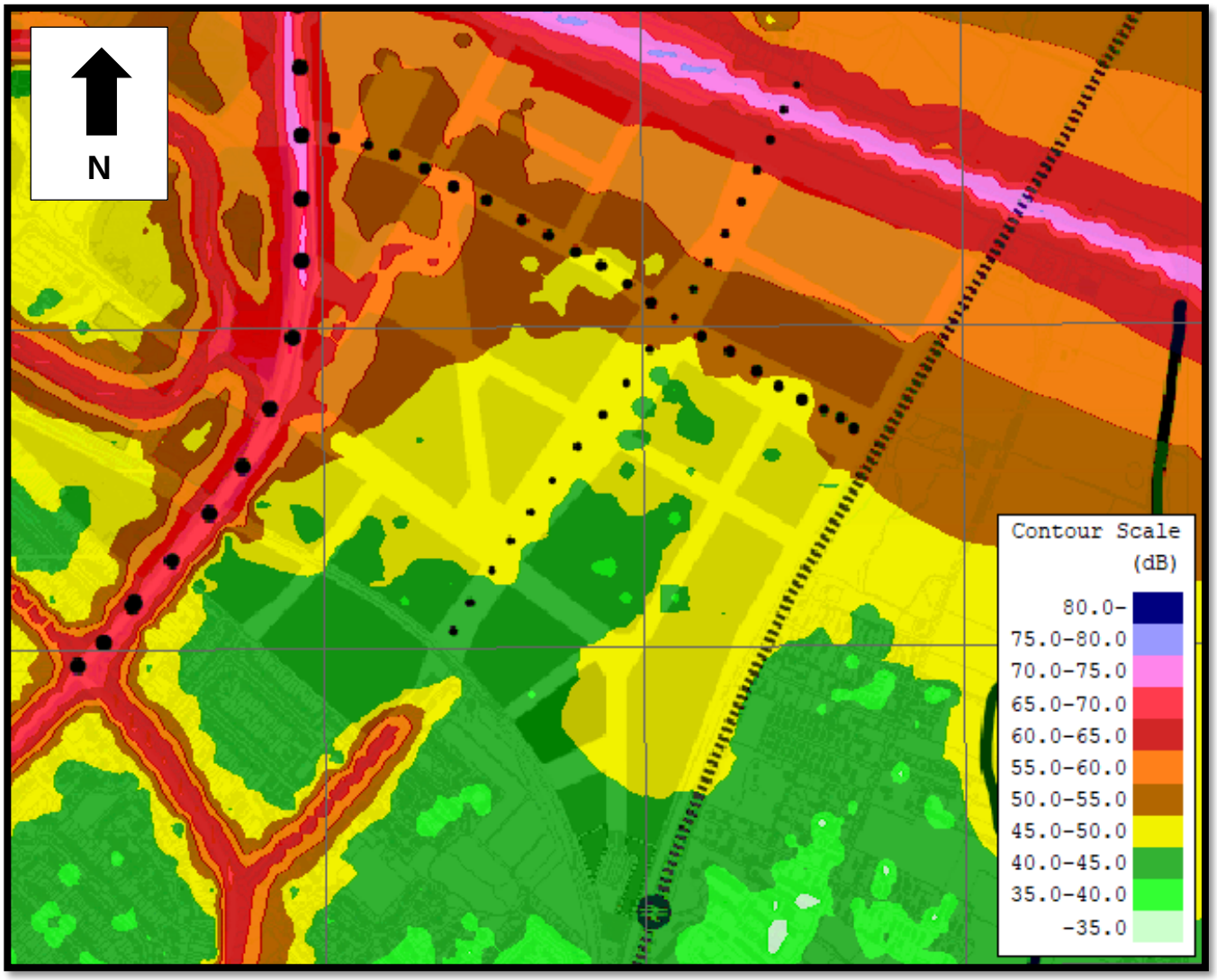


Figure 4-5 - No Mitigation – Daytime $L_{Aeq, 16hr}$ – Second Floor

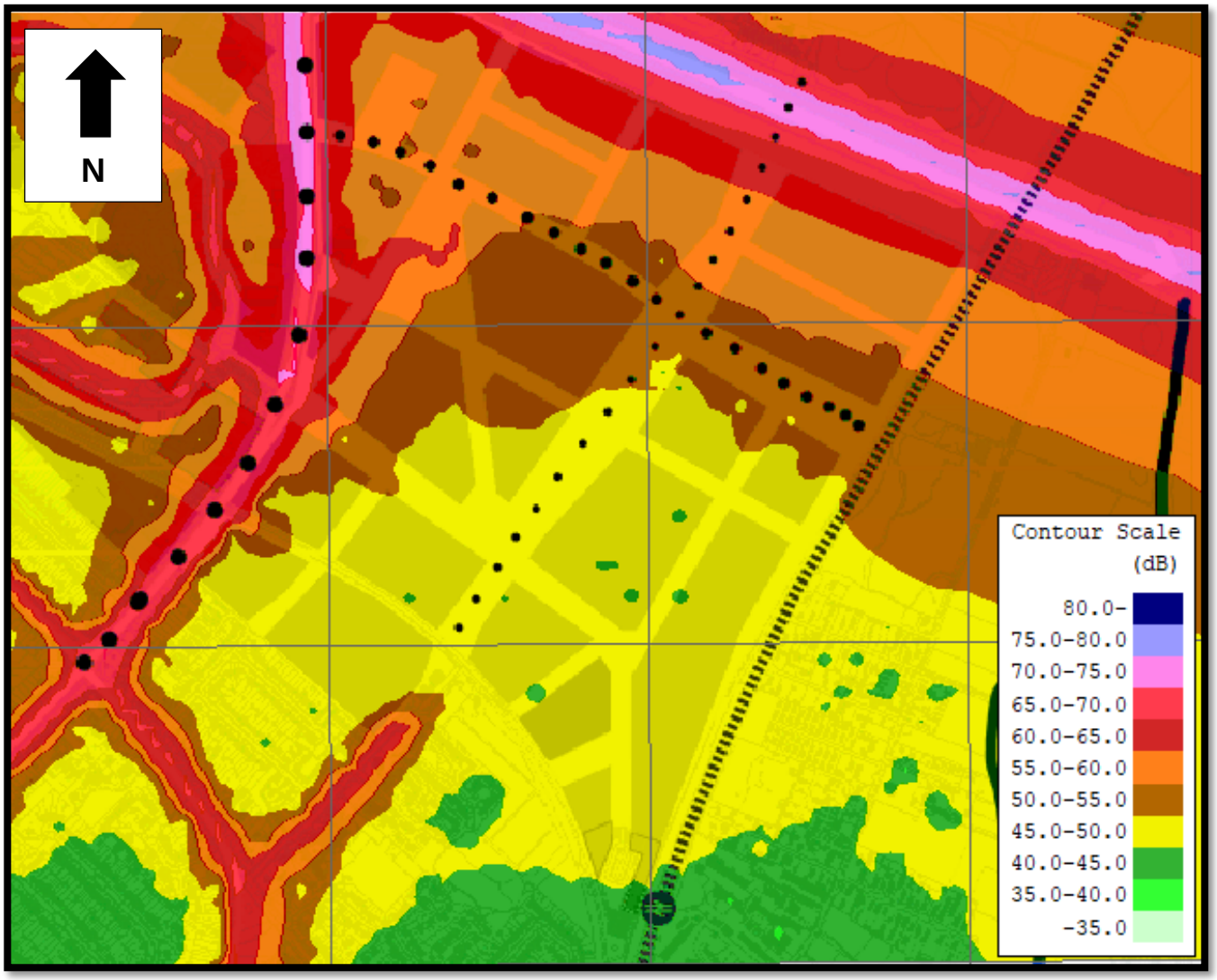


Figure 4-6 - No Mitigation – Daytime $L_{Aeq, 16hr}$ – Fifth Floor

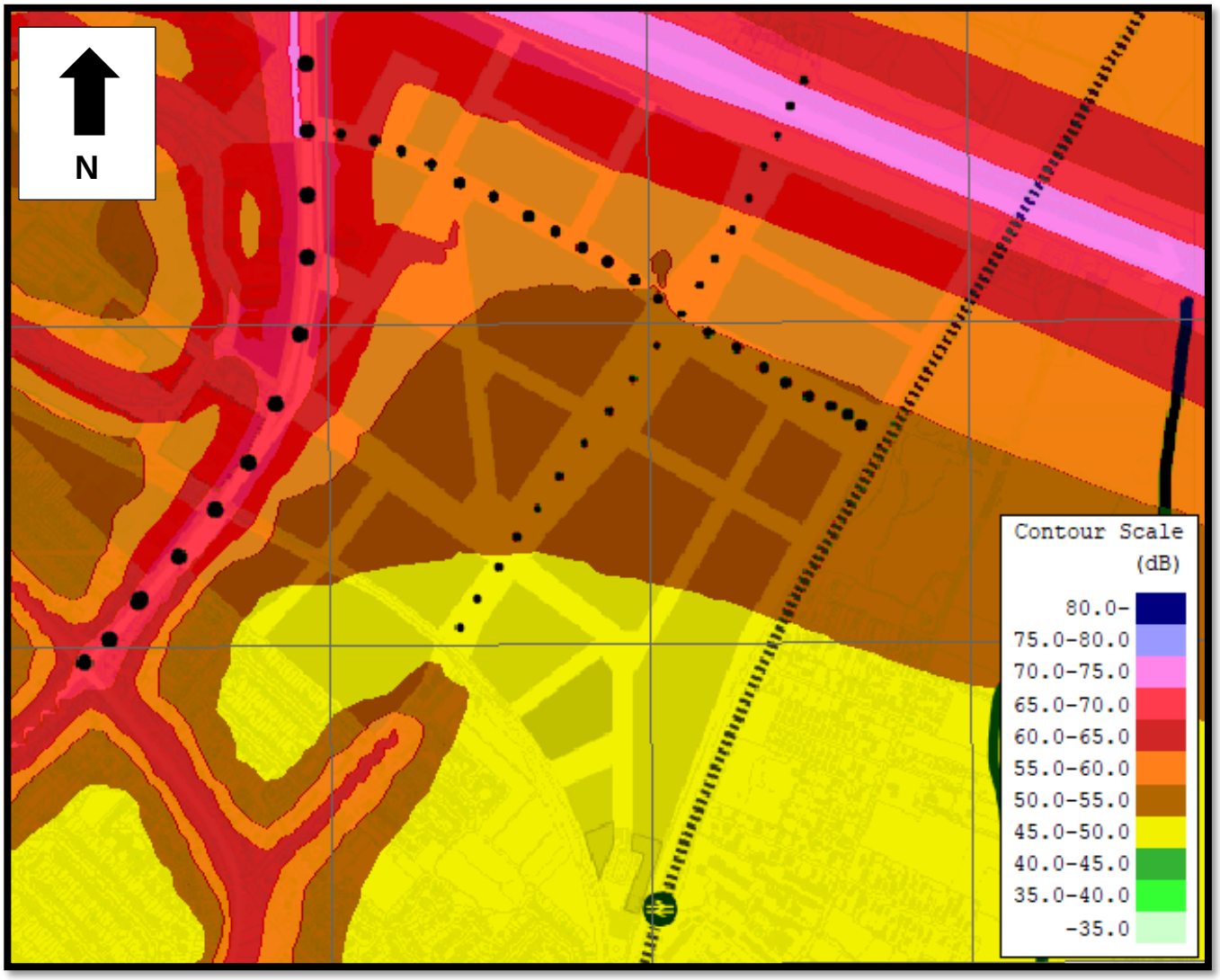


Figure 4-7 - No Mitigation – Day, Evening and Night L_{den} – Ground Floor

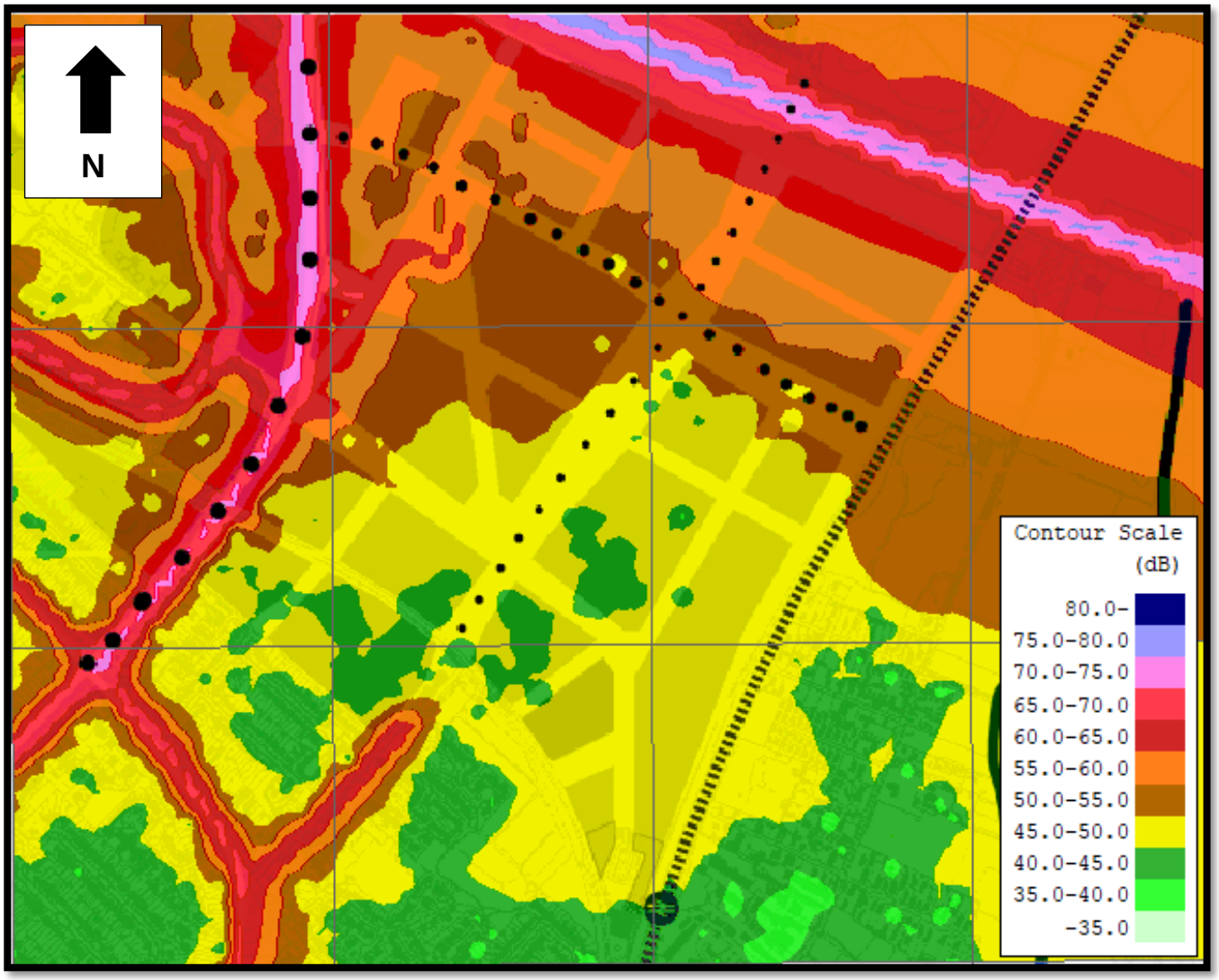


Figure 4-8 - No Mitigation – Day, Evening and Night L_{den} – Second Floor

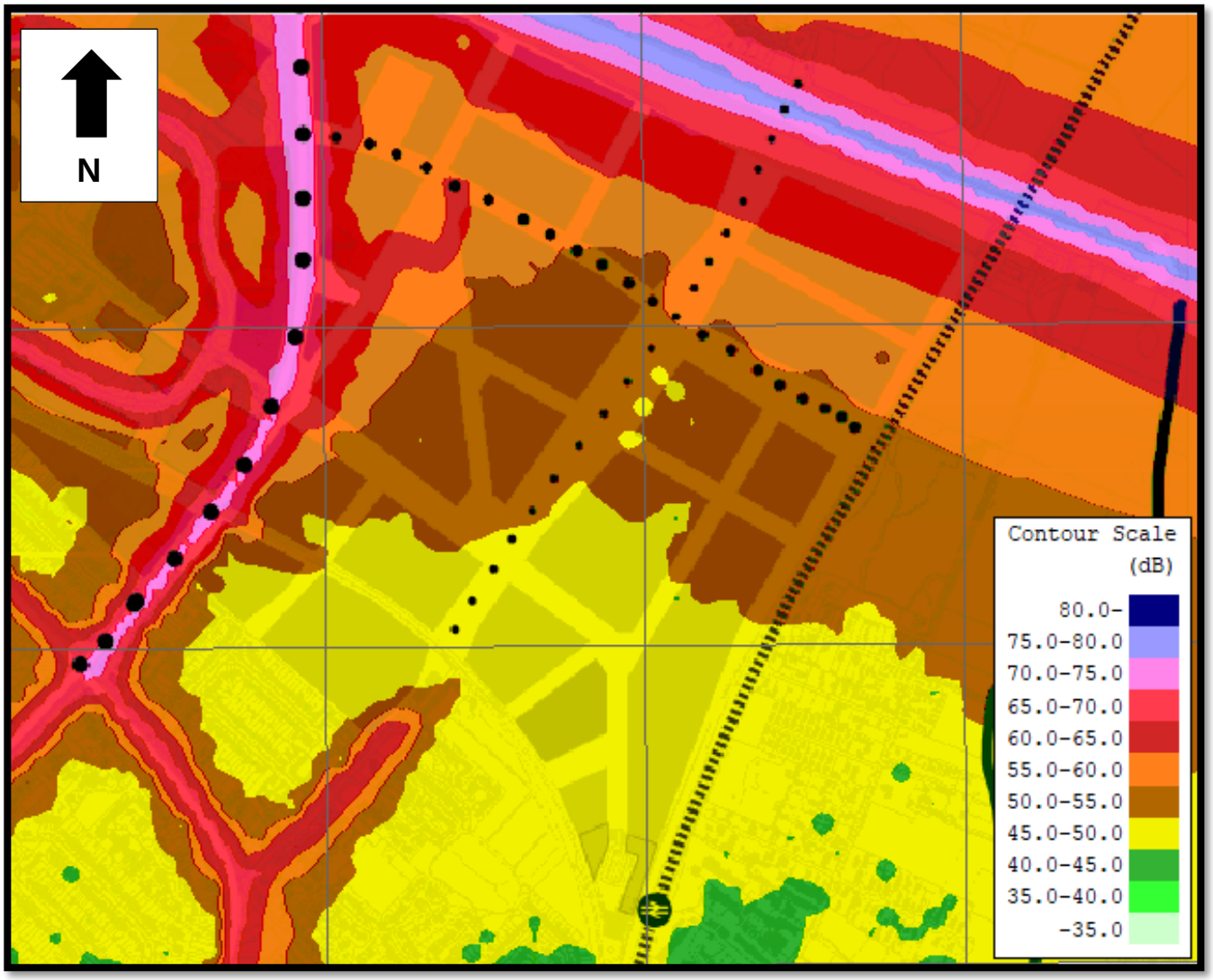
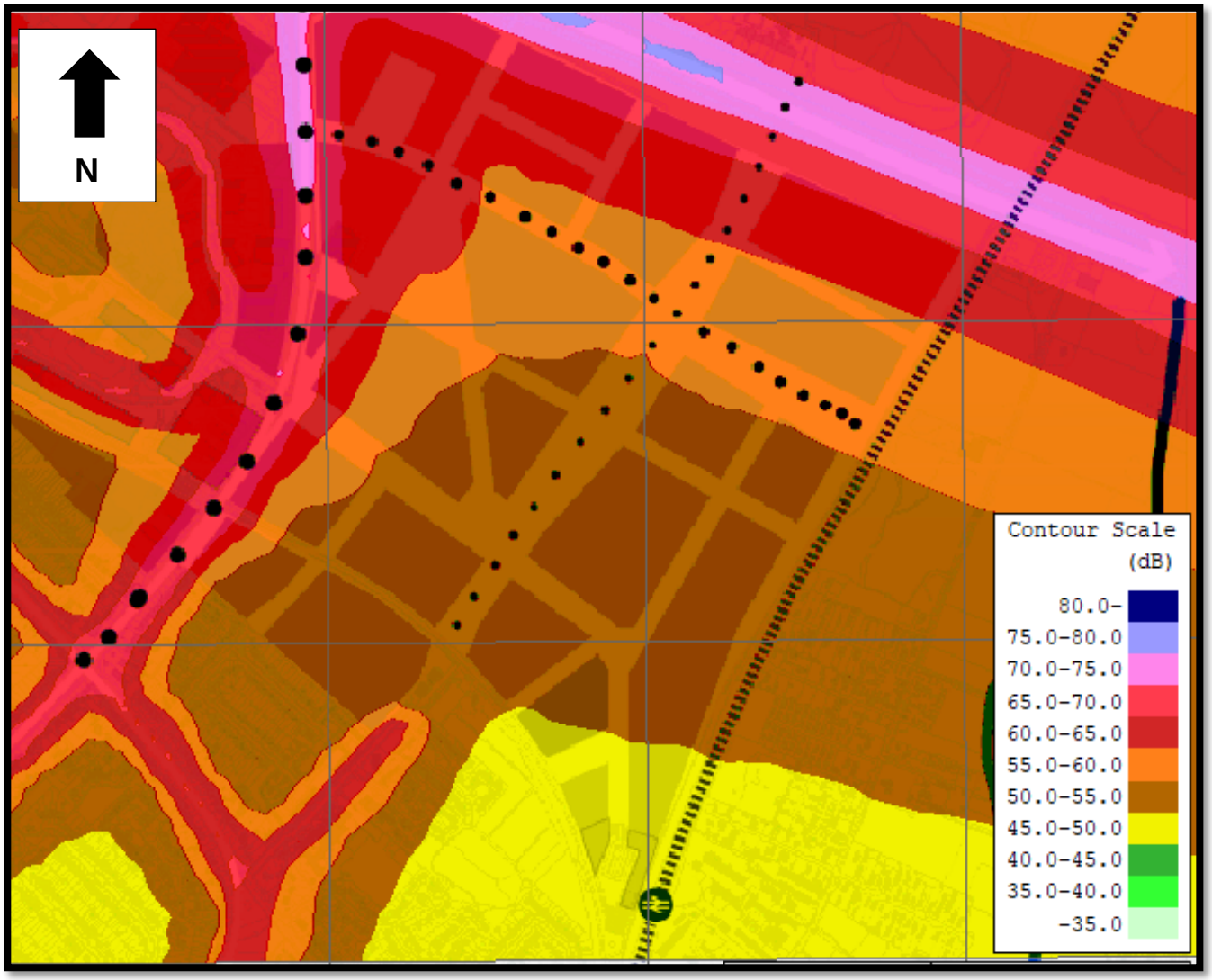


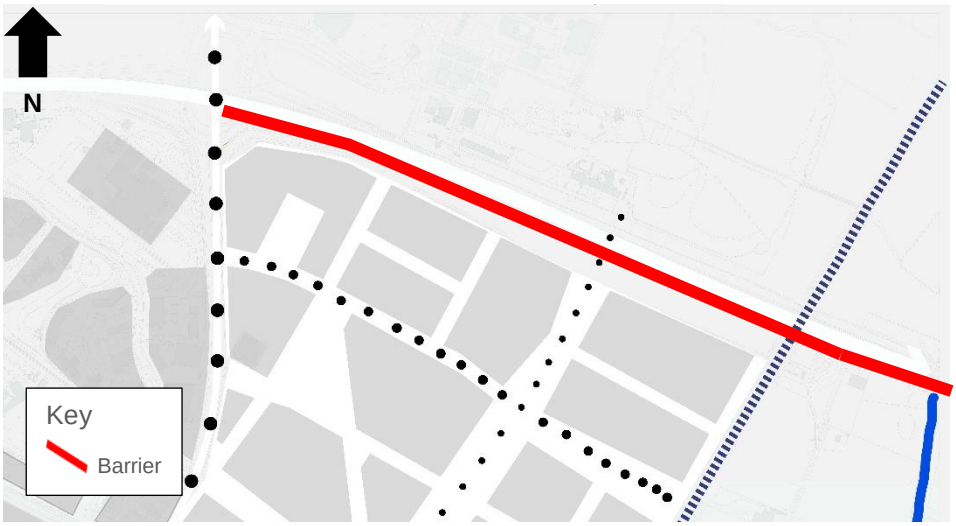
Figure 4-9 - No Mitigation – Day, Evening and Night L_{den} – Fifth Floor



4.1.2. Mitigation Option 1 –Roadside Barrier

The first road traffic noise mitigation option that has been considered is a 1,150m long noise barrier that would be installed alongside the A14 towards the northern boundary of the proposed development. The noise barrier would extend from Cowley Road to just beyond the River Cam (shown in blue). Figure 4-10 shows the location of the noise barrier.

Figure 4-10 - Suggested Location of Roadside Barrier



Three different options have been modelled, a 2m high, a 4m high and a 5m high environmental noise barrier. The barrier is situated adjacent to the A14, with the base of the barrier at road height, the development area behind the barrier varies from being at road height to the west and 6m below road height to the east.

a) A 2m High Environmental Noise Barrier

- The night time $L_{Aeq, 8hr}$ noise contours are shown from Figure 4-11 to Figure 4-13,
- The daytime $L_{Aeq, 16hr}$ noise contours are shown from Figure 4-14 to Figure 4-16 and
- The day, evening and night, L_{den}, contours are shown from Figure 4-17 to Figure 4-19.

b) A 4m High Environmental Noise Barrier

- The night time $L_{Aeq, 8hr}$ noise contours are shown from Figure 4-20 to Figure 4-22,
- The daytime $L_{Aeq, 16hr}$ noise contours are shown from Figure 4-23 to Figure 4-25, and
- The day, evening and night, L_{den}, contours are shown from Figure 4-26 to Figure 4-28.

c) A 5m High Environmental Noise Barrier

- The night time $L_{Aeq, 8hr}$ noise contours are shown from Figure 4-29 to Figure 4-31,
- The daytime $L_{Aeq, 16hr}$ noise contours are shown from Figure 4-32 to Figure 4-34, and
- The day, evening and night, L_{den}, contours are shown from Figure 4-35 to Figure 4-37.

2m High Roadside Barrier

Figure 4-11 - 2m high roadside barrier – Night Time $L_{Aeq, 8hr}$ – Ground Floor

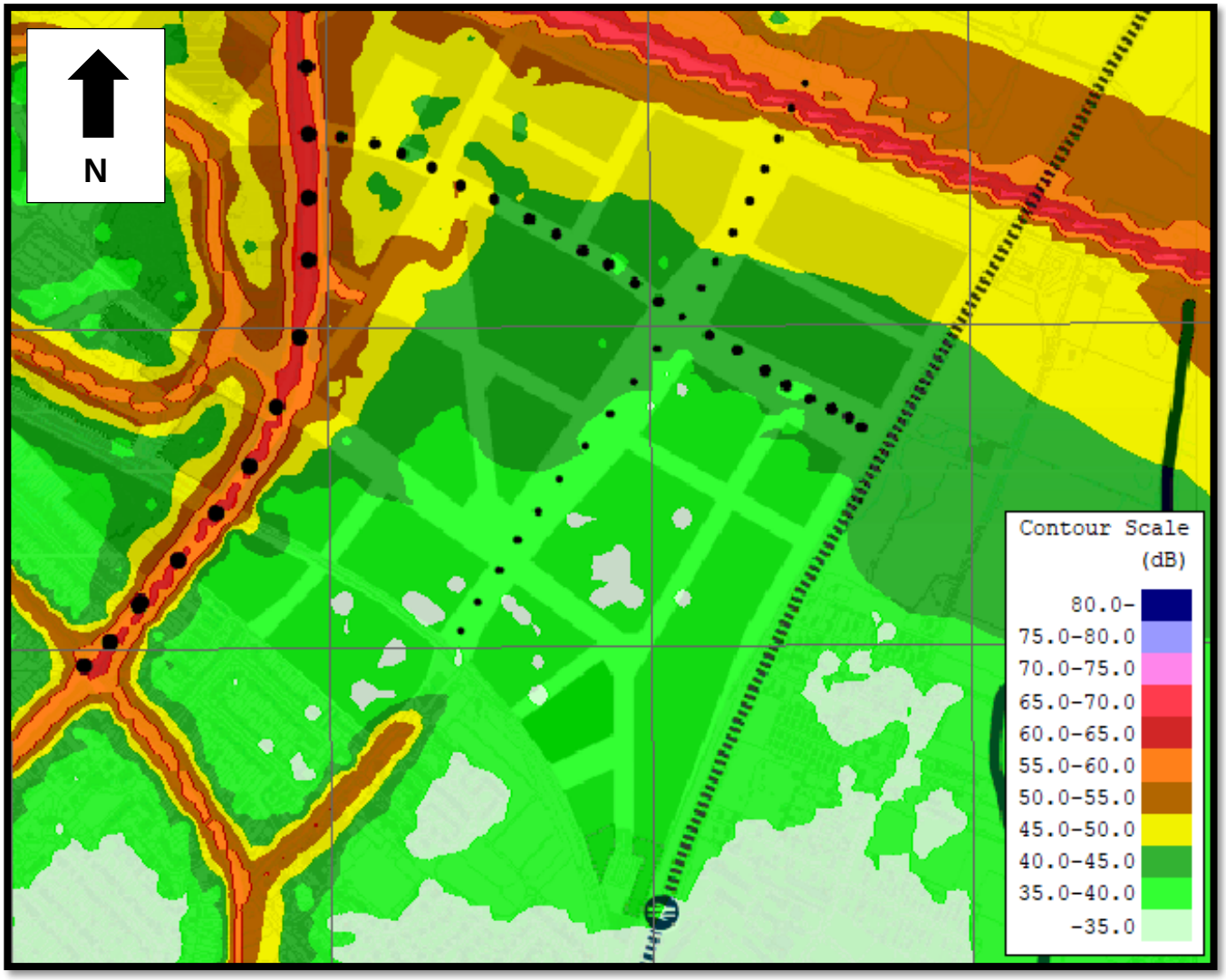


Figure 4-12 - 2m high roadside barrier – Night Time $L_{Aeq, 8hr}$ – Second Floor

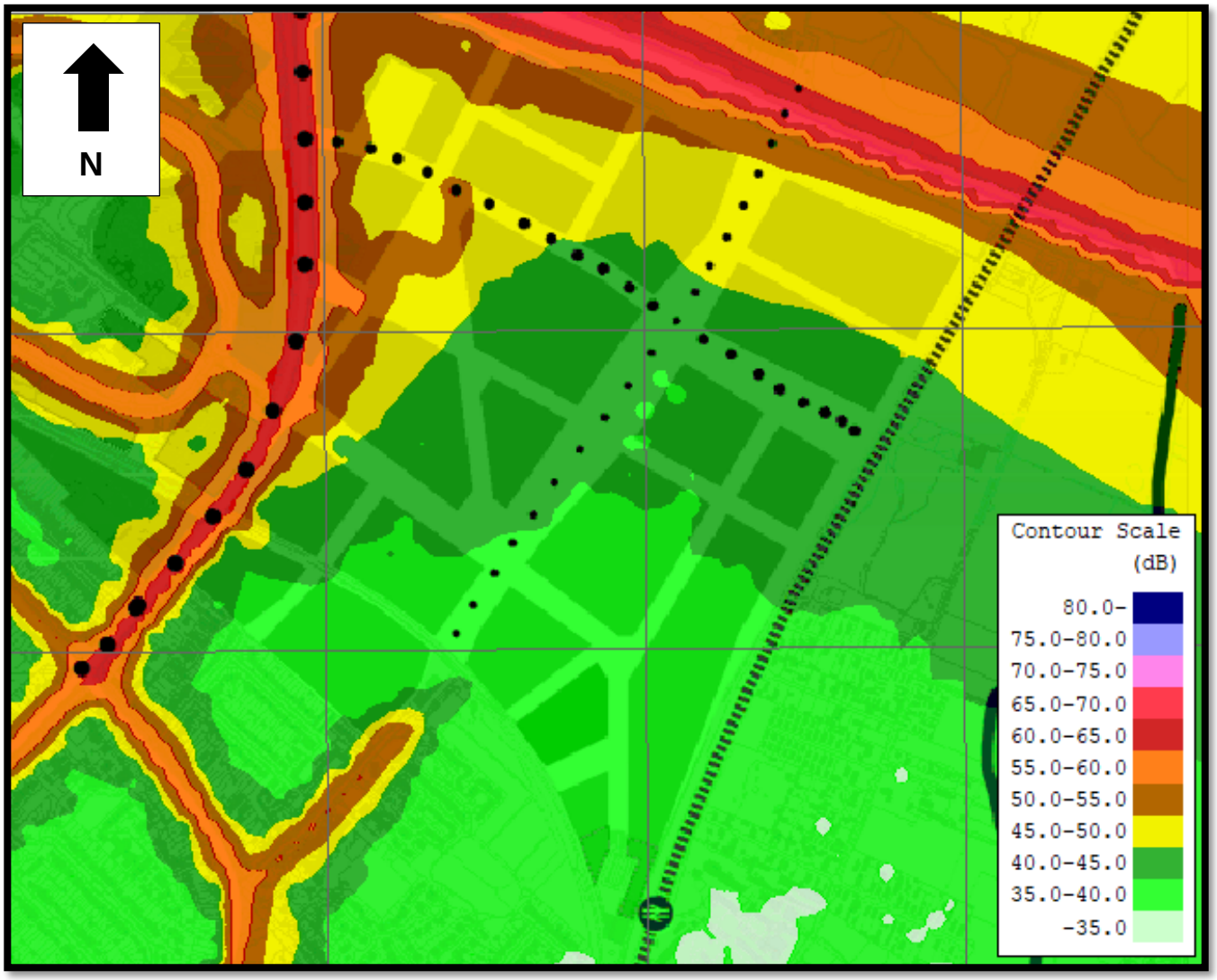


Figure 4-13 - 2m high roadside barrier – Night Time $L_{Aeq, 8hr}$ – Fifth Floor

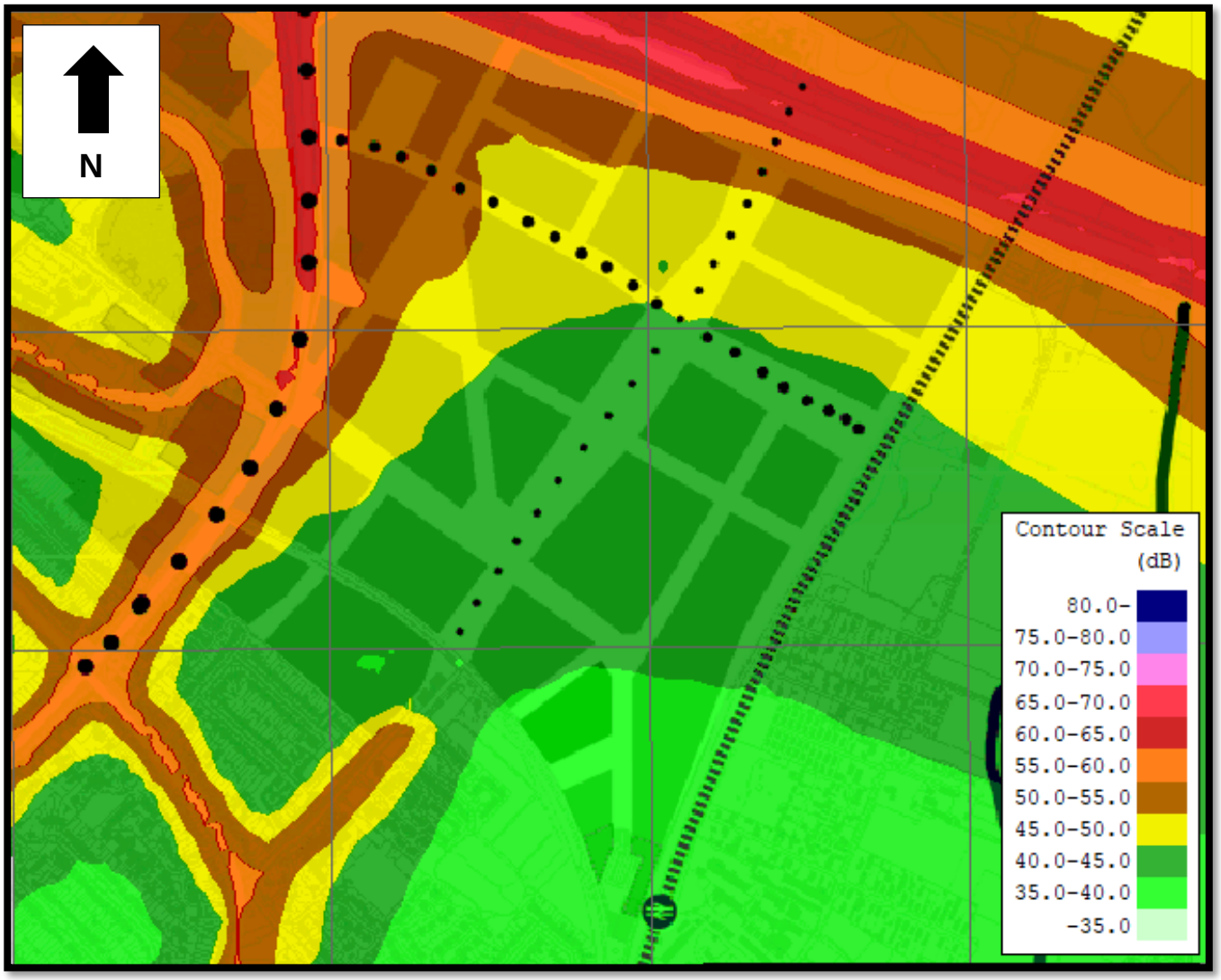


Figure 4-14 - 2m high roadside barrier – Daytime $L_{Aeq, 16hr}$ – Ground Floor

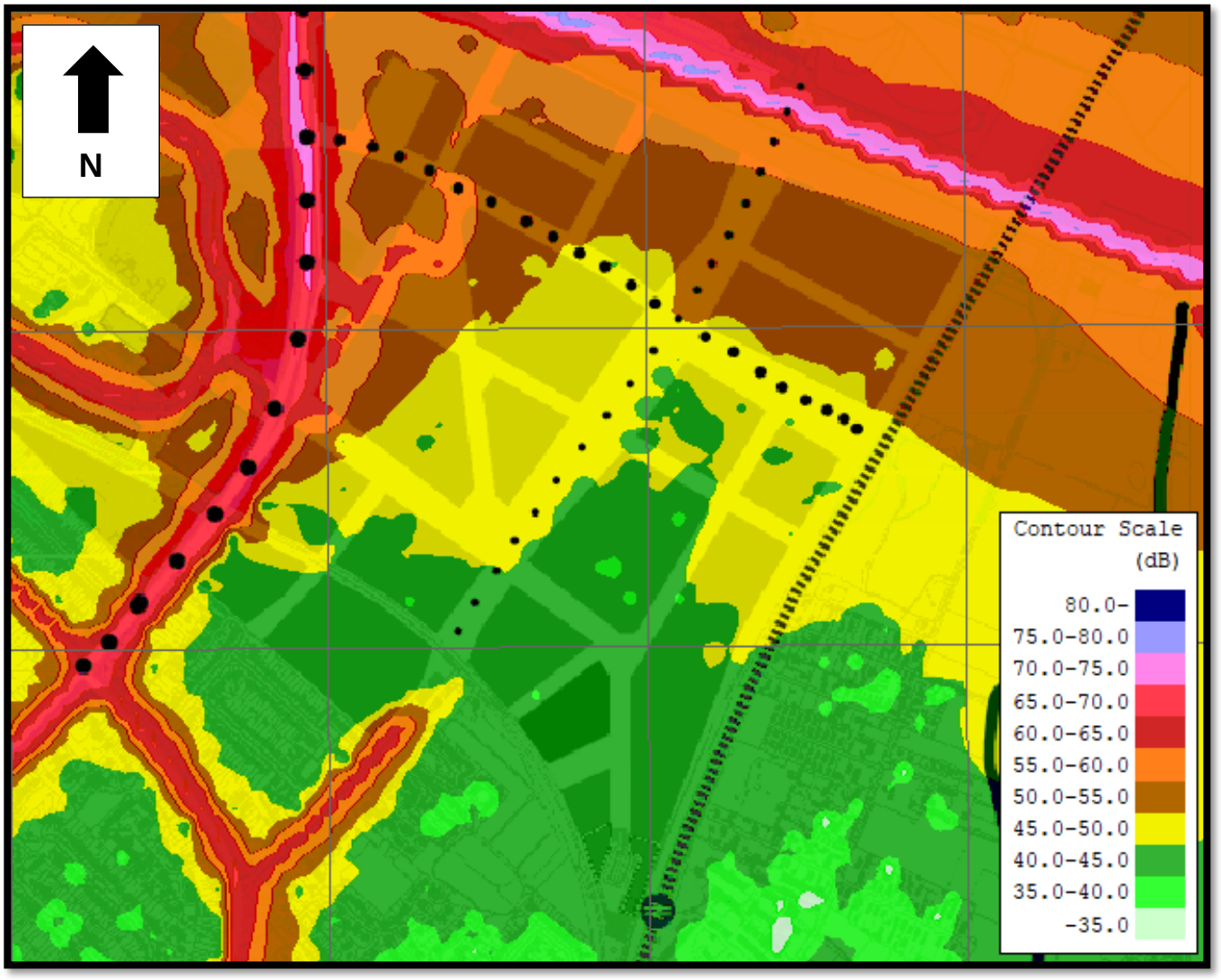


Figure 4-15 - 2m high roadside barrier – Daytime $L_{Aeq, 16hr}$ – Second Floor

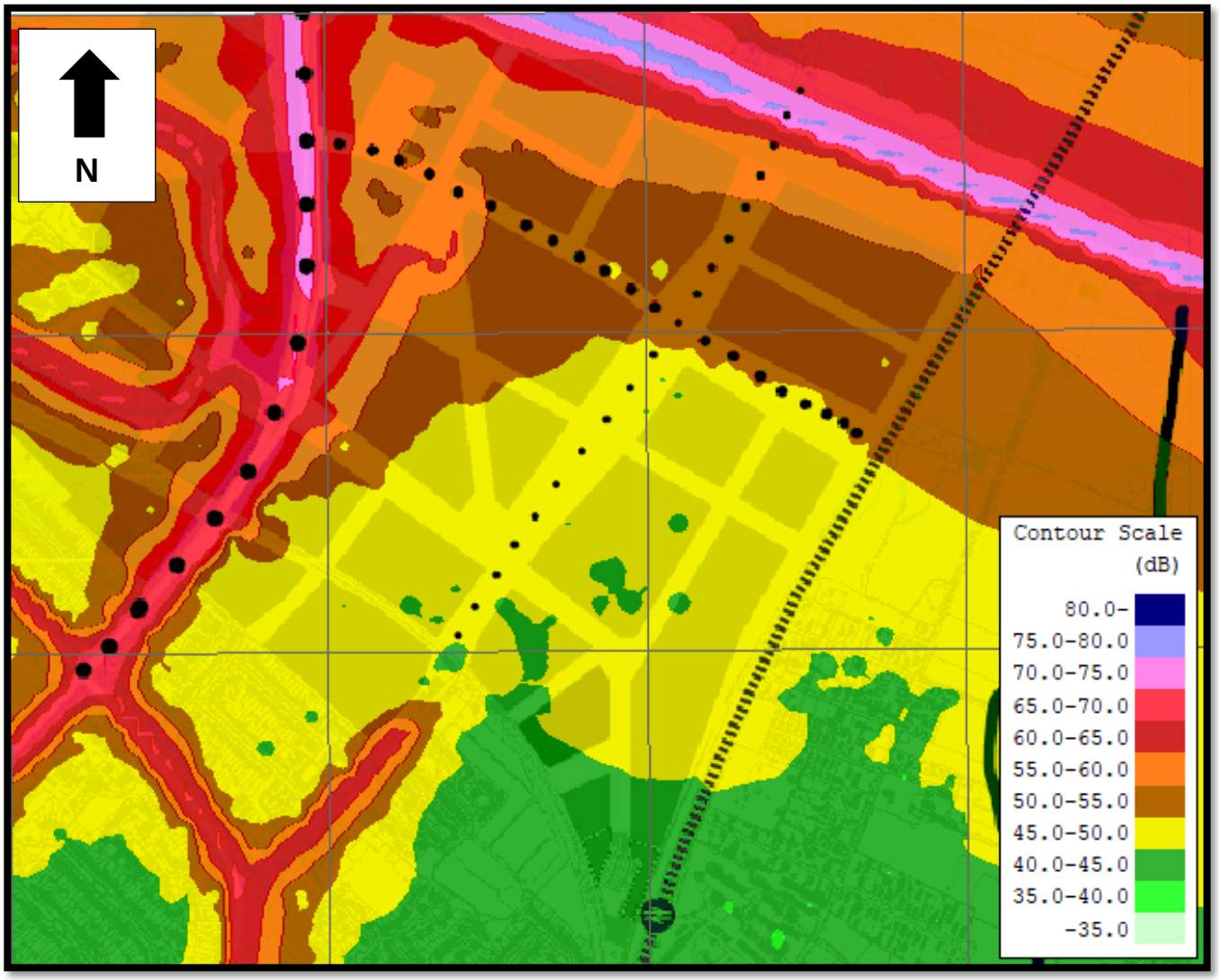


Figure 4-16 - 2m high roadside barrier – Daytime $L_{Aeq, 16hr}$ – Fifth Floor

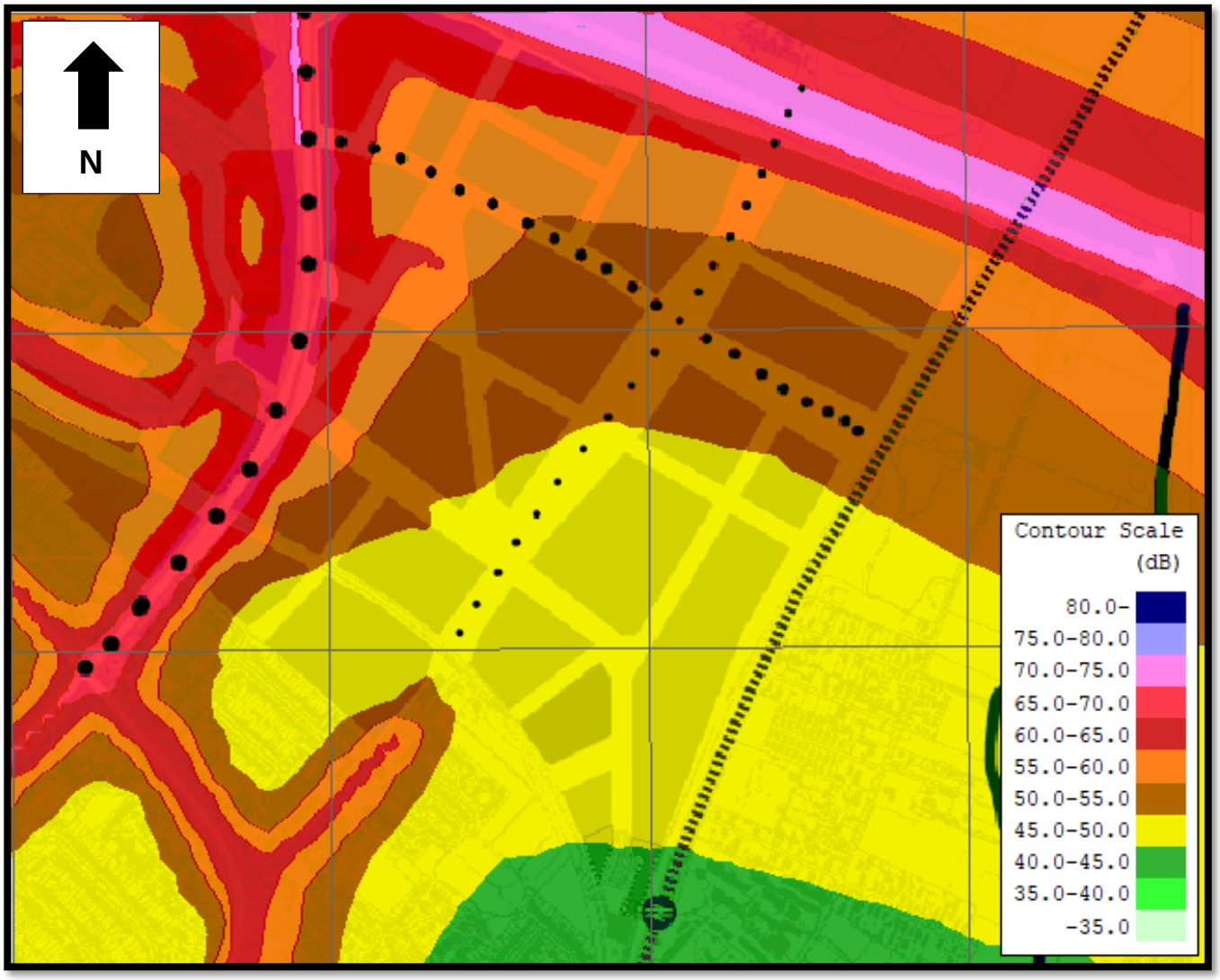


Figure 4-17 - 2m high roadside barrier – Day, Evening and Night L_{den} – Ground Floor

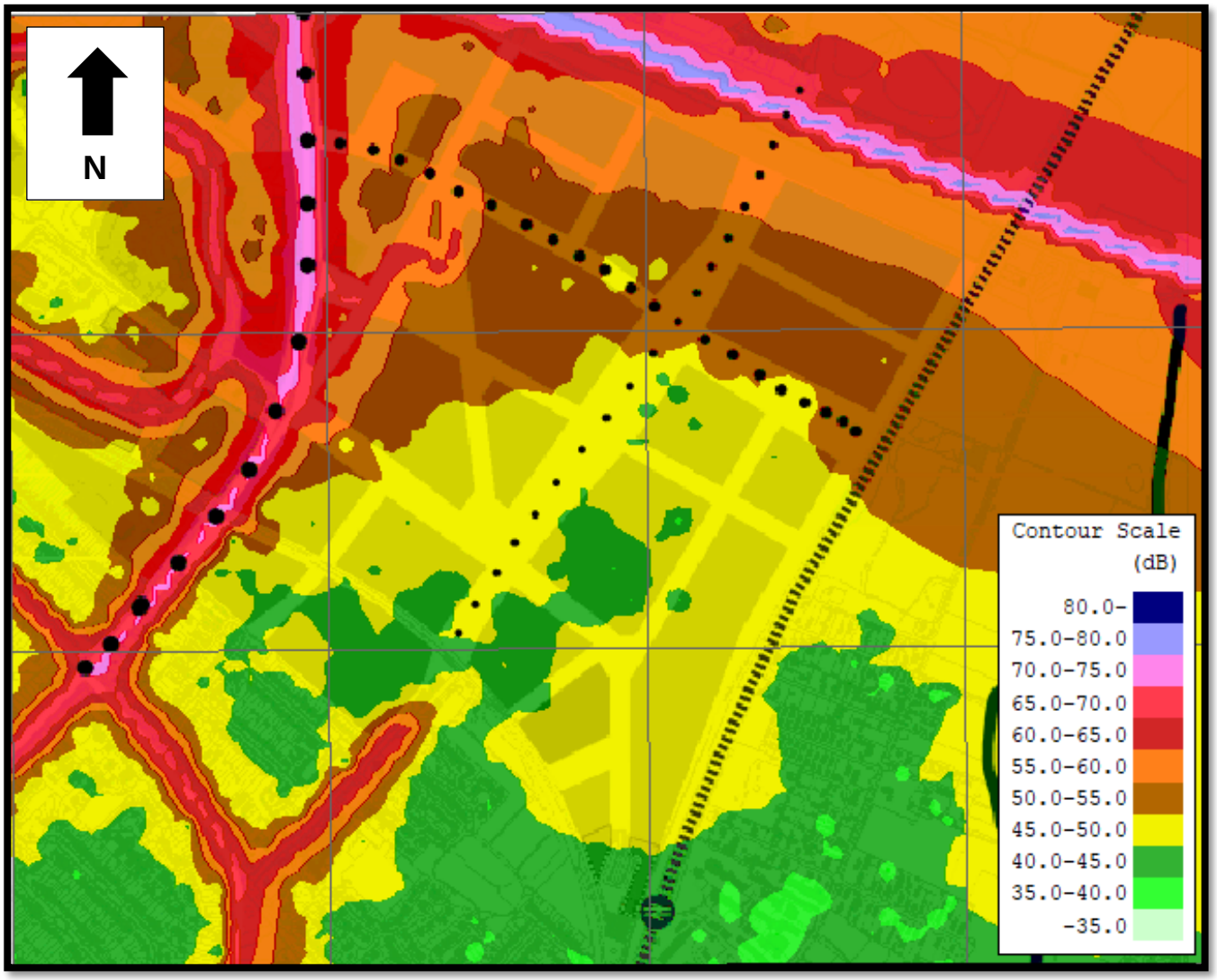


Figure 4-18 - 2m high roadside barrier – Day, Evening and Night L_{den} – Second Floor

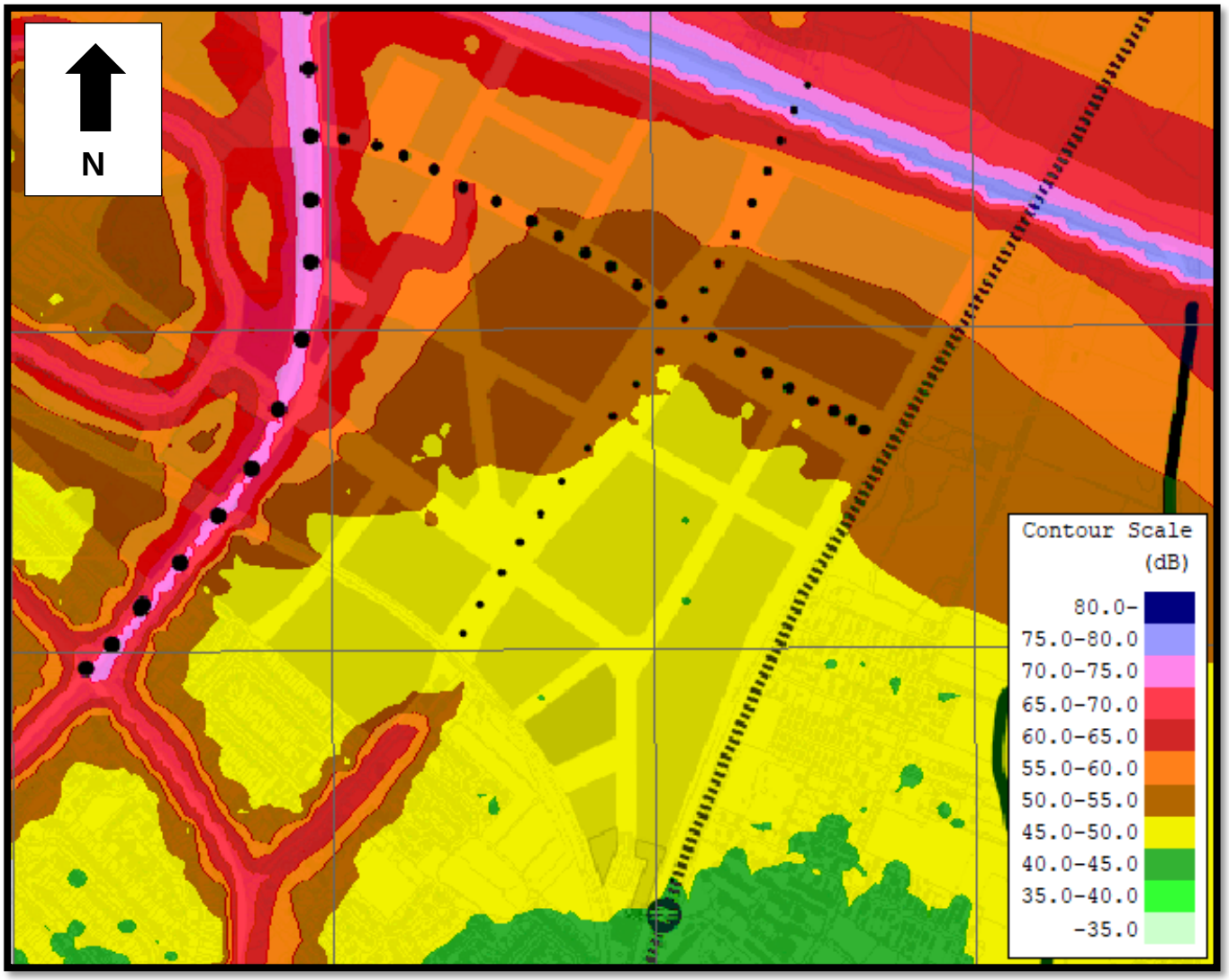
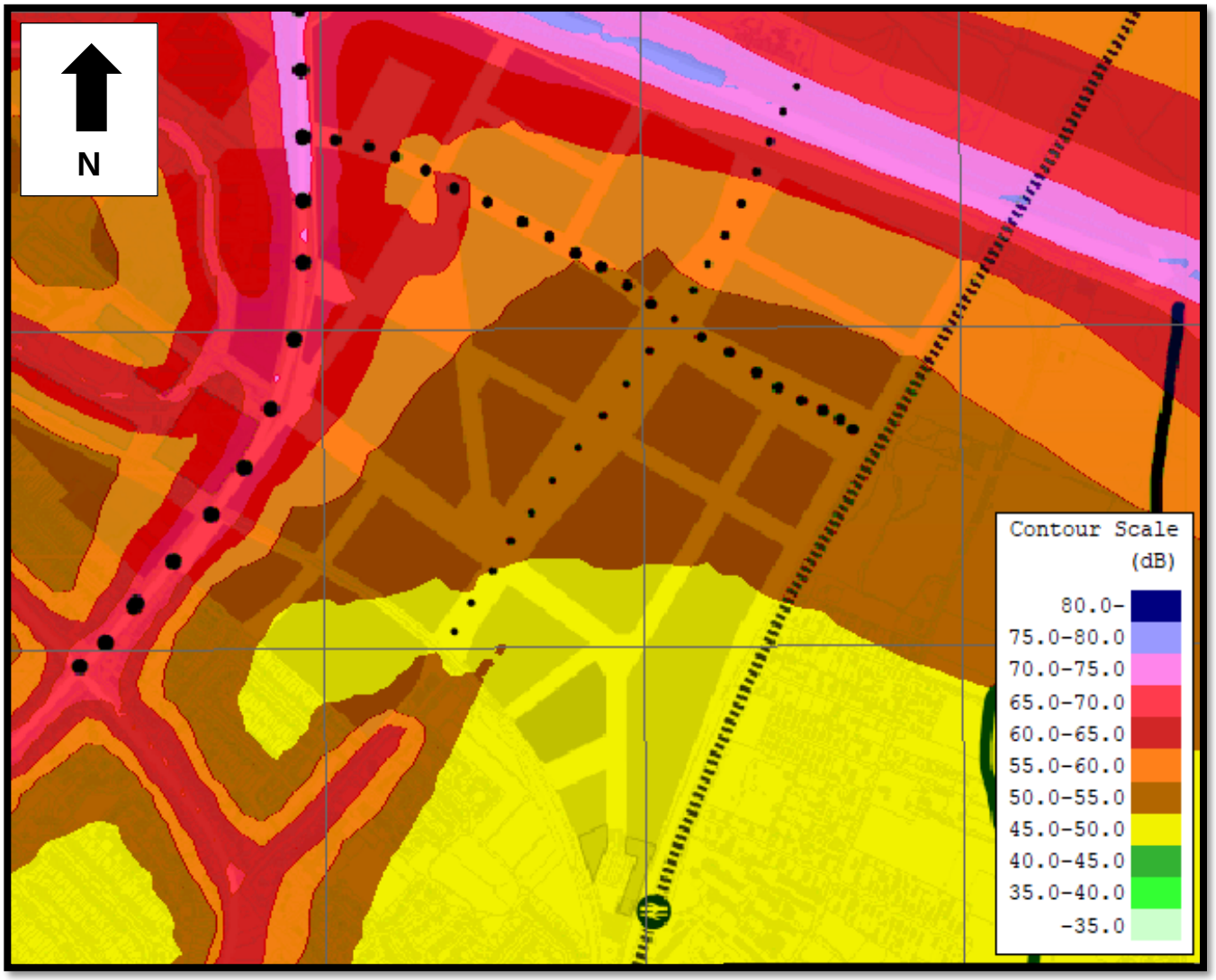


Figure 4-19 - 2m high roadside barrier – Day, Evening and Night L_{den} – Fifth Floor



4m High Roadside Barrier

Figure 4-20 - 4m high roadside barrier – Night Time $L_{Aeq, 8hr}$ – Ground Floor

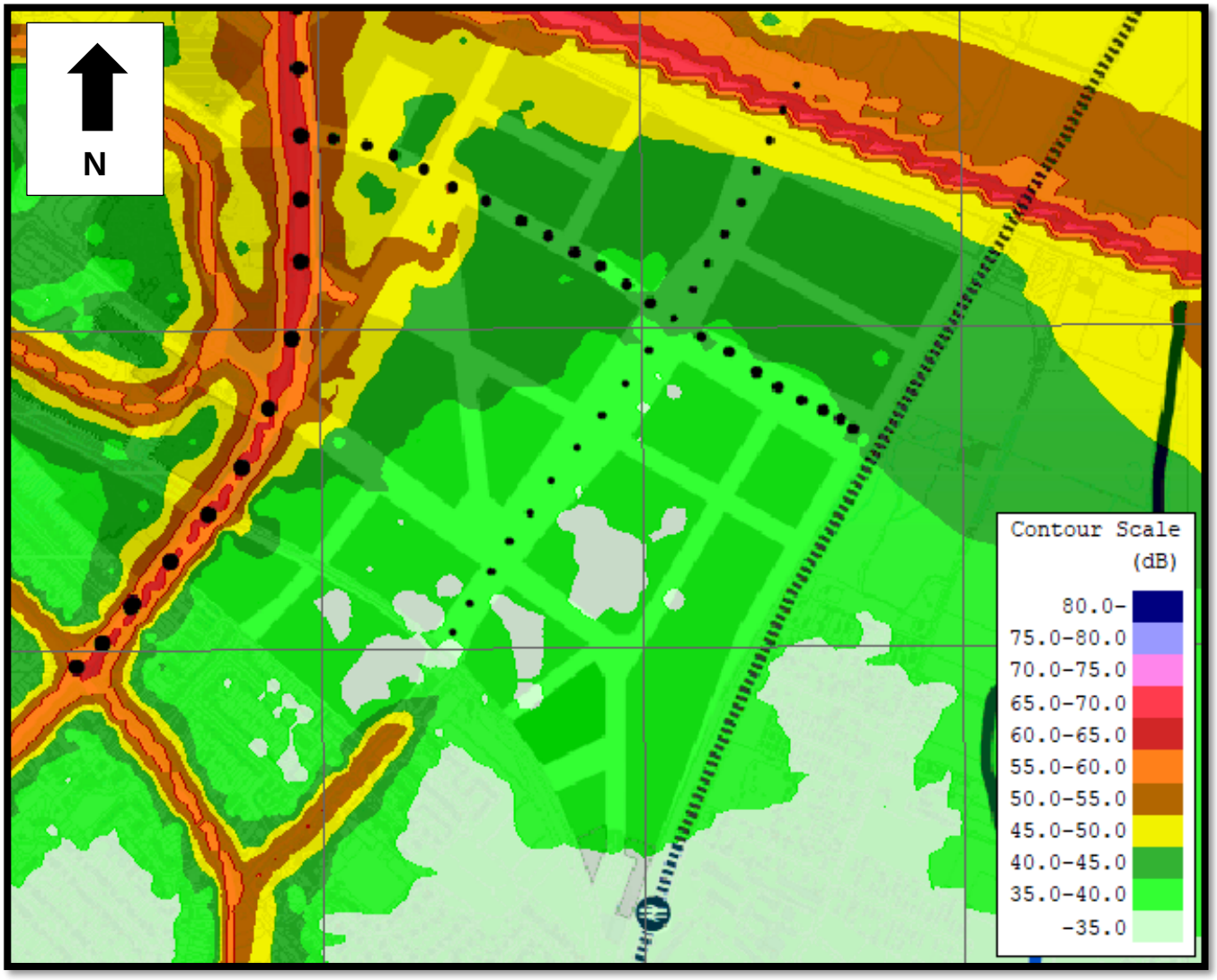


Figure 4-21 - 4m high roadside barrier – Night Time $L_{Aeq, 8hr}$ – Second Floor

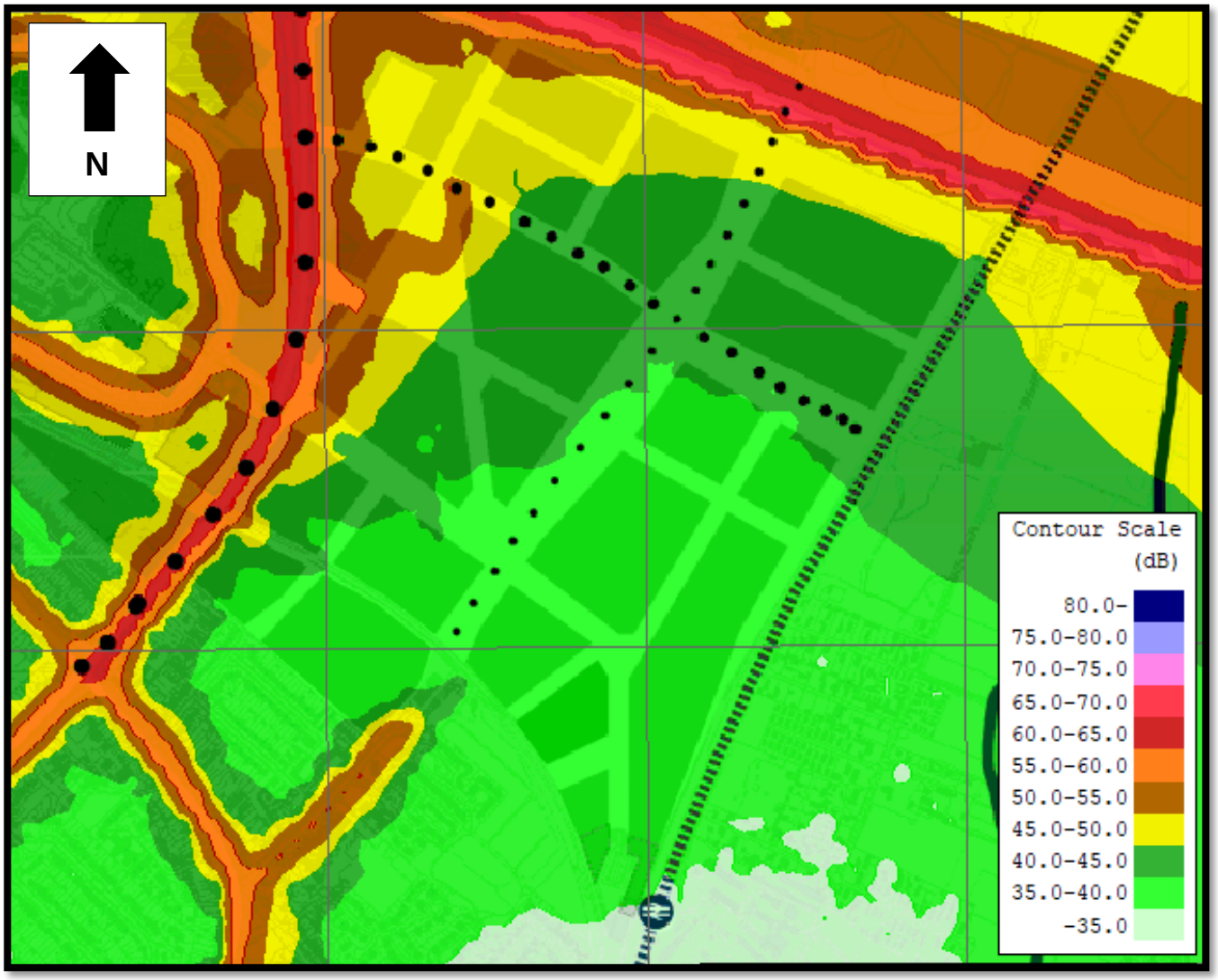


Figure 4-22 - 4m high roadside barrier – Night Time $L_{Aeq, 8hr}$ – Fifth Floor

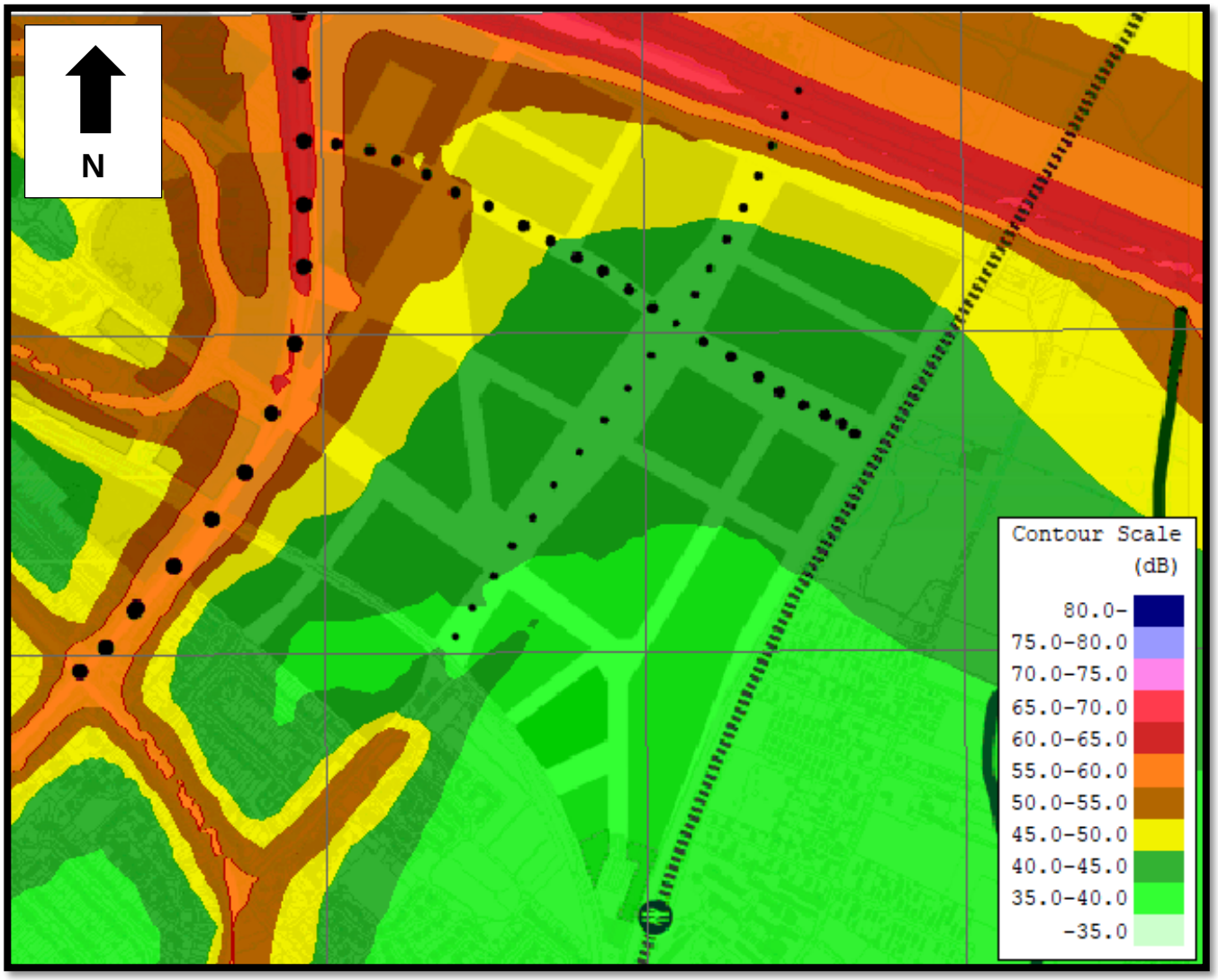


Figure 4-23 - 4m high roadside barrier – Daytime $L_{Aeq, 16hr}$ – Ground Floor

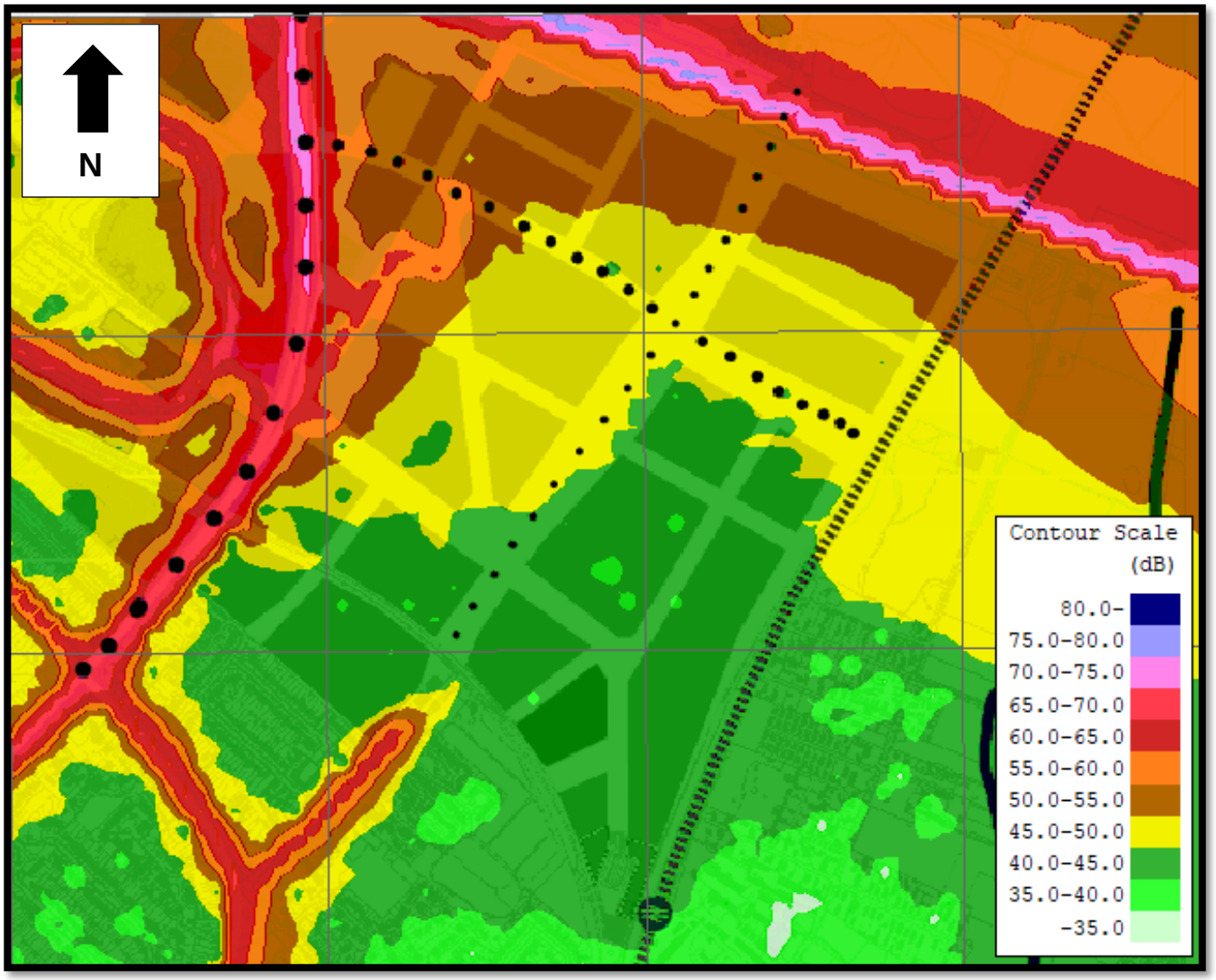


Figure 4-24 - 4m high roadside barrier – Daytime $L_{Aeq, 16hr}$ – Second Floor

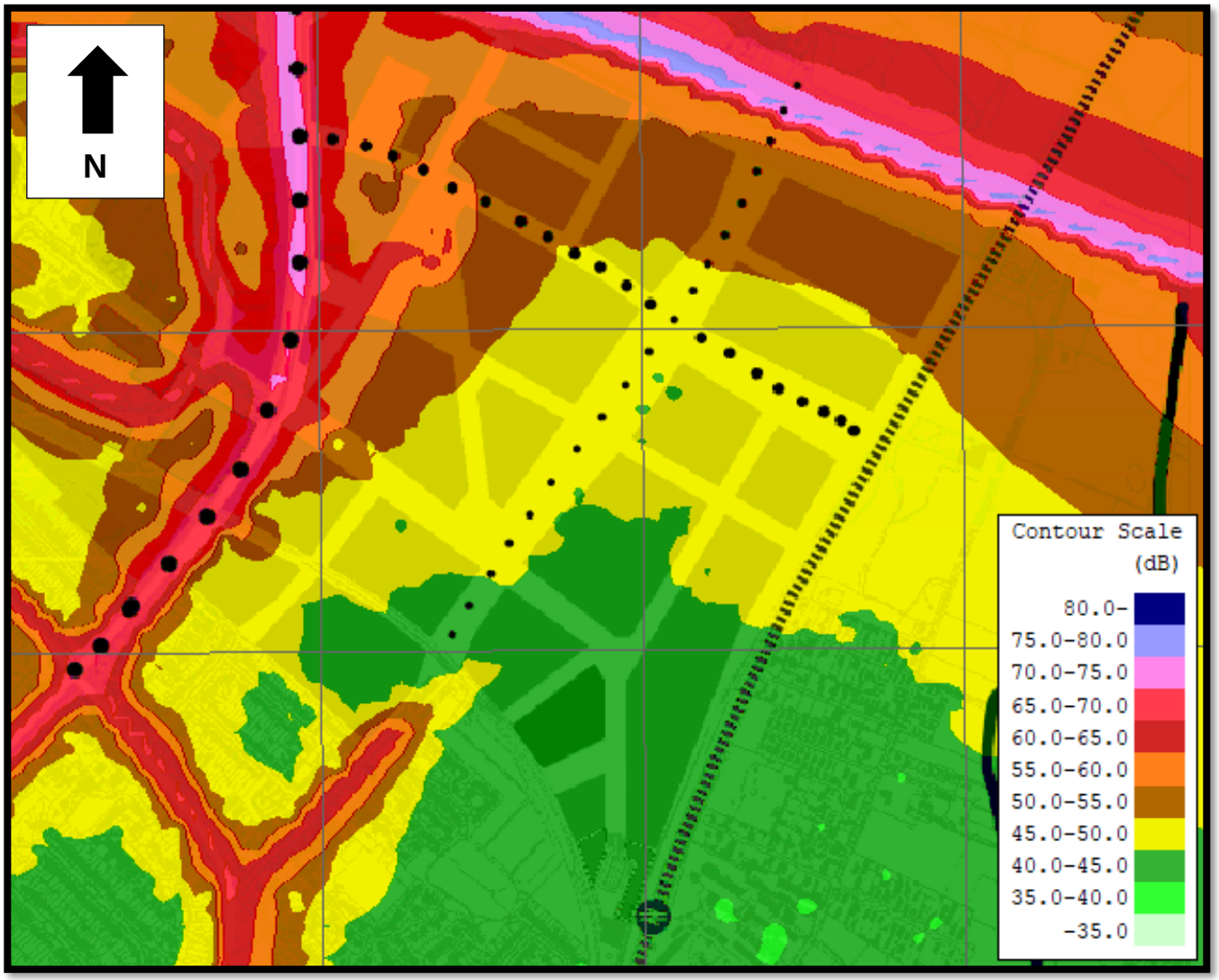


Figure 4-25 - 4m high roadside barrier – Daytime $L_{Aeq, 16hr}$ – Fifth Floor

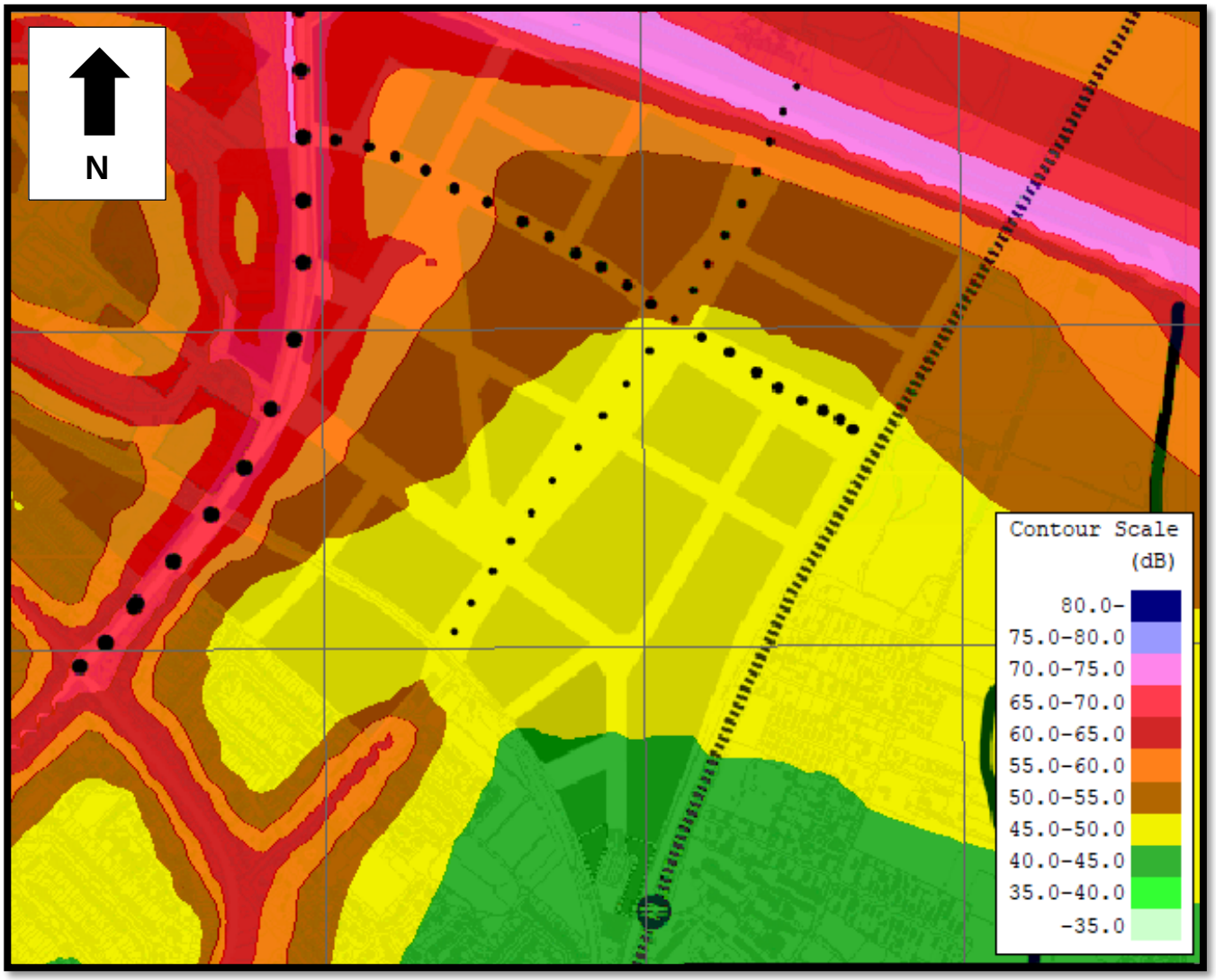


Figure 4-26 - 4m high roadside barrier – Day, Evening and Night L_{den} – Ground Floor

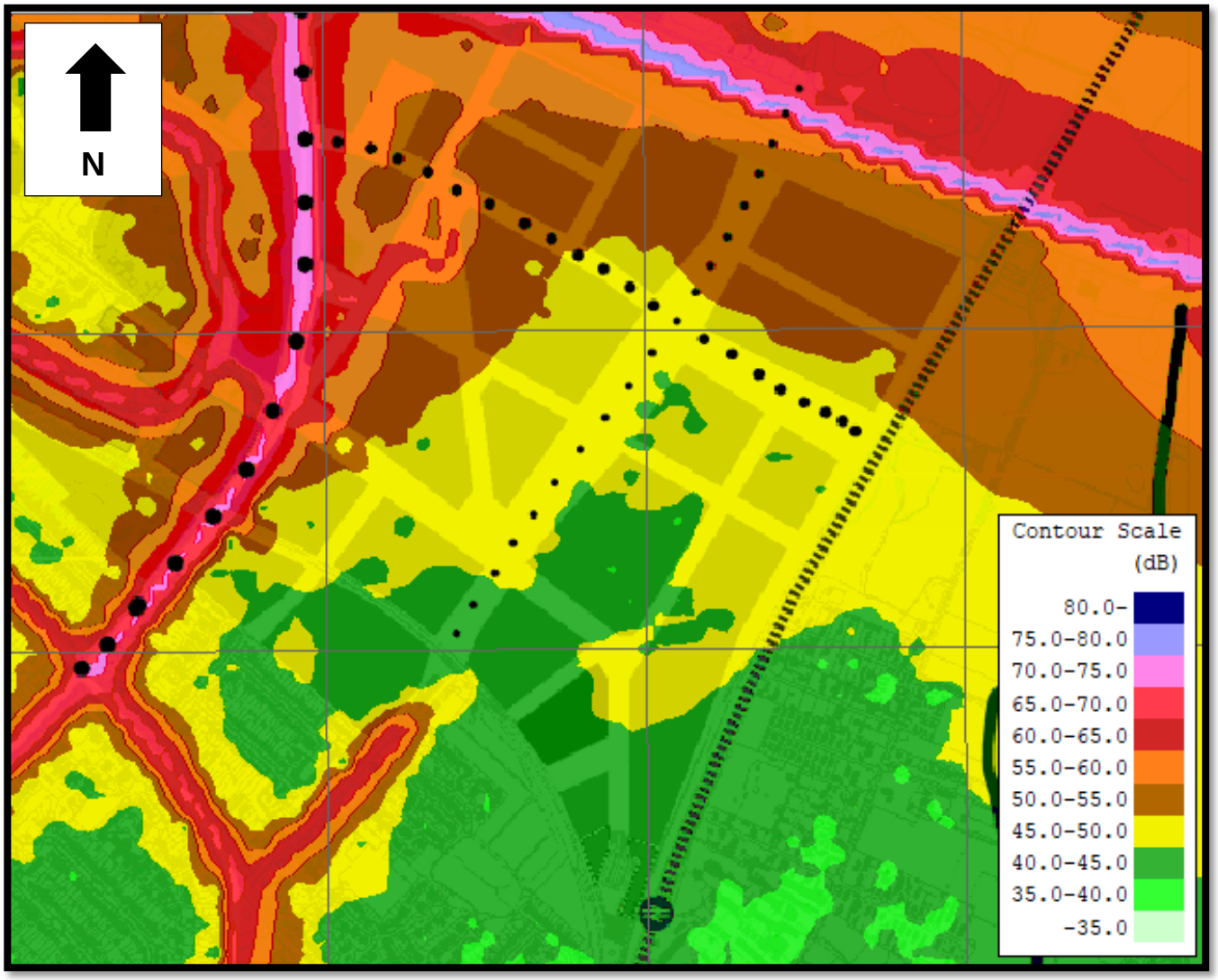


Figure 4-27 - 4m high roadside barrier – Day, Evening and Night L_{den} – Second Floor

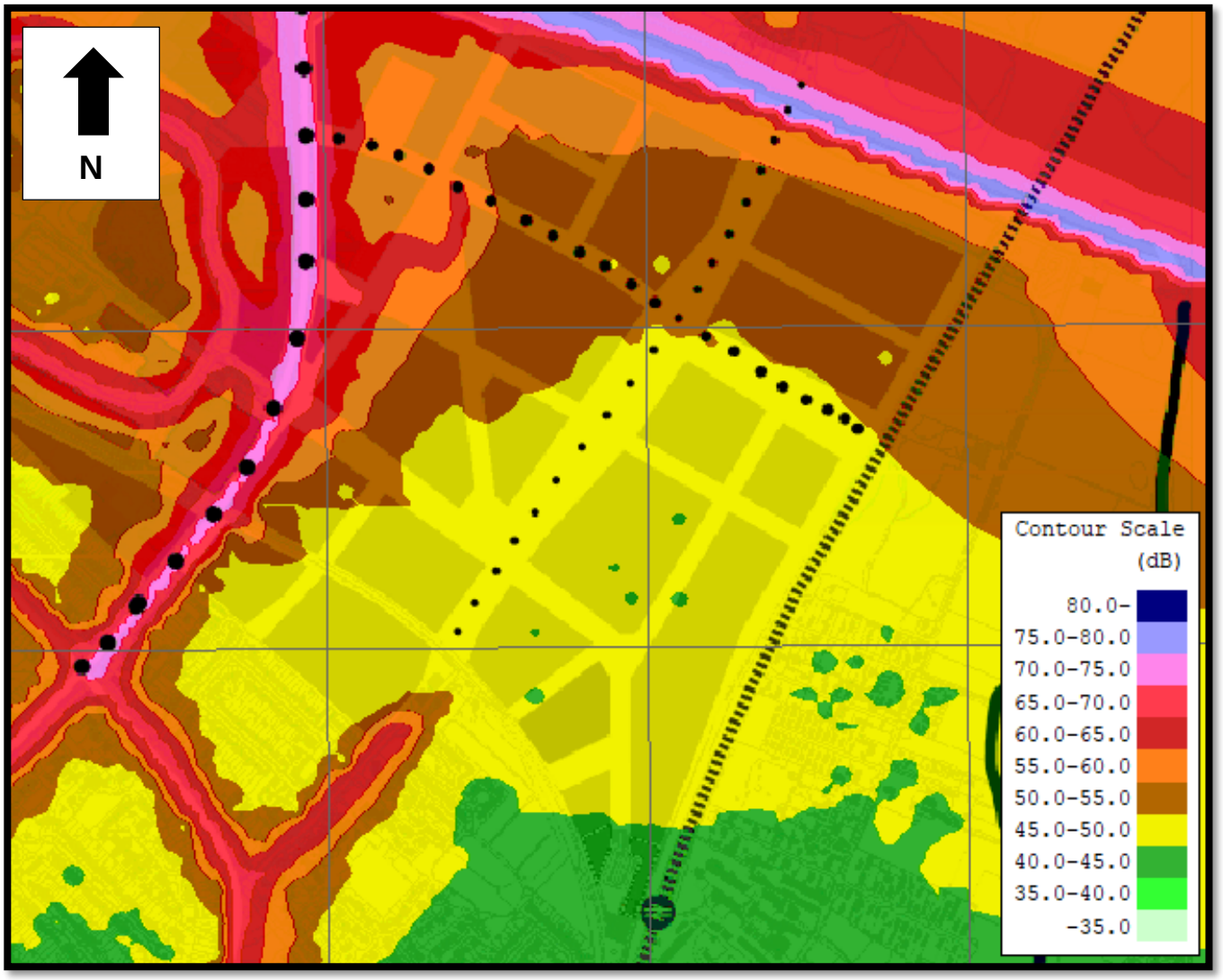
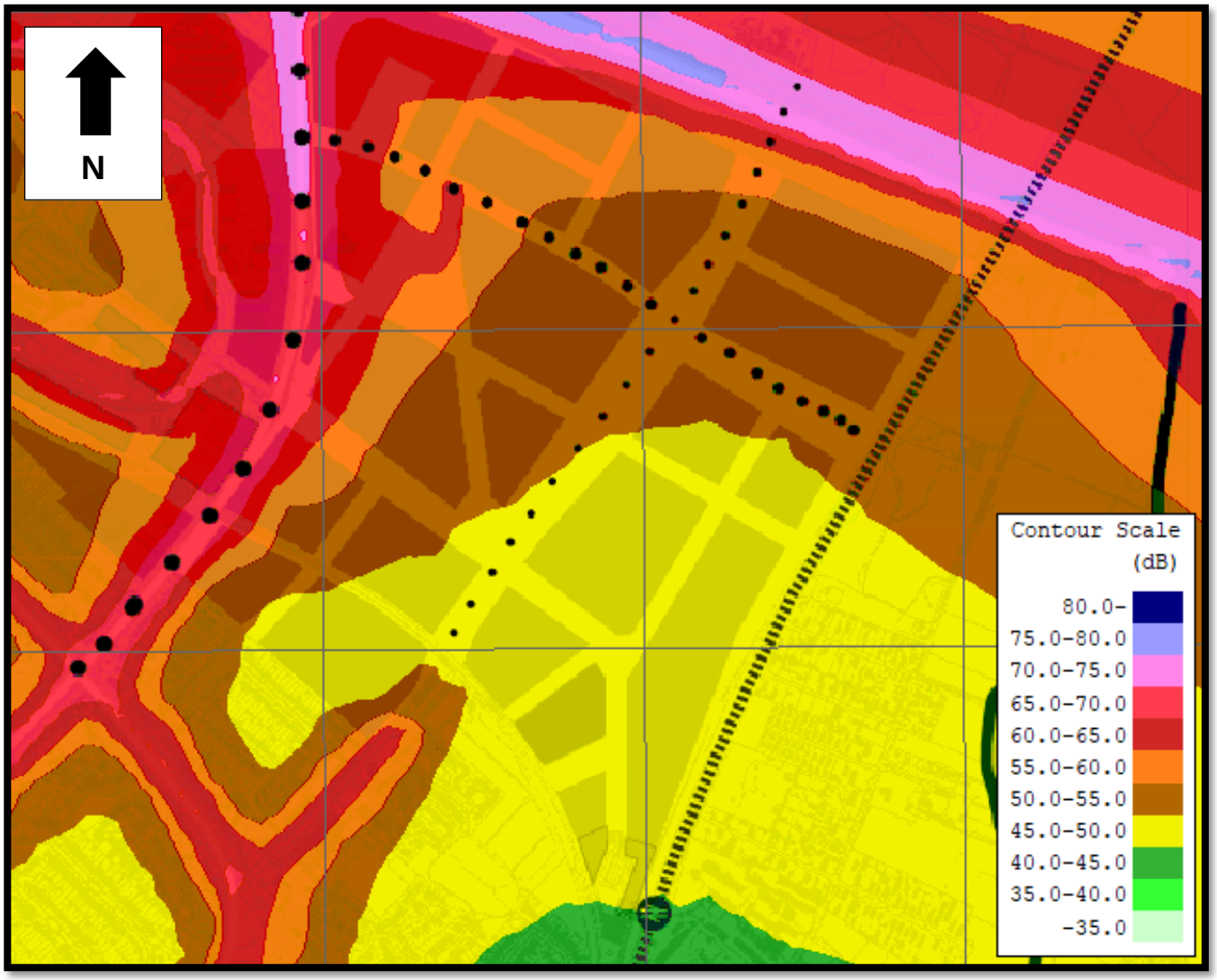


Figure 4-28 - 4m high roadside barrier – Day, Evening and Night L_{den} – Fifth Floor



5m High Roadside Barrier

Figure 4-29 - 5m high roadside barrier – Night Time $L_{Aeq, 8hr}$ – Ground Floor

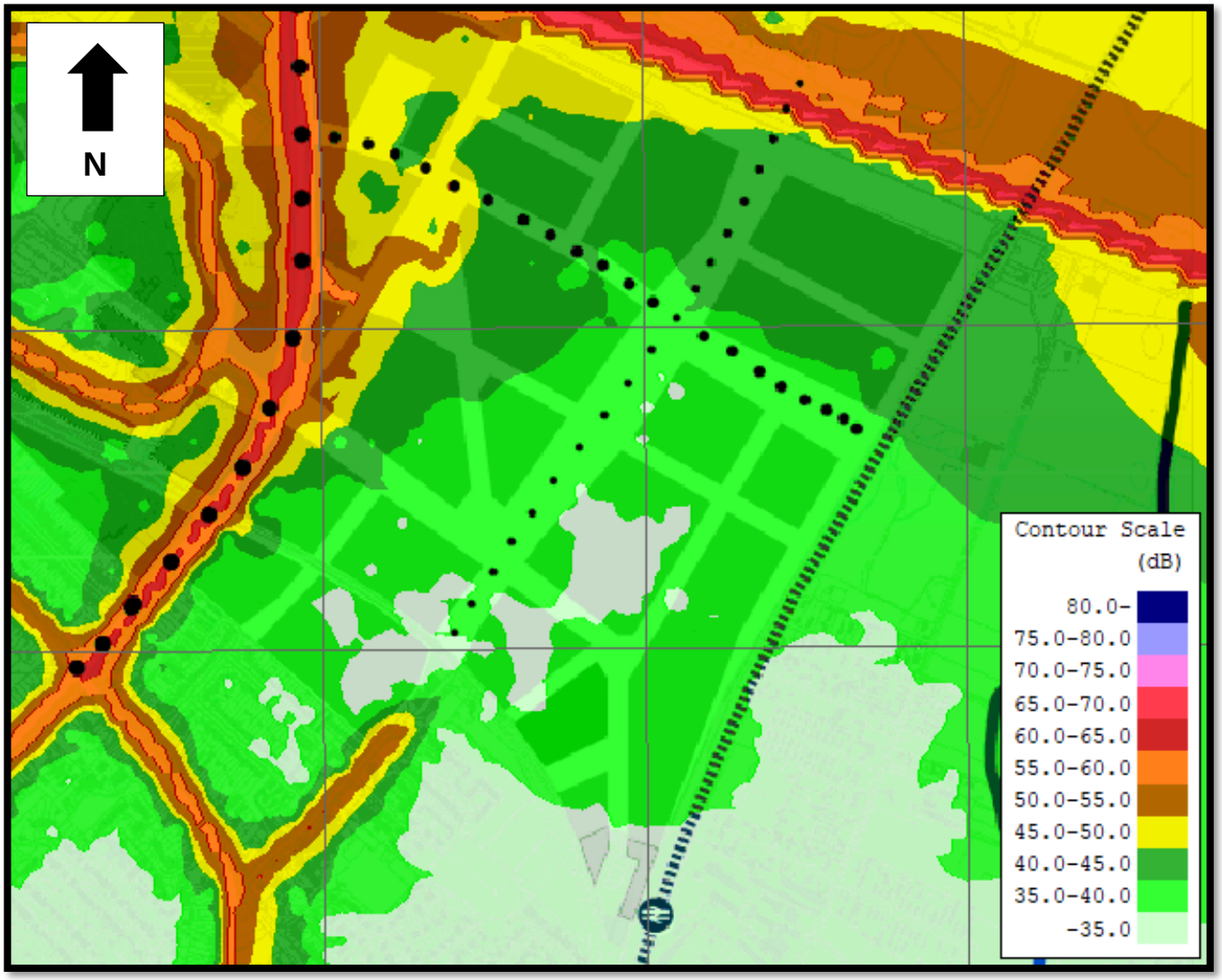


Figure 4-30 - 5m high roadside barrier – Night Time $L_{Aeq, 8hr}$ – Second Floor

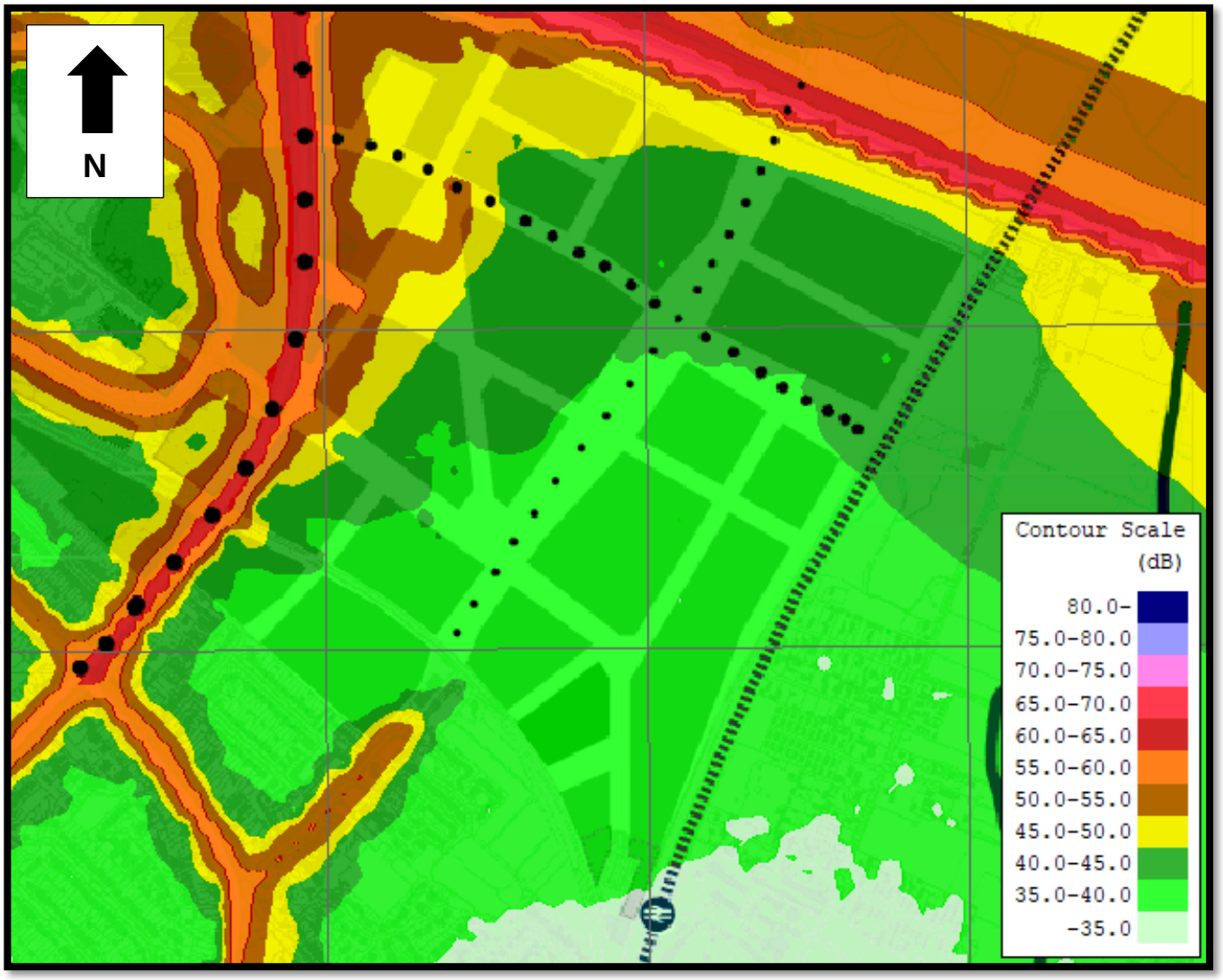


Figure 4-31 - 5m high roadside barrier – Night Time $L_{Aeq, 8hr}$ – Fifth Floor

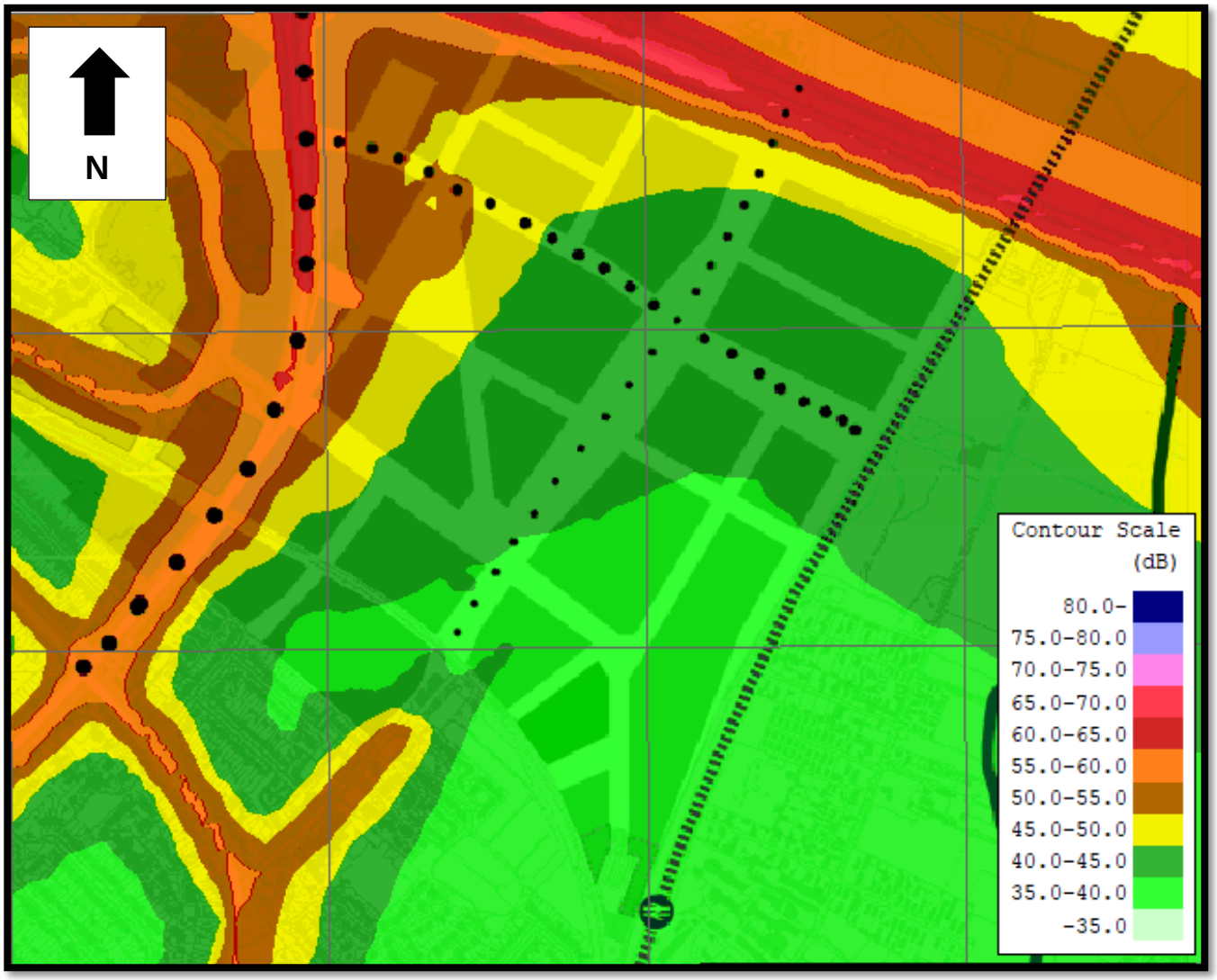


Figure 4-32 - 5m high roadside barrier – Daytime $L_{Aeq, 16hr}$ – Ground Floor

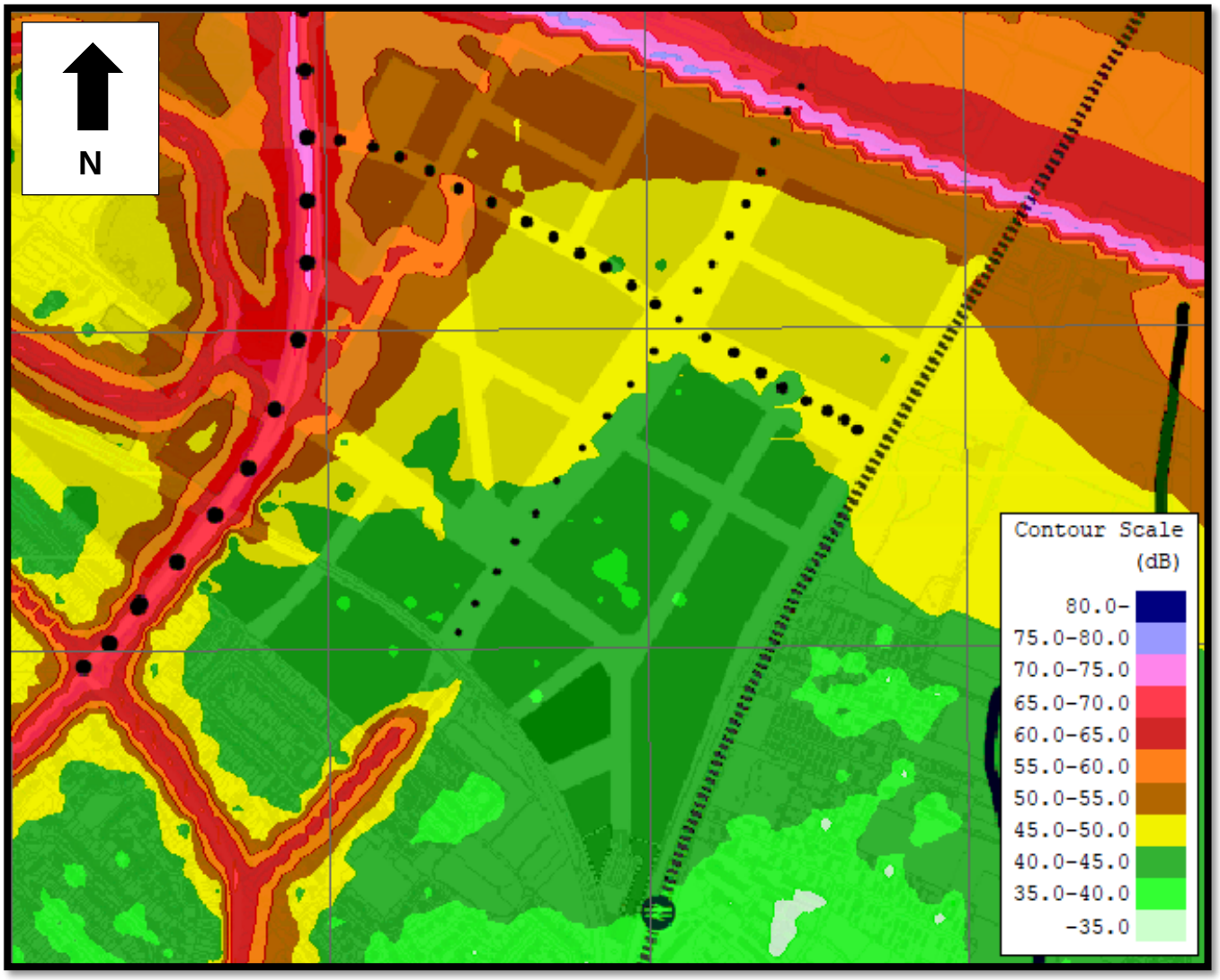


Figure 4-33 - 5m high roadside barrier – Daytime $L_{Aeq, 16hr}$ – Second Floor

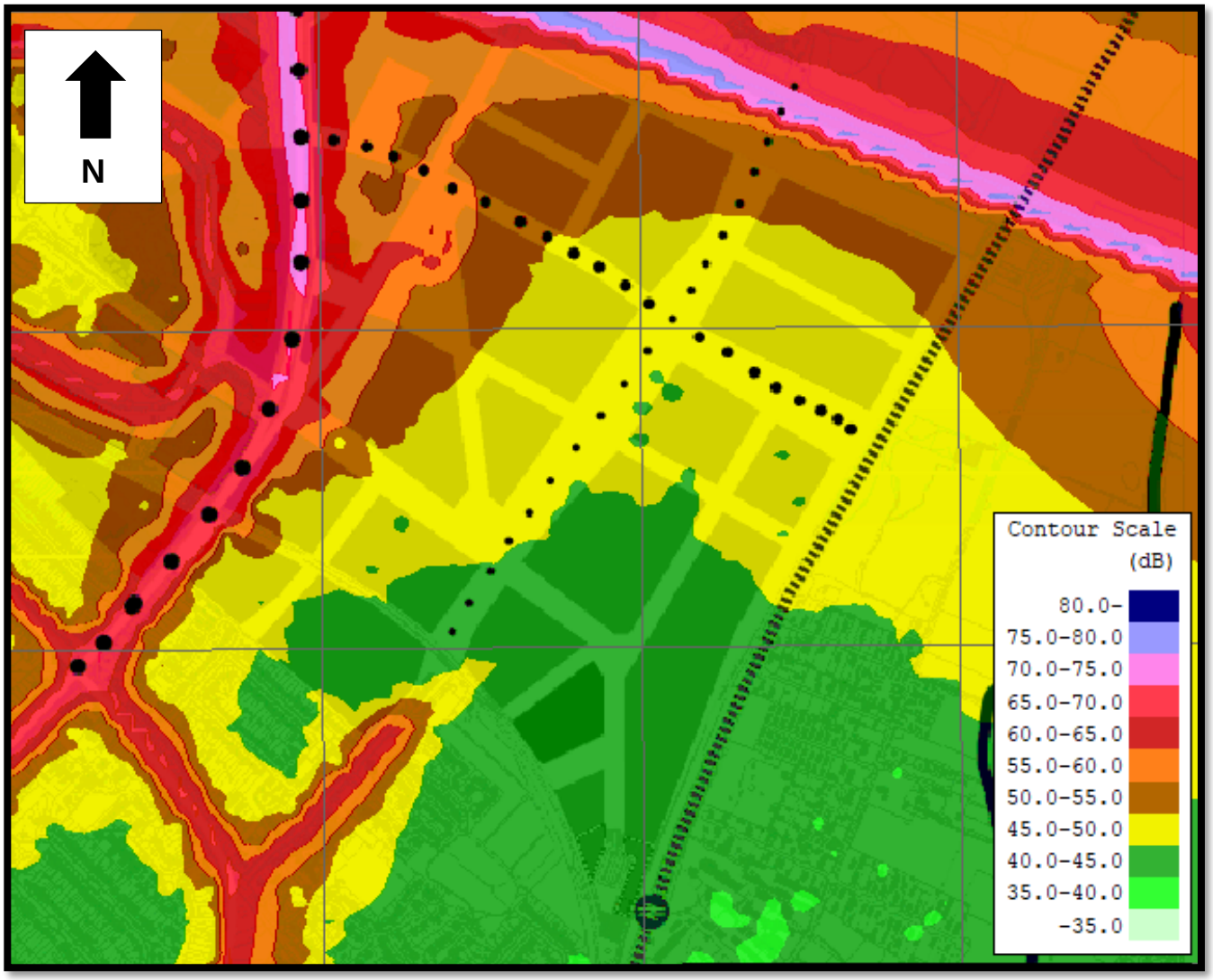


Figure 4-34 - 5m high roadside barrier – Daytime $L_{Aeq, 16hr}$ – Fifth Floor

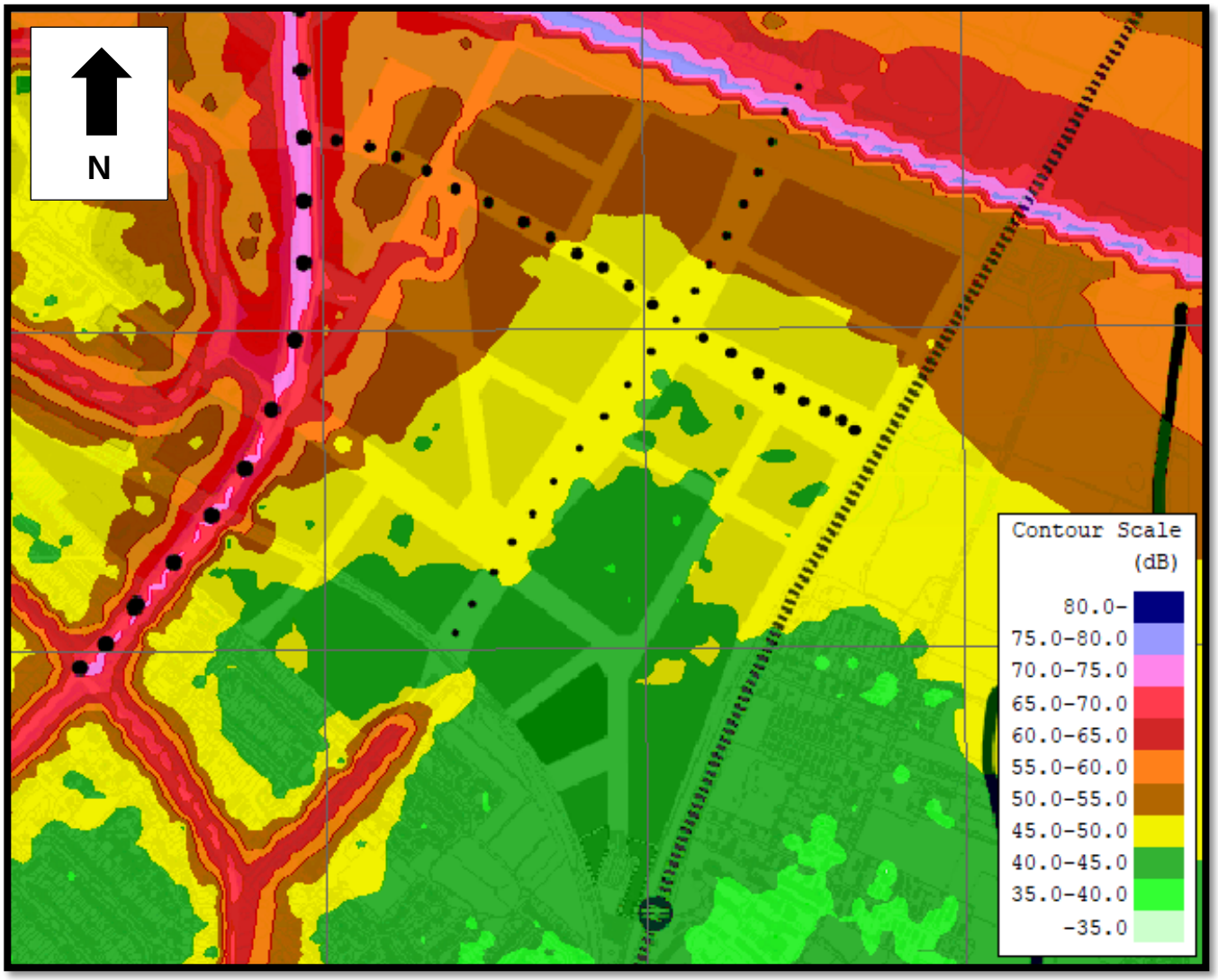


Figure 4-35 - 5m high roadside barrier – Day, Evening and Night L_{den} – Ground Floor

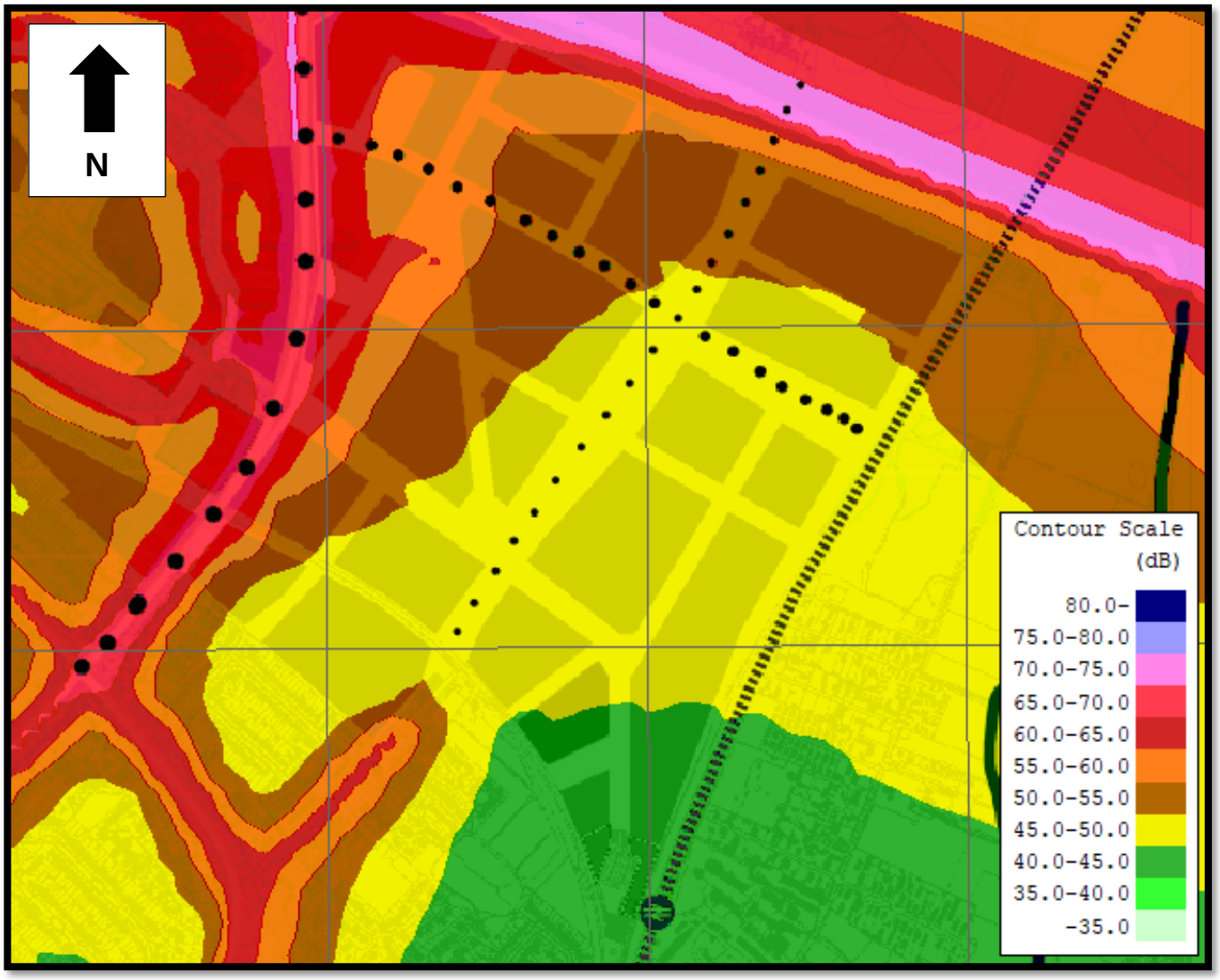


Figure 4-36 - 5m high roadside barrier – Day, Evening and Night L_{den} – Second Floor

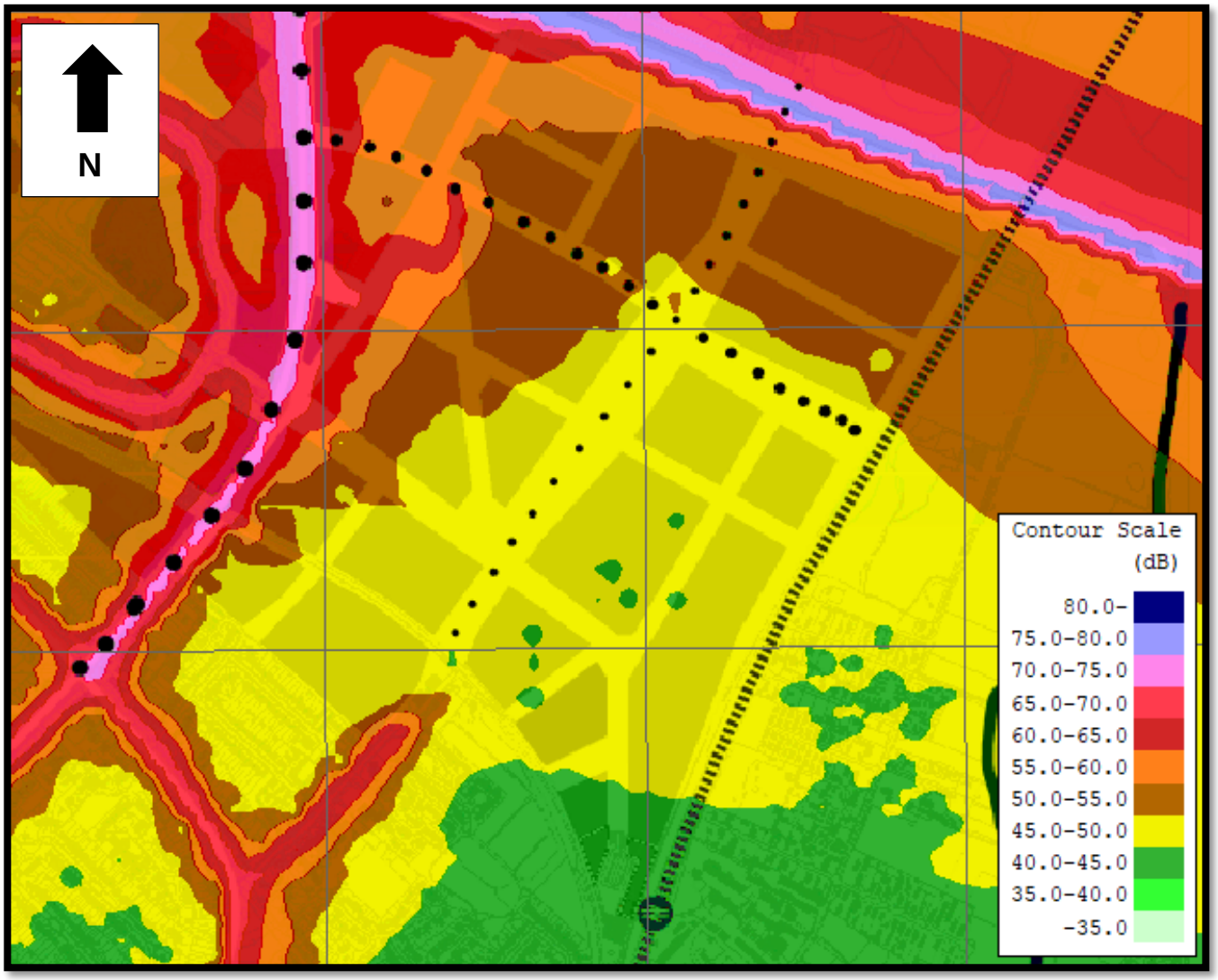
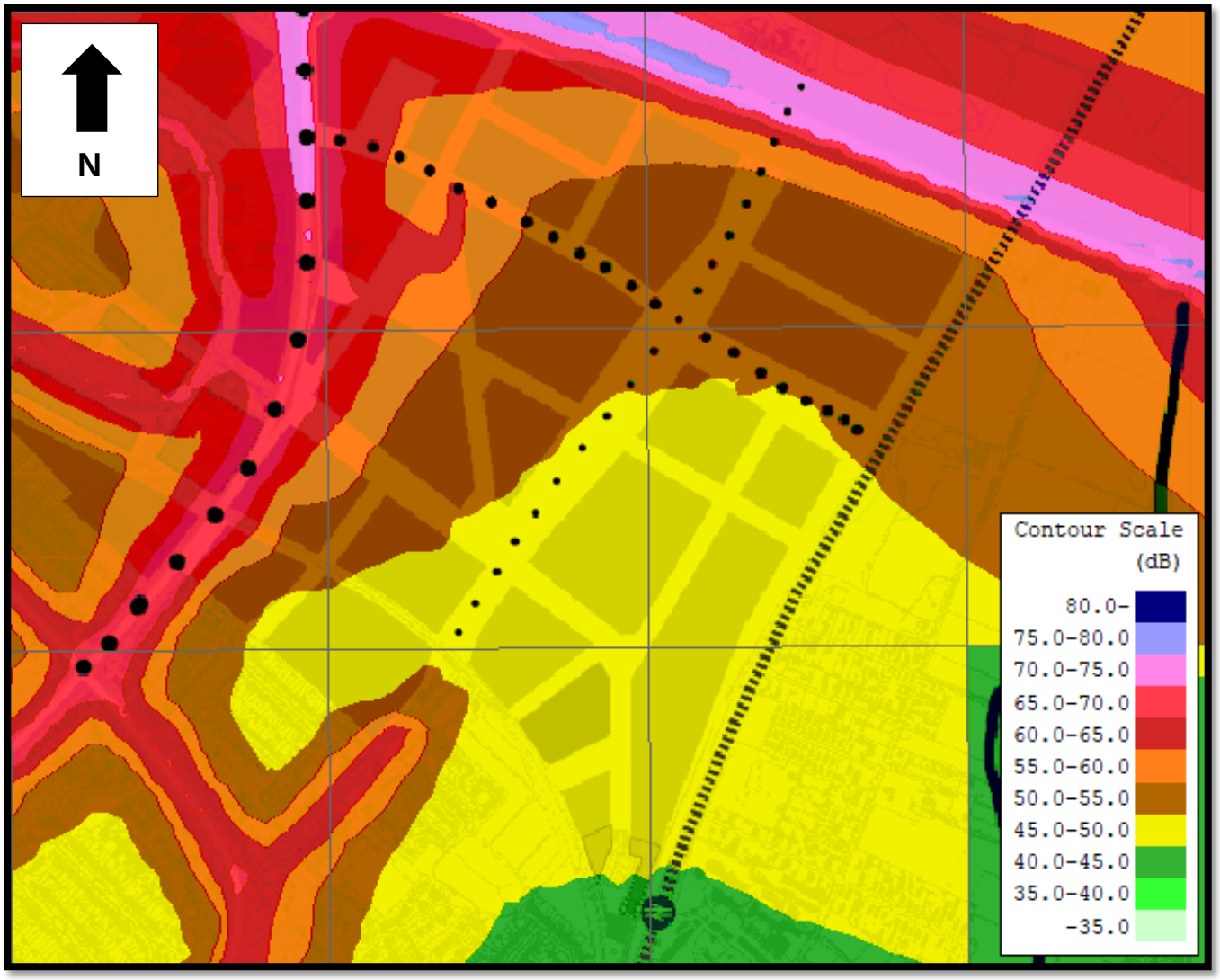


Figure 4-37 - 5m high roadside barrier – Day, Evening and Night L_{den} – Fifth Floor

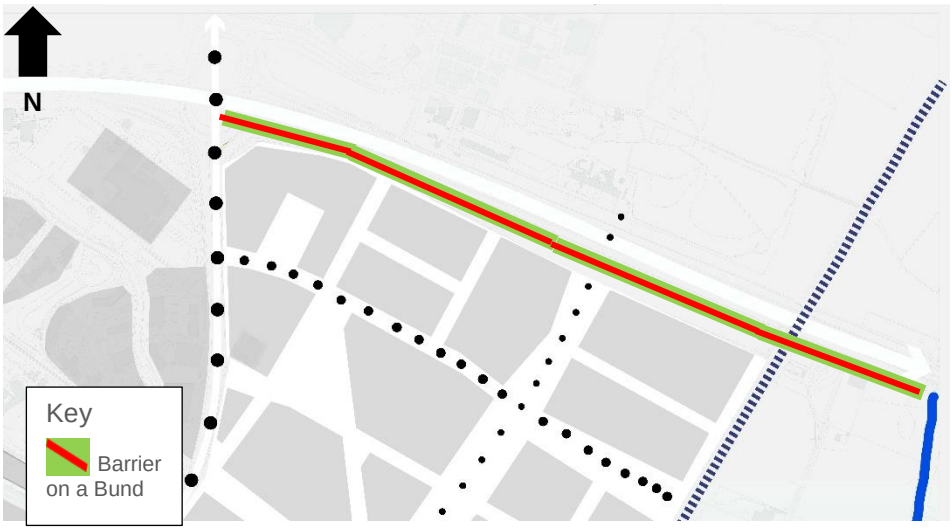


4.1.3. Mitigation Option 2 – Barrier on a 3m high Bund

The second option considered for reducing road traffic noise is a 1km long earth bund with an environmental noise barrier on top. The bund is assumed to have a slope of 1:3 and would be situated in the tree line at the bottom of the embankment of the A14, between Cowley Road and the railway line.

The noise bund is of equal height throughout at 3m high for the length of the bund, and approximately 18m wide. The top of the bund is below the surface of the A14 for the eastern half of the bund. Two different heights of environmental noise barriers have been tested on top of the bund, at 3m and 4m tall. Figure 4-38 - Suggested Location of the 3m or 4m high Barrier on a 3m High Bundshows the location of the earth bund and barrier and Figure 4-39 shows a sketch of the bund.

Figure 4-38 - Suggested Location of the 3m or 4m high Barrier on a 3m High Bund



Two different options have been modelled, the bund with a 3m high and a 4m high environmental noise barrier. Only the results at ground floor have been calculated.

a) A 3m High Environmental Noise Barrier

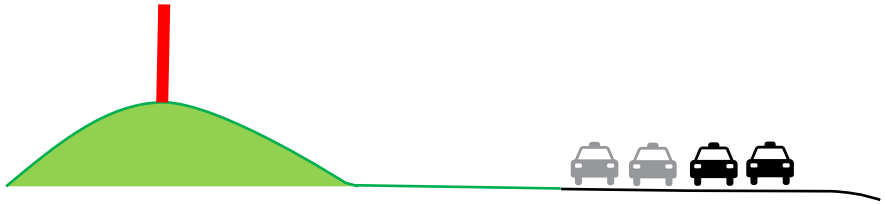
- The night time $L_{Aeq, 8hr}$ noise contours are shown in Figure 4-40,
- The daytime $L_{Aeq, 16hr}$ noise contours are shown in Figure 4-41, and
- The day, evening and night, L_{den}, contours are shown in Figure 4-42.

b) A 4m High Environmental Noise Barrier

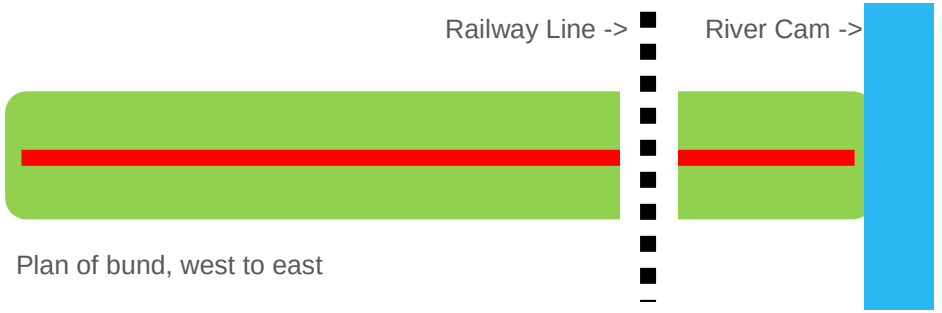
- The night time $L_{Aeq, 8hr}$ noise contours are shown in Figure 4-43,
- The daytime $L_{Aeq, 16hr}$ noise contours are shown in Figure 4-44, and
- The day, evening and night, L_{den}, contours are shown in Figure 4-45.

Figure 4-39 - Sketches of 3m High Bund

Western end of bund - 0m



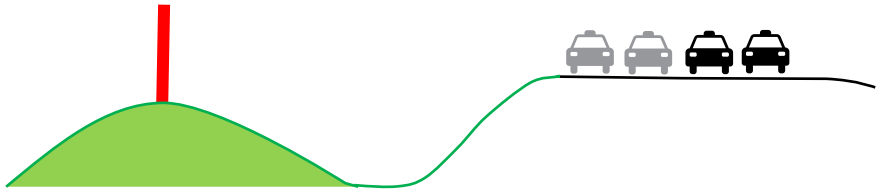
Profile of bund



100m from Western End

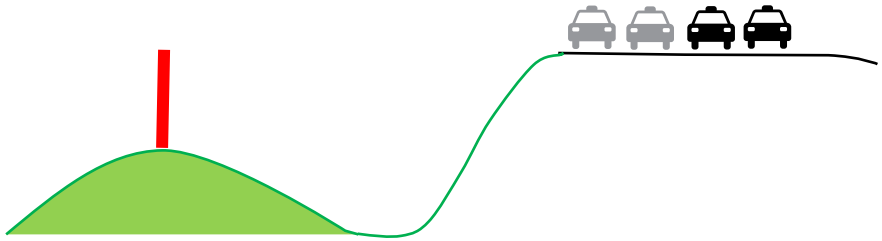
Profile of bund

300m from Western End



Profile of bund

600m from Western End to Eastern End



Profile of bund

3m High Barrier on a 3m Bund

Figure 4-40 - 3m high barrier on a 3m bund – Night Time $L_{Aeq, 8hr}$ – Ground Floor

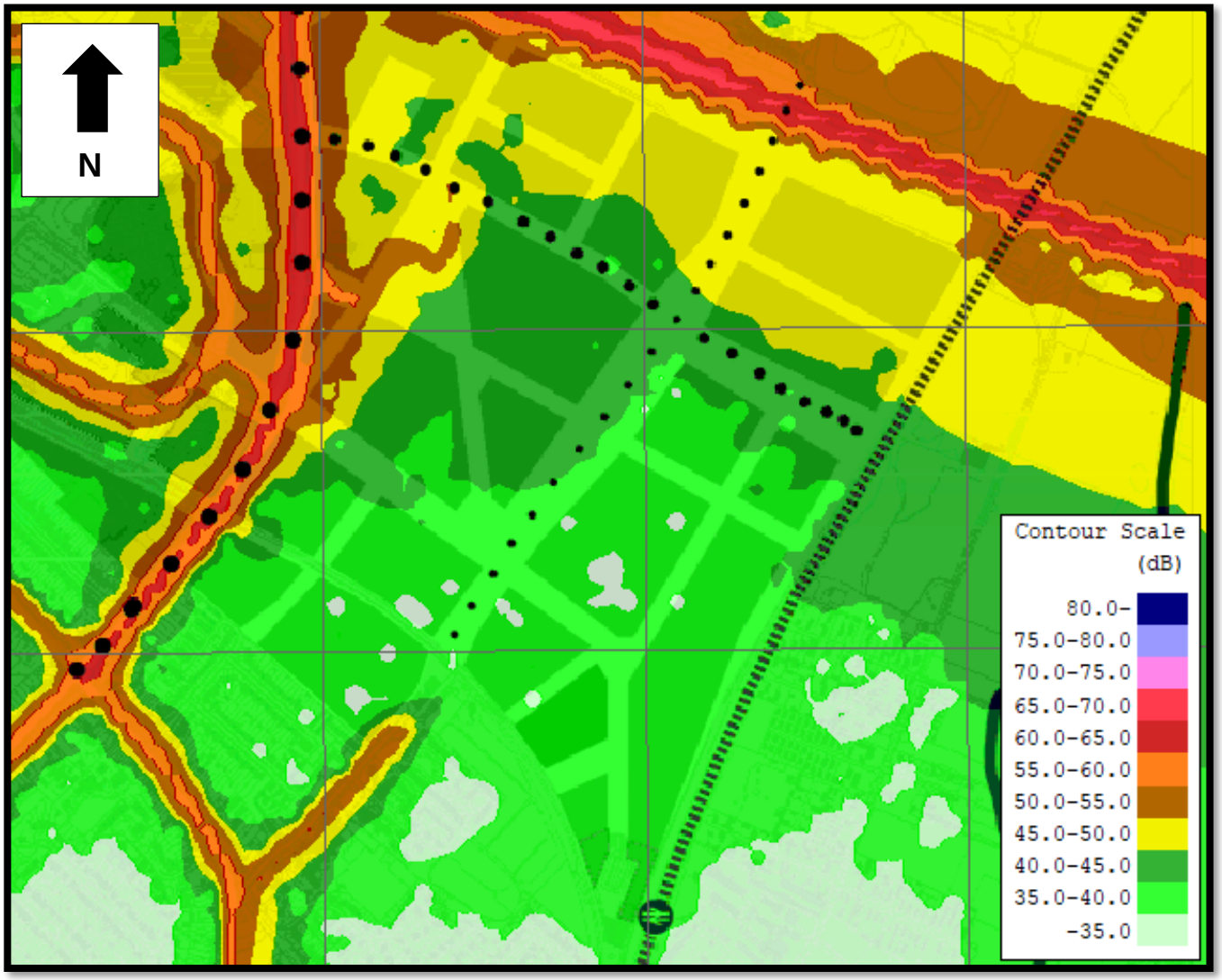


Figure 4-41 - 3m high barrier on a 3m bund – Daytime $L_{Aeq, 16hr}$ – Ground Floor

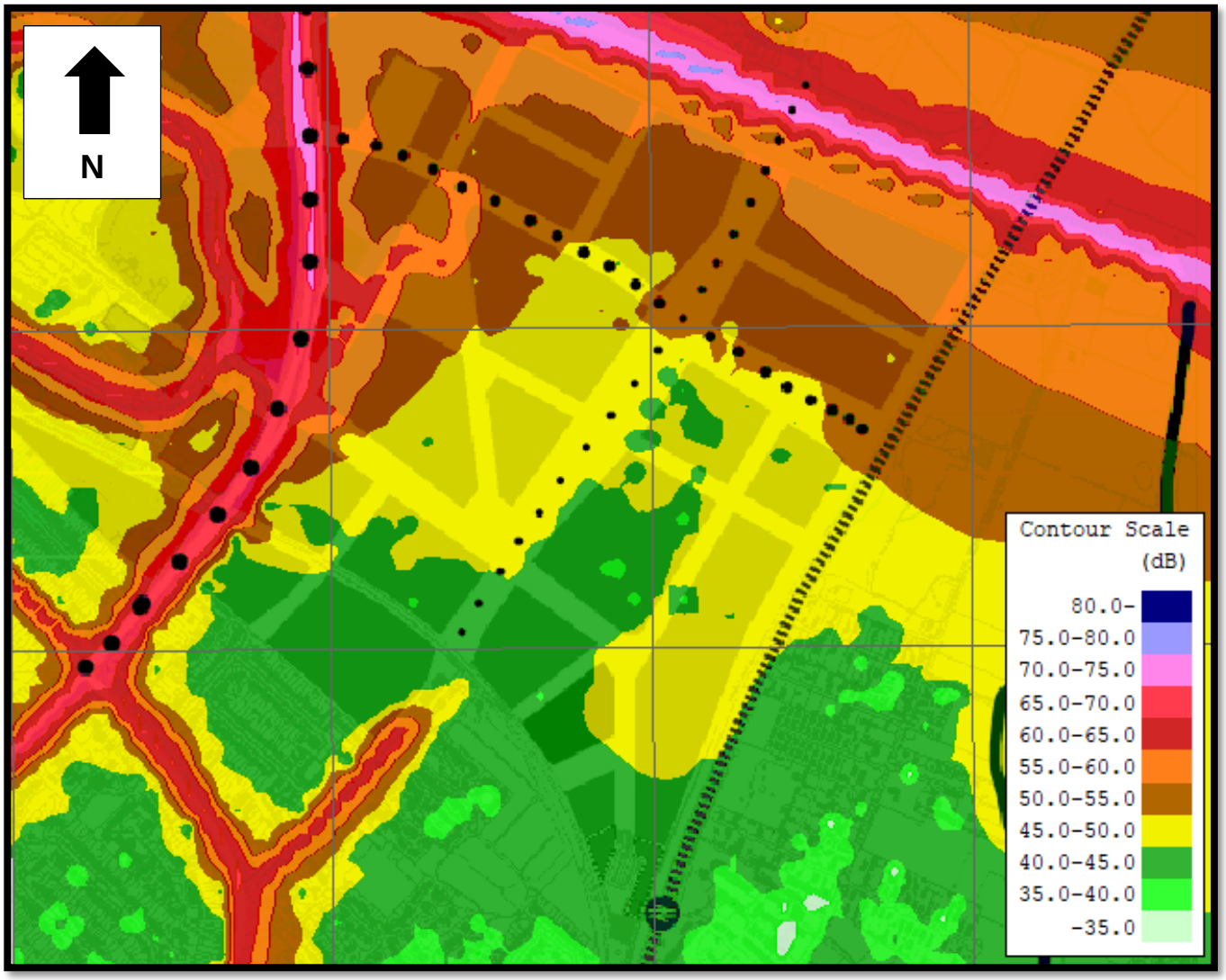
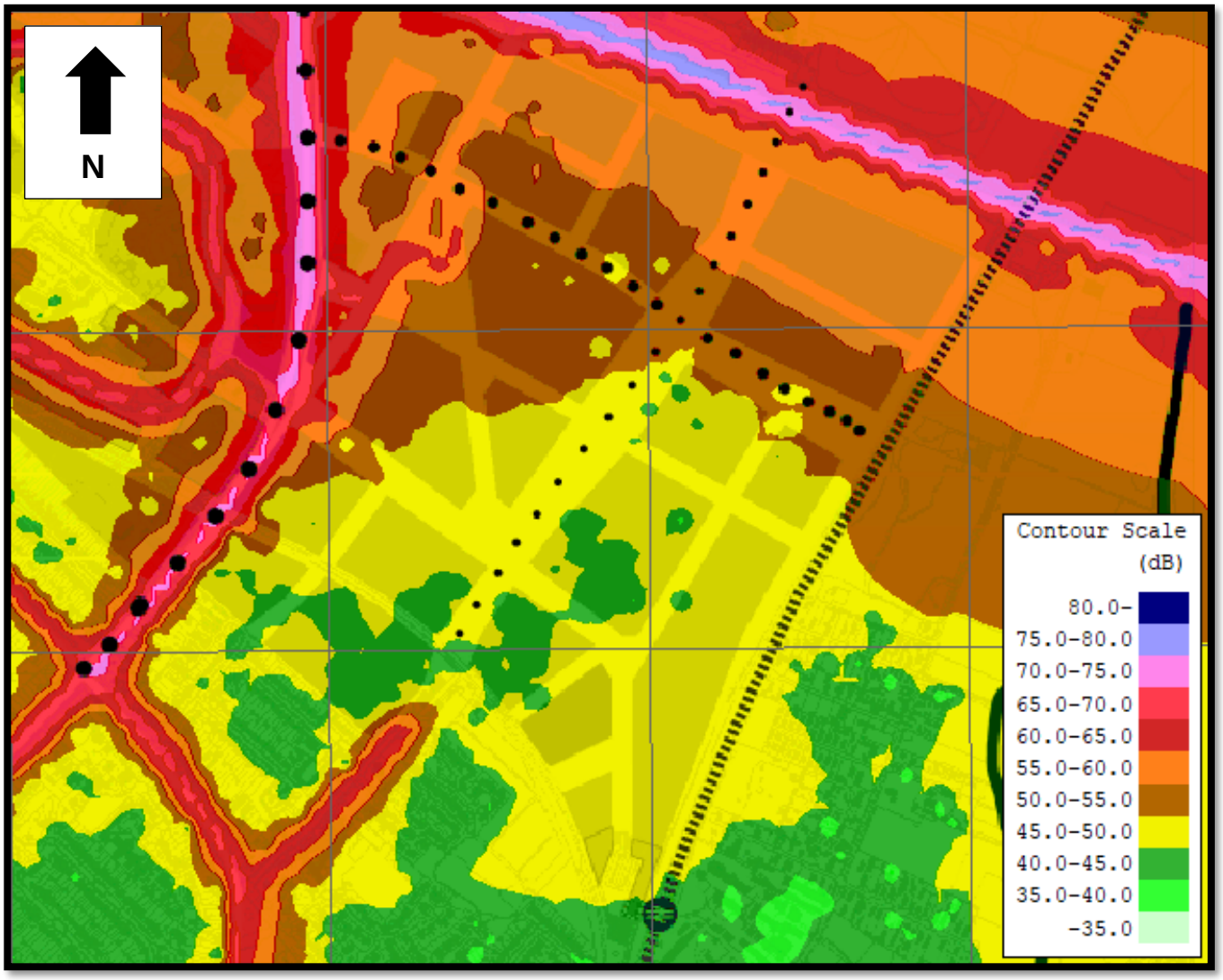


Figure 4-42 - 3m high barrier on a 3m bund – Day, Evening and Night L_{den} – Ground Floor



4m High Barrier on a 3m Bund

Figure 4-43 - 4m high barrier on a 3m bund – Night Time $L_{Aeq, 8hr}$ – Ground Floor

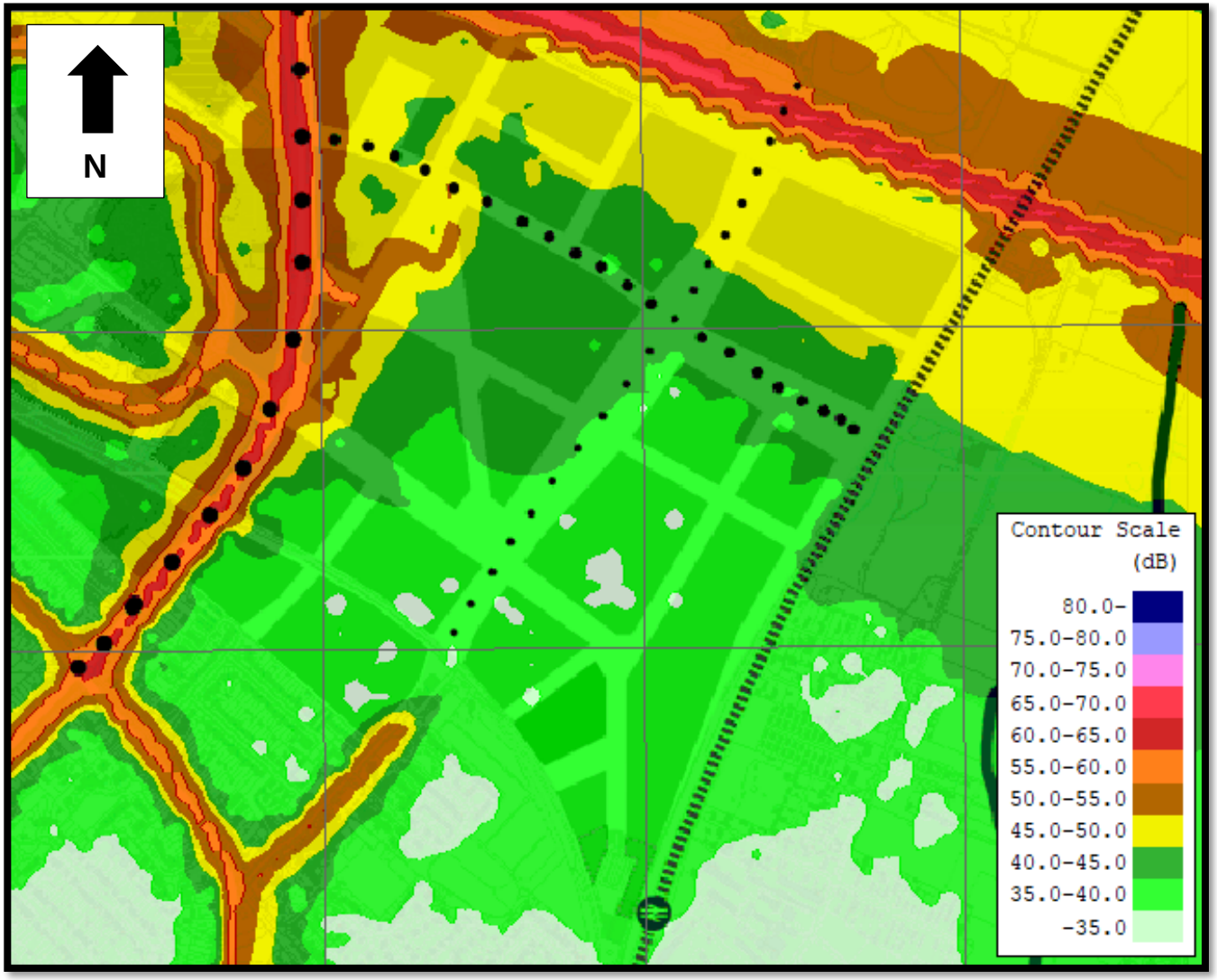


Figure 4-44 - 4m high barrier on a 3m bund – Daytime $L_{Aeq, 16hr}$ – Ground Floor

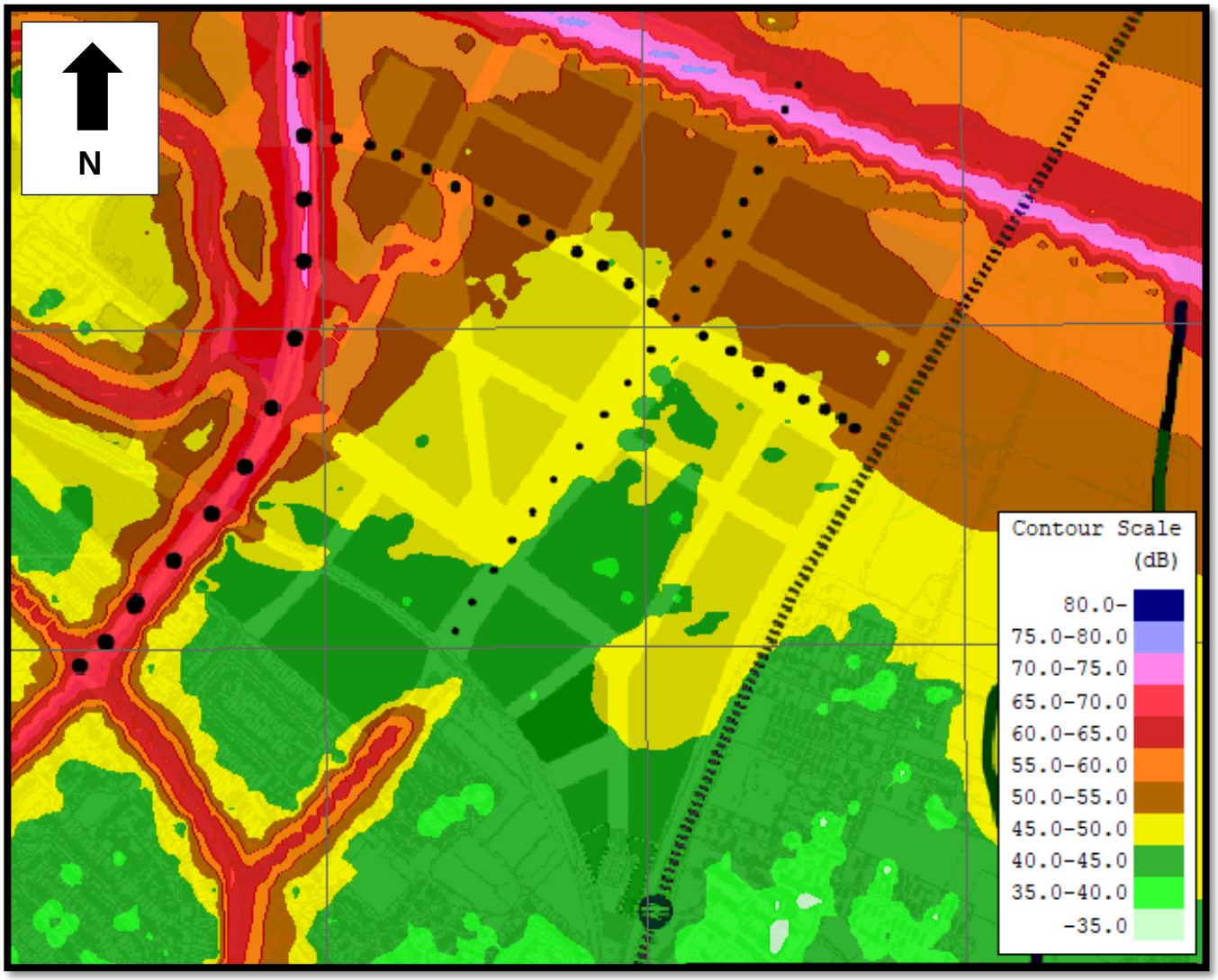
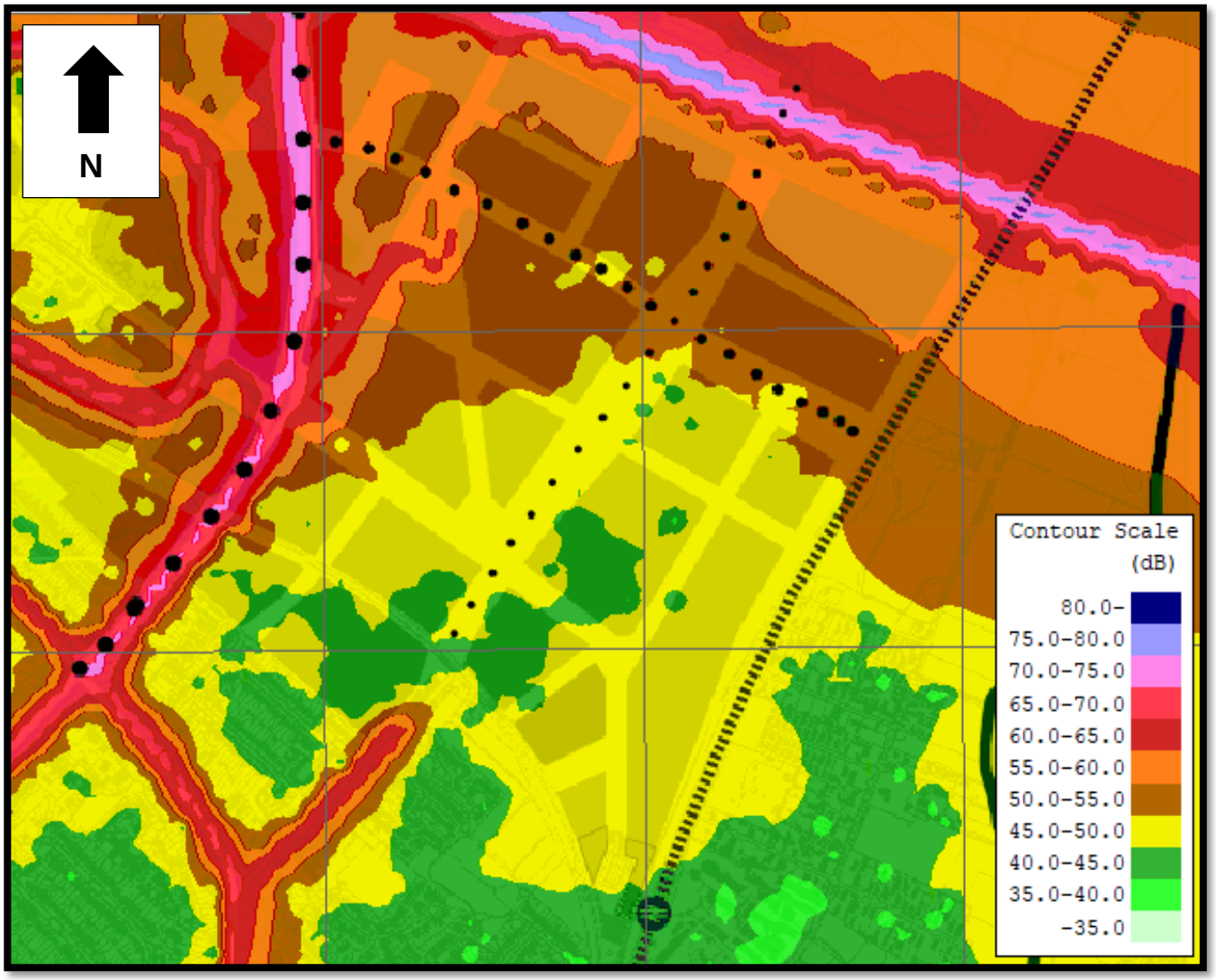


Figure 4-45 - 4m high barrier on a 3m bund – Day, Evening and Night L_{den} – Ground Floor



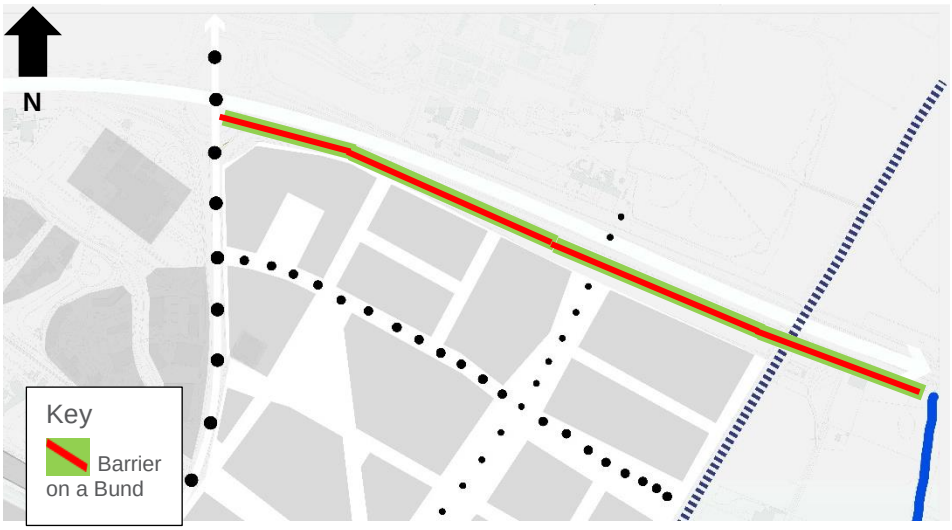
4.1.4. Mitigation Option 3 – Barrier on a Road Height Bund

The third option that has been considered for reducing road traffic noise at the proposed development is a variant of Mitigation Option 2, where a 1km long earth bund with an environmental noise barrier on top would be installed. Like Mitigation Option 2, the bund is assumed to have a slope of 1:3 and would be situated in the tree line at the bottom of the embankment of the A14, between Cowley Road and the railway line.

The noise bund is of variable height beginning at around 3m high to the West, and approximately 18m wide, and ending approximately 6m high to the East, and 36m wide, and does not drop below the A14 road height.

The first 150m of the bund, at the Western end, is above the surface of the A14; by up to 3m. The rest of the bund is at the same height as the surface of the A14. Two different heights of environmental noise barriers have been tested on top of the bund, at 3m and 4m tall. Figure 4-46 - Suggested Location of the 3m or 4m High Barrier on a Road Height Bundshows the location of the earth bund and barrier and Figure 4-47 shows a sketch of the bund.

Figure 4-46 - Suggested Location of the 3m or 4m High Barrier on a Road Height Bund



Two different options have been modelled, the bund with a 3m high and a 4m high environmental noise barrier. Only the results at ground floor have been calculated.

a) A 3m High Environmental Noise Barrier

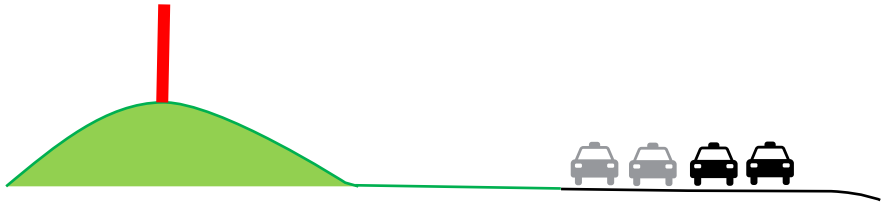
- The night time $L_{Aeq, 8hr}$ noise contours are shown in Figure 4-48,
- The daytime $L_{Aeq, 16hr}$ noise contours are shown in Figure 4-49, and
- The day, evening and night, L_{den}, contours are shown in Figure 4-50.

b) A 4m High Environmental Noise Barrier

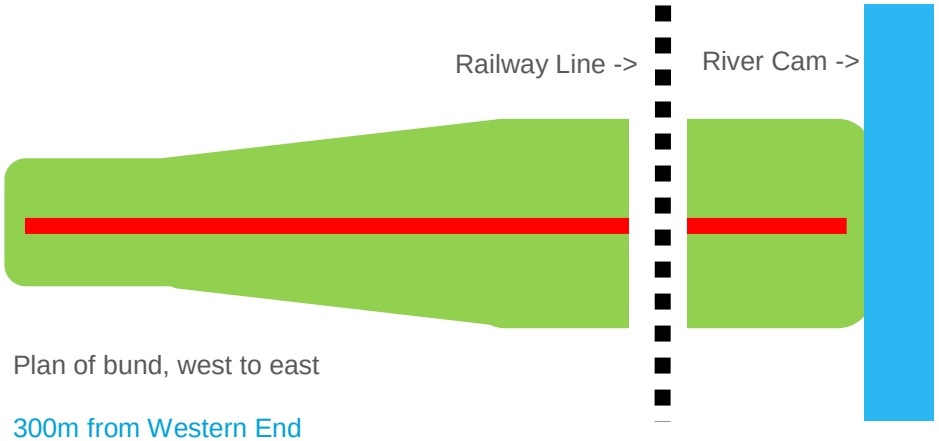
- The night time $L_{Aeq, 8hr}$ noise contours are shown in Figure 4-51,
- The daytime $L_{Aeq, 16hr}$ noise contours are shown in Figure 4-52, and
- The day, evening and night, L_{den}, contours are shown in Figure 4-53.

Figure 4-47 - Sketches of Road Height Bund

Western end of bund - 0m



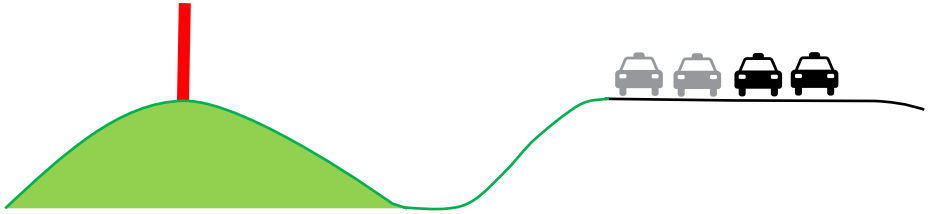
Profile of bund



100m from Western End

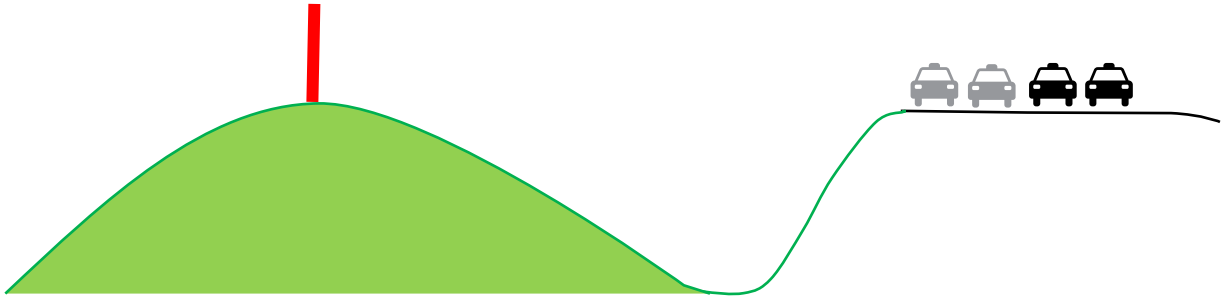
Profile of bund

300m from Western End



Profile of bund

600m from Western End to Eastern End



Profile of bund

3m High Barrier on a Road Height Bund

Figure 4-48 - 3m high barrier on a road height bund – Night Time $L_{Aeq, 8hr}$ – Ground Floor

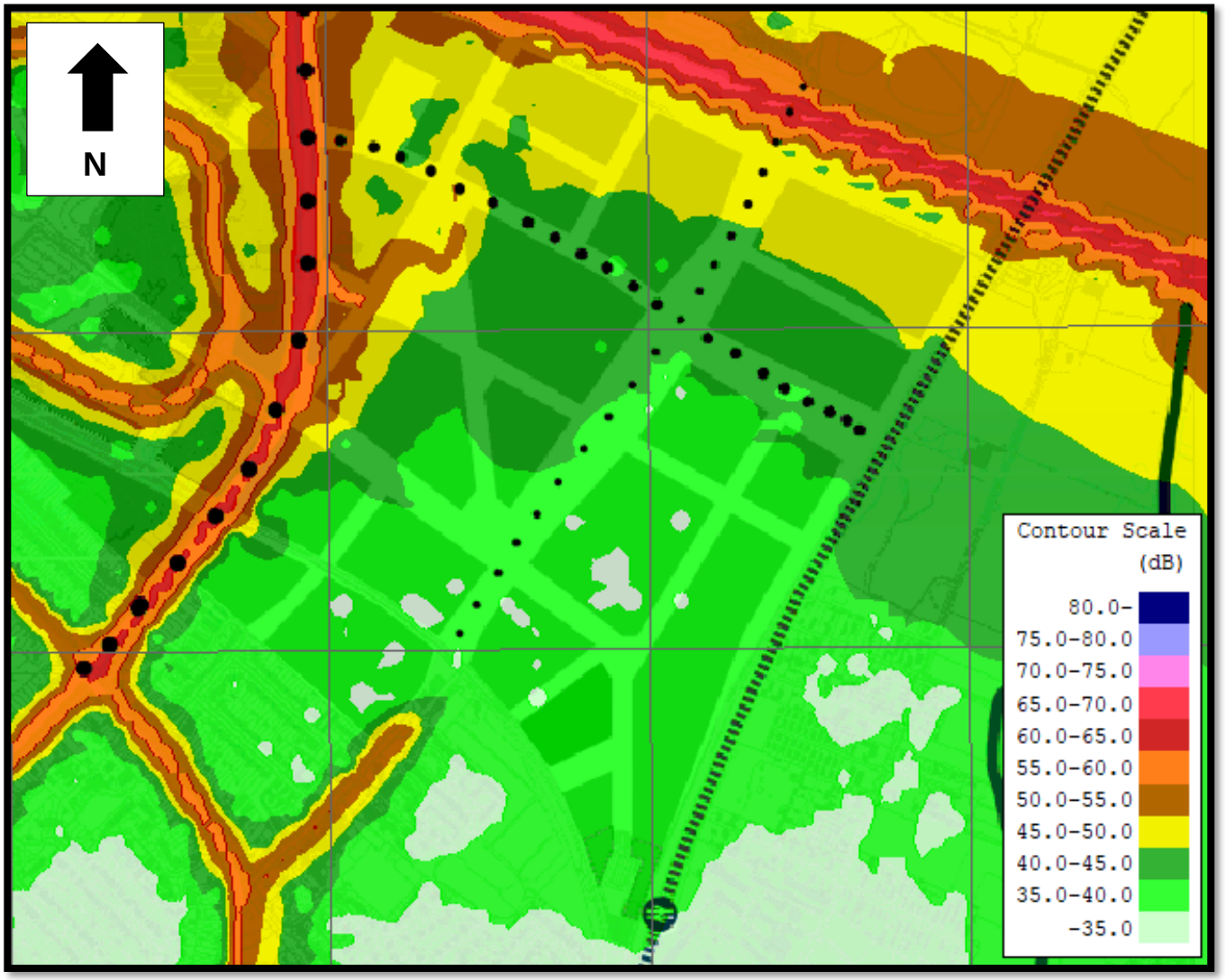


Figure 4-49 - 3m high barrier on a road height bund – Daytime $L_{Aeq, 16hr}$ – Ground Floor

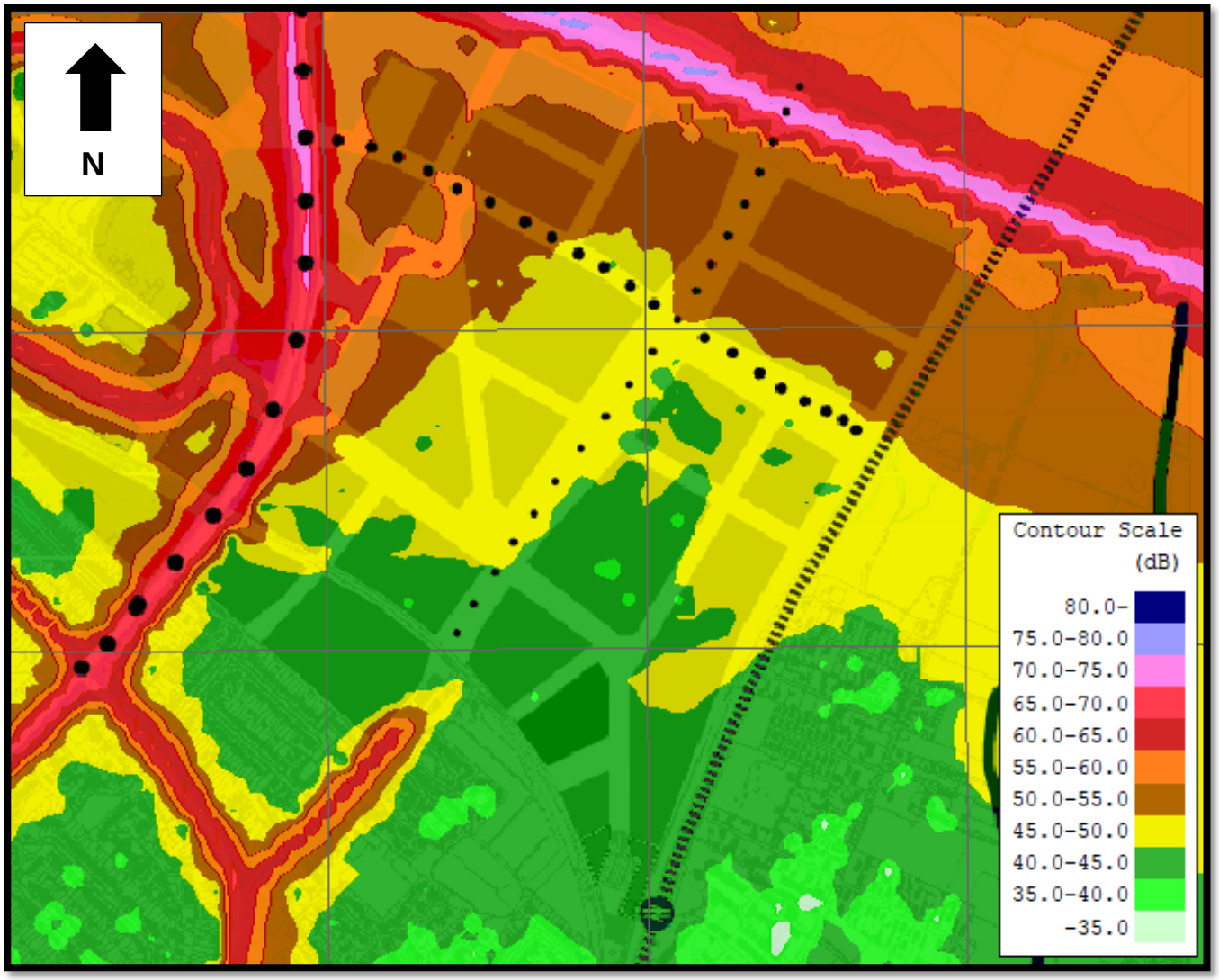
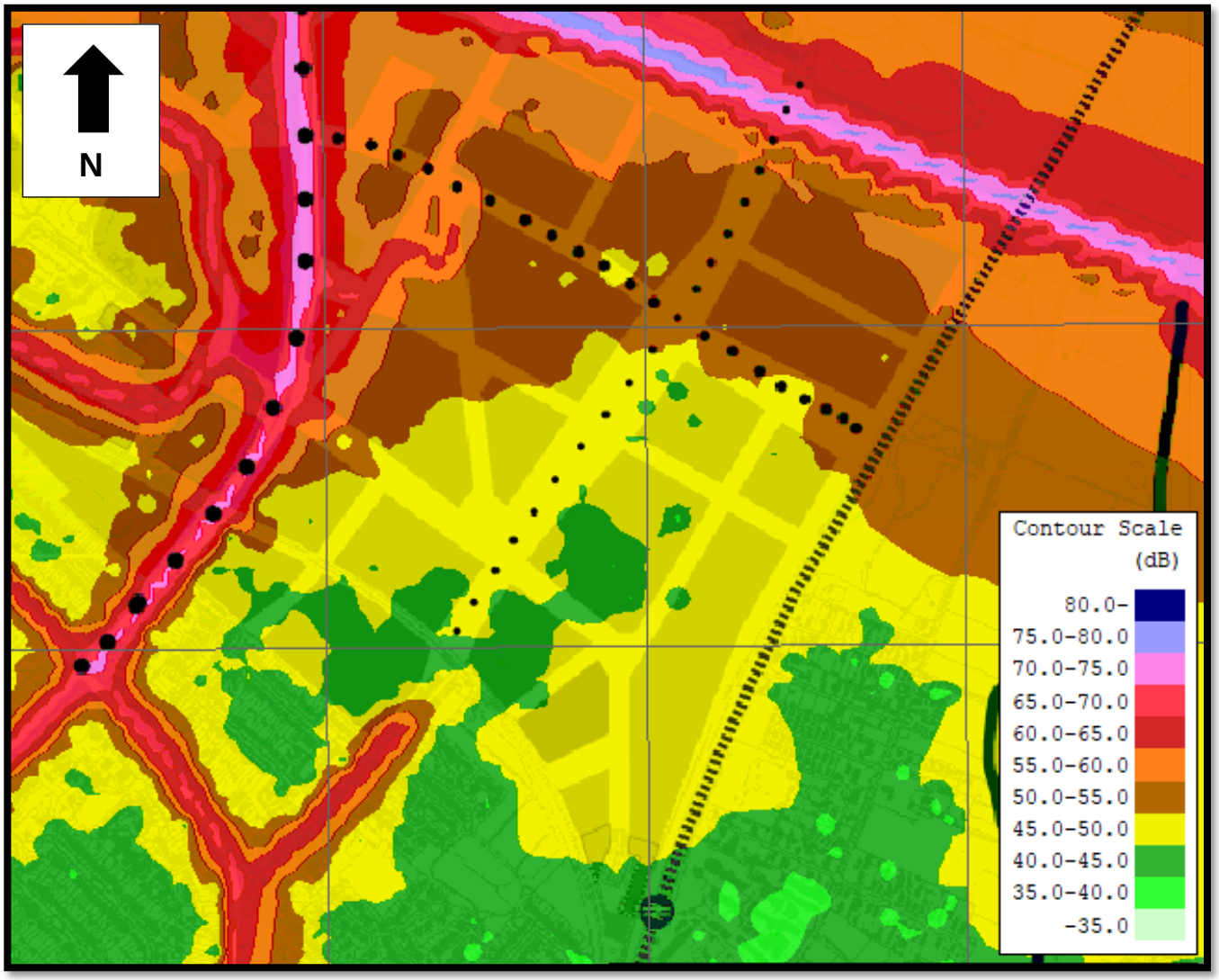


Figure 4-50 - 3m high barrier on a road height bund – Day, Evening and Night L_{den} – Ground Floor



4m High Barrier on a Road Height Bund

Figure 4-51 - 4m high barrier on a road height bund – Night Time $L_{Aeq, 8hr}$ – Ground Floor

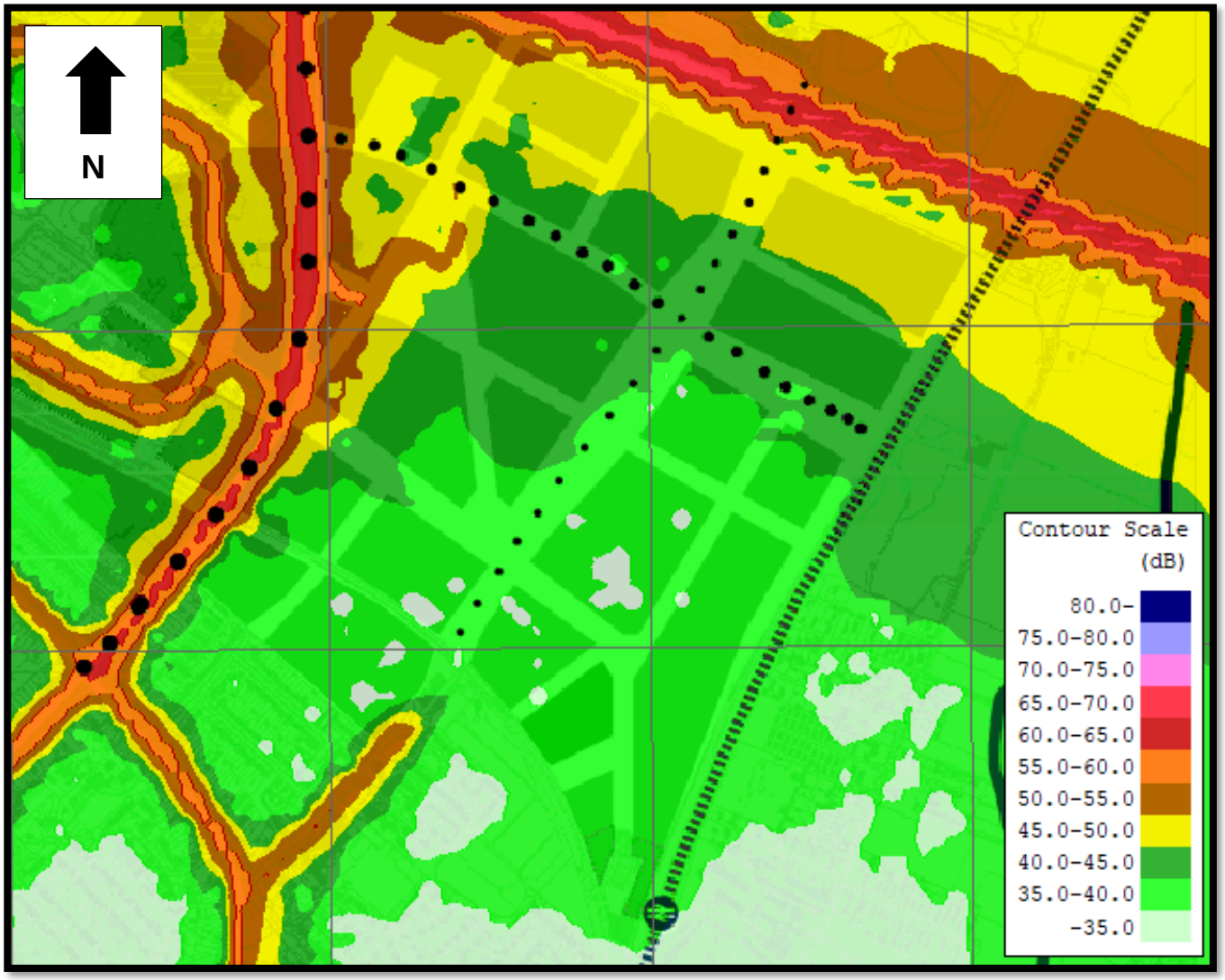


Figure 4-52 - 4m high barrier on a road height bund – Daytime $L_{Aeq, 16hr}$ – Ground Floor

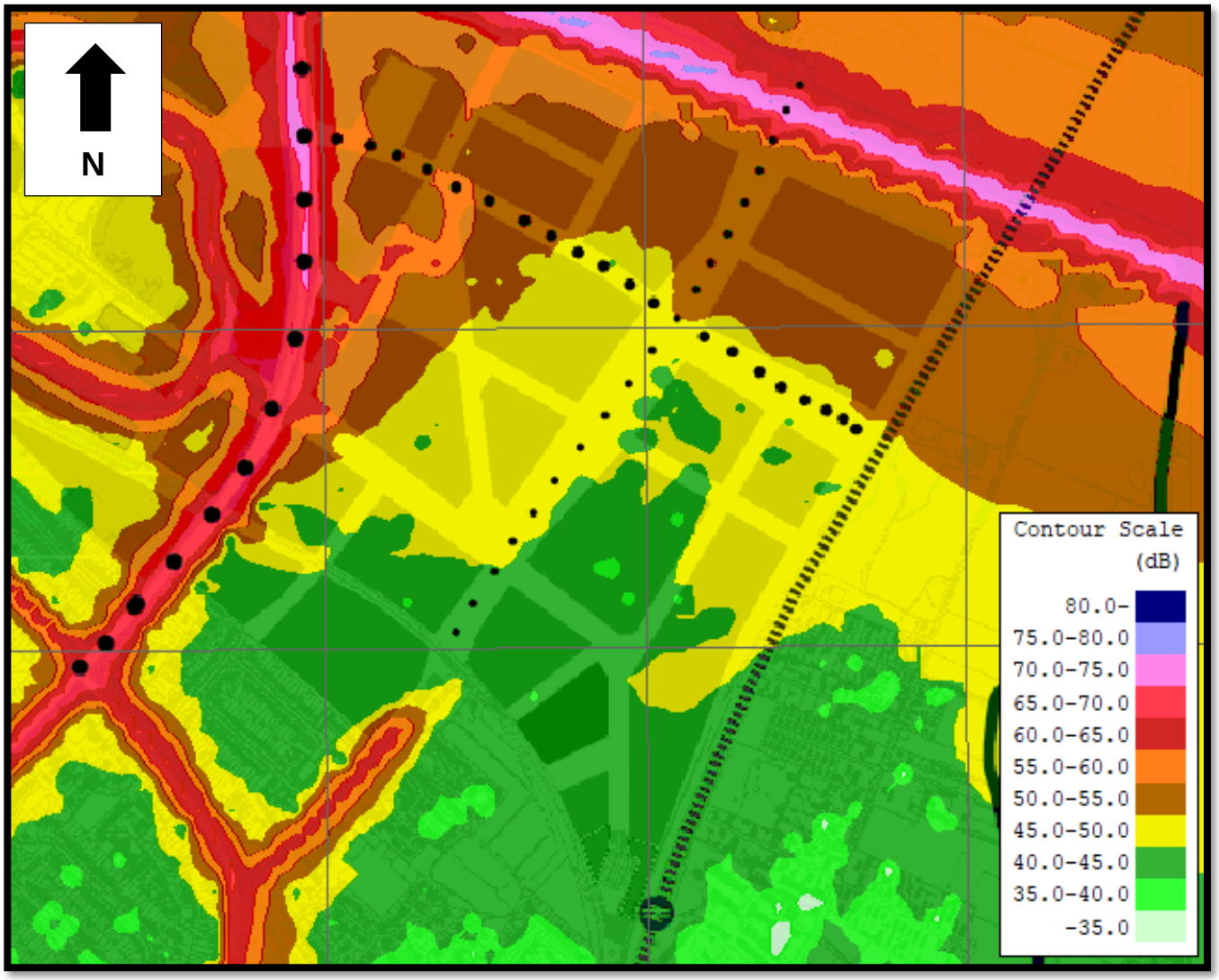
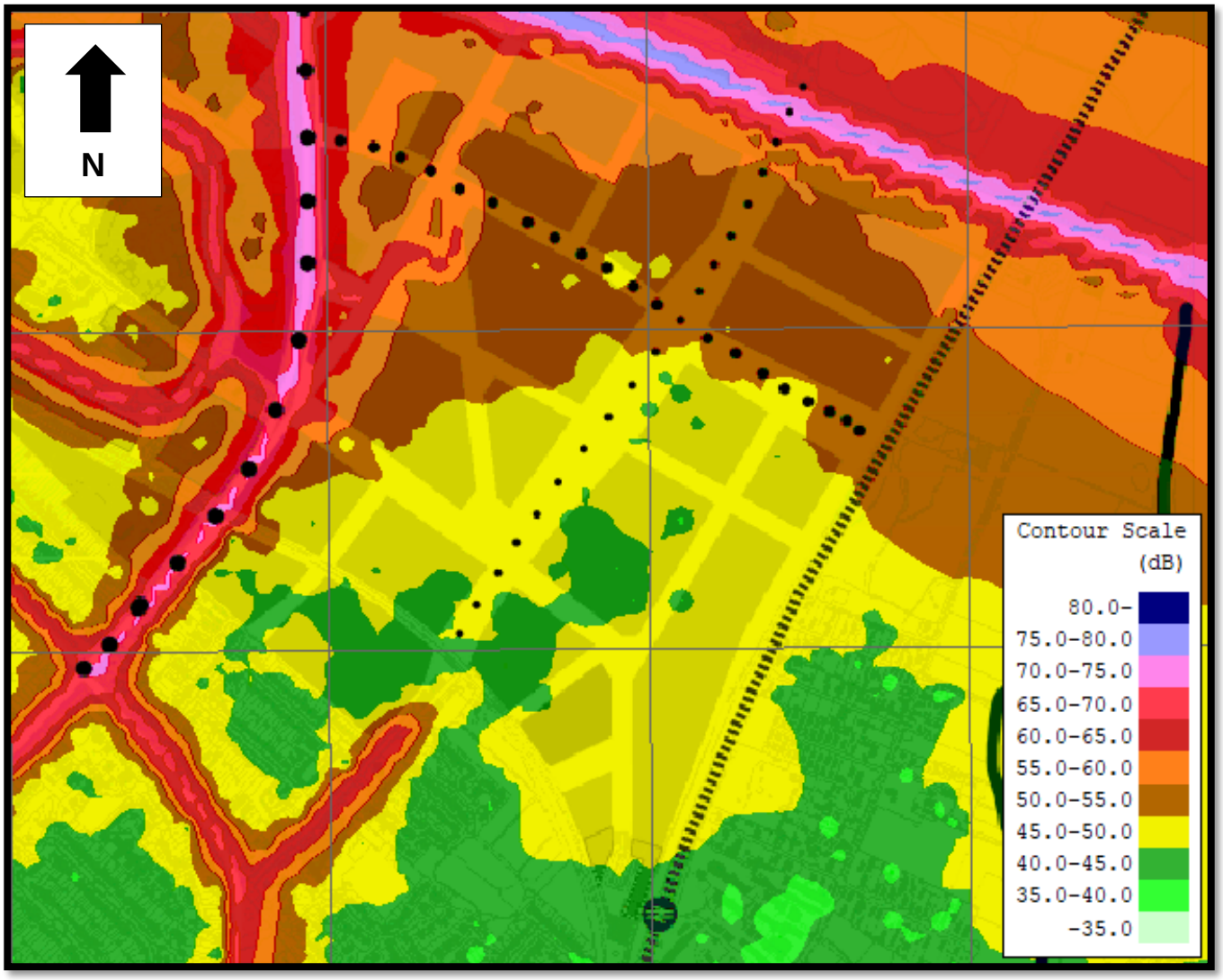


Figure 4-53 - 4m high barrier on a road height bund – Day, Evening and Night L_{den} – Ground Floor

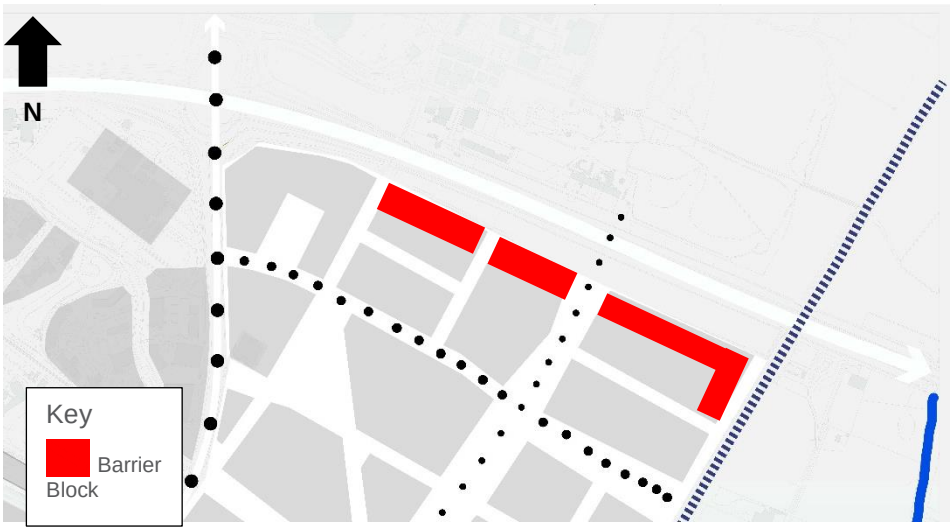


4.1.5. Mitigation Option 4 – Barrier Block

The fourth option for reducing road traffic noise at the proposed development from the A14 is a series of tall buildings, located along the northern edge of the site, next to the A14.

These blocks of buildings would act as a barrier, providing screening from road traffic noise to the buildings behind them and the rest of the site. These buildings could be commercial or residential, but if apartments they would be designed with all openable windows located to the south, with garden space located behind the blocks. Figure 4-54 shows the location of the blocks.

Figure 4-54 - Suggested Location of the Barrier Apartment Blocks



Mitigation Option 4 is based on the proposed site layout shown in the Masterplan provided, with apartment blocks located to the north of the site. Only the results at ground floor have been calculated.

a) 4 Storey Barrier Block

- The night time $L_{Aeq, 8hr}$ noise contours are shown in Figure 4-55,
- The daytime $L_{Aeq, 16hr}$ noise contours are shown in Figure 4-56, and
- The day, evening and night, L_{den}, contours are shown in Figure 4-57.

b) 8 Storey Barrier Block

- The night time $L_{Aeq, 8hr}$ noise contours are shown in Figure 4-58,
- The daytime $L_{Aeq, 16hr}$ noise contours are shown in Figure 4-59, and
- The day, evening and night, L_{den}, contours are shown in Figure 4-60.

c) 4 Storey Barrier Block and the 4m High Roadside Barrier

- The night time $L_{Aeq, 8hr}$ noise contours are shown in Figure 4-61,
- The daytime $L_{Aeq, 16hr}$ noise contours are shown in Figure 4-62, and
- The day, evening and night, L_{den}, contours are shown in Figure 4-63.

4 Storey Barrier Block

Figure 4-55 - 4 Storey Barrier Block – Night Time $L_{Aeq, 8hr}$ – Ground Floor

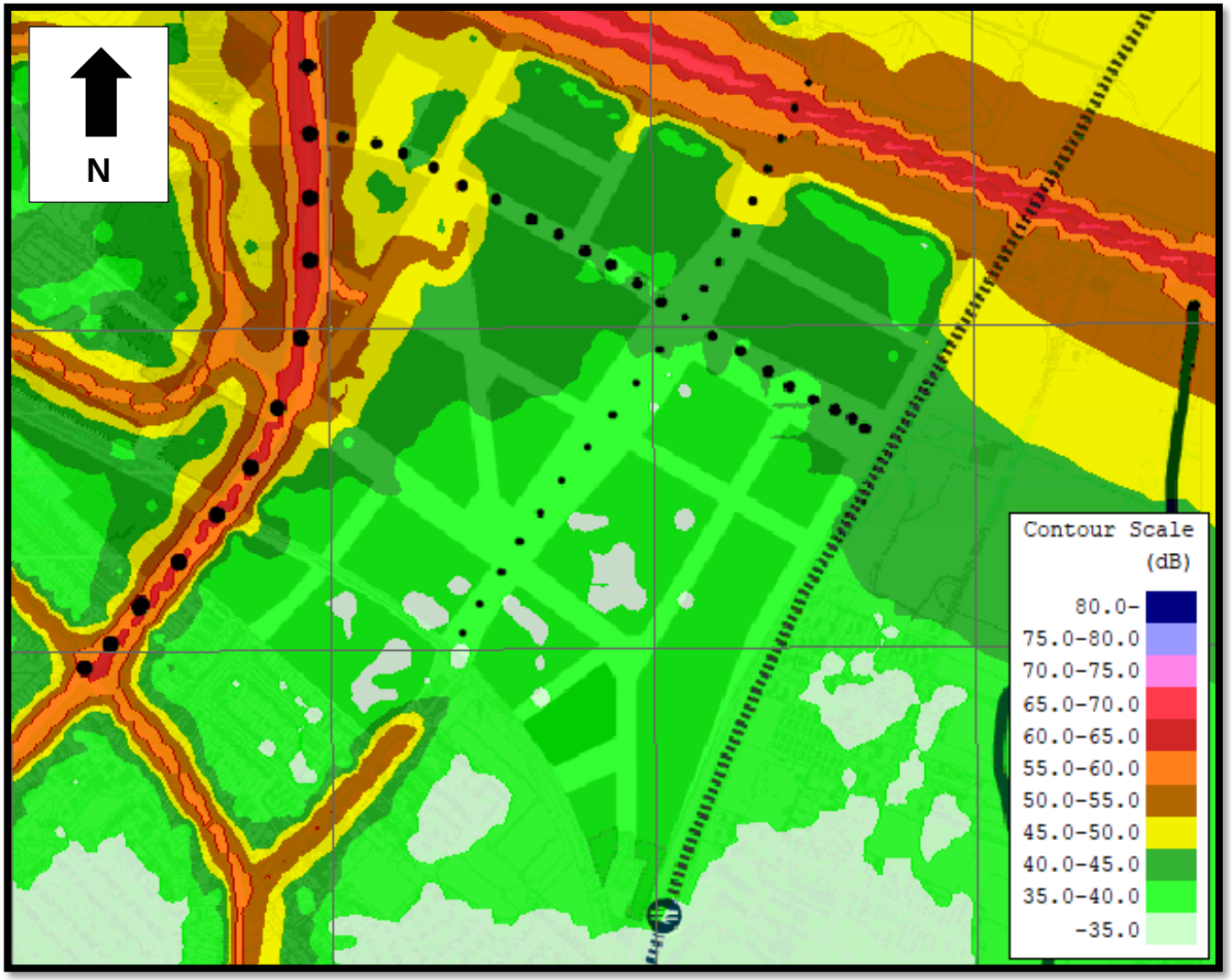


Figure 4-56 - 4 Storey Barrier Block – Daytime $L_{Aeq, 16hr}$ – Ground Floor

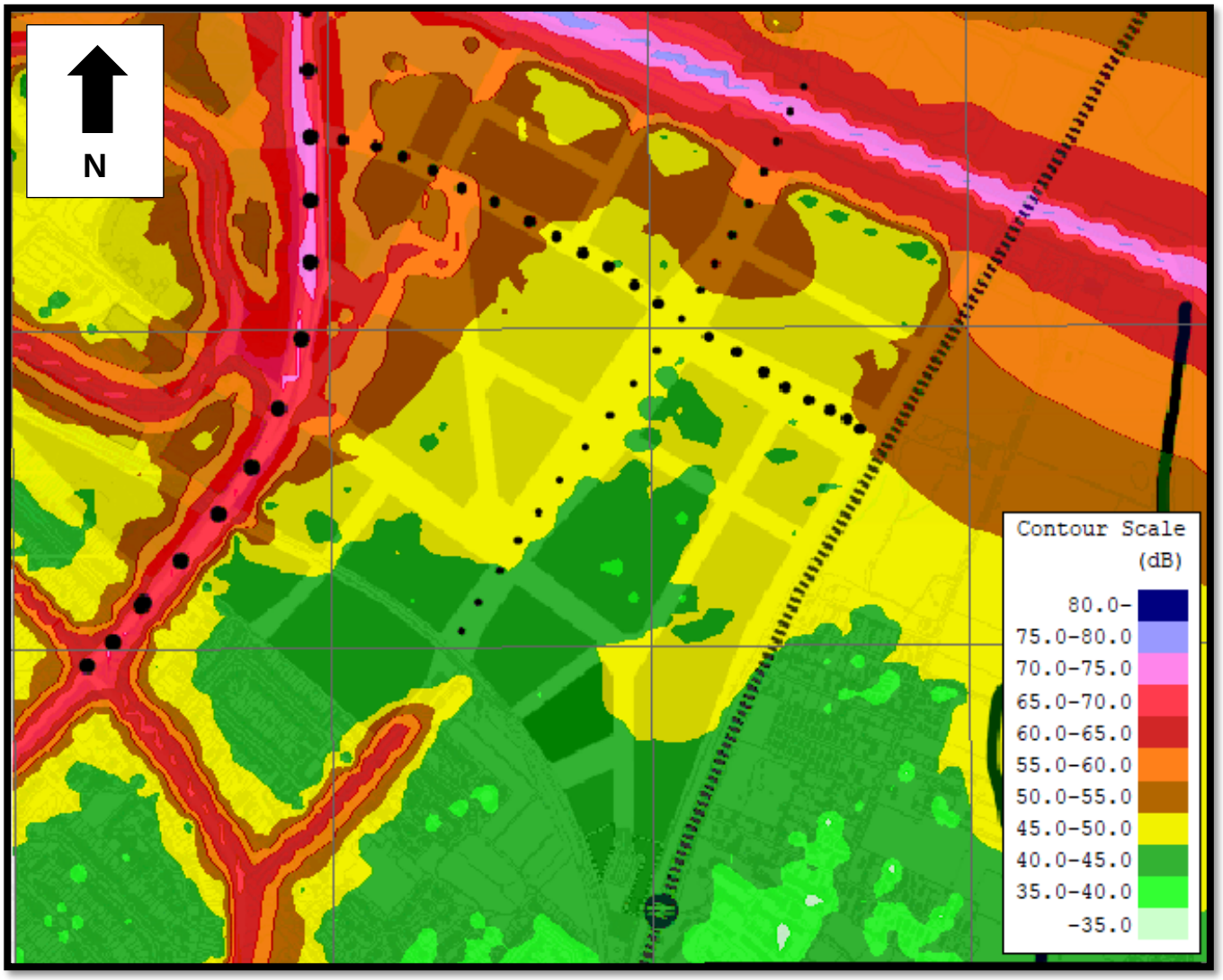
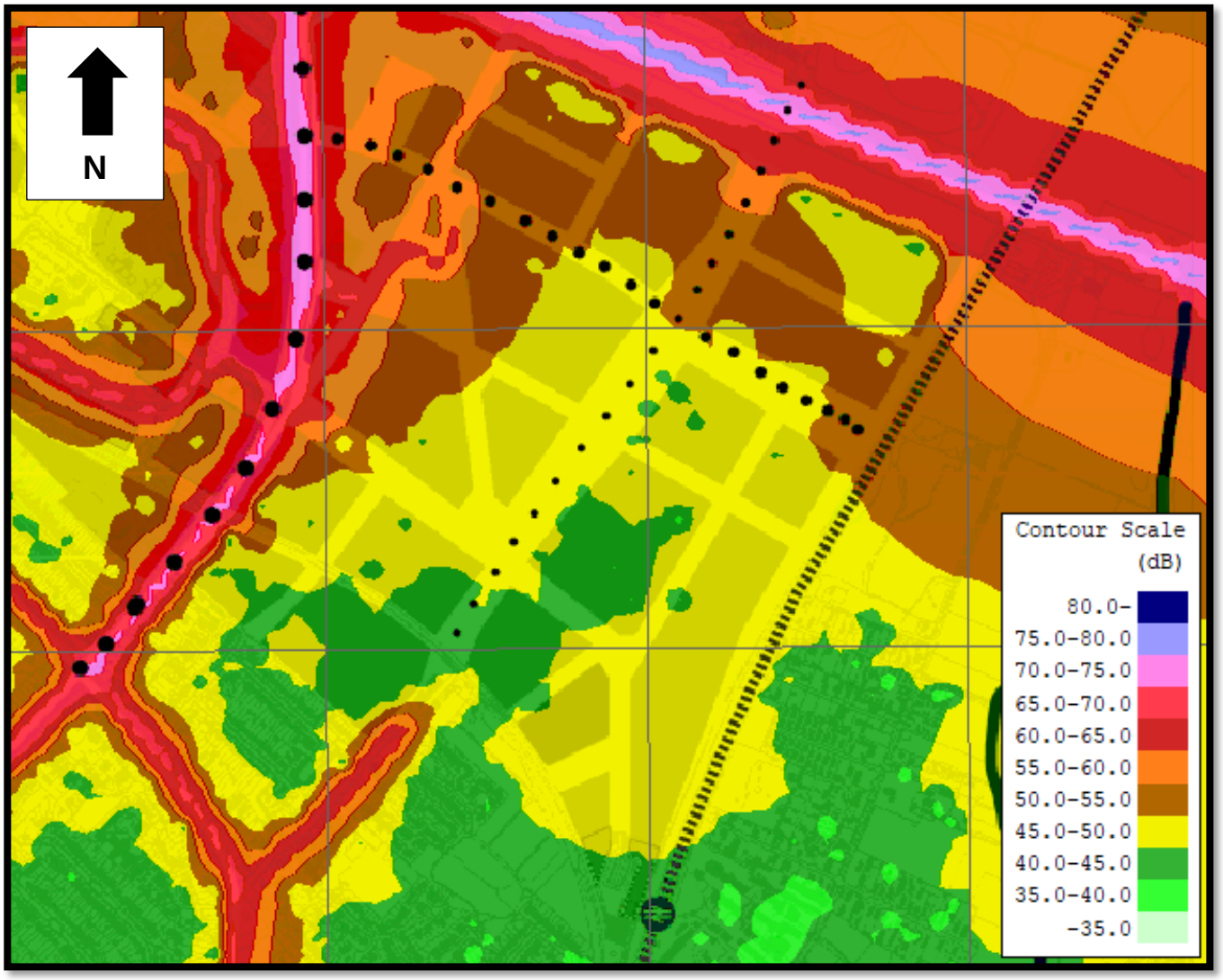


Figure 4-57 - 4 Storey Barrier Block – Day, Evening and Night L_{den} – Ground Floor



8 Storey Barrier Block

Figure 4-58 - 8 Storey Barrier Block – Night Time $L_{Aeq, 8hr}$ – Ground Floor

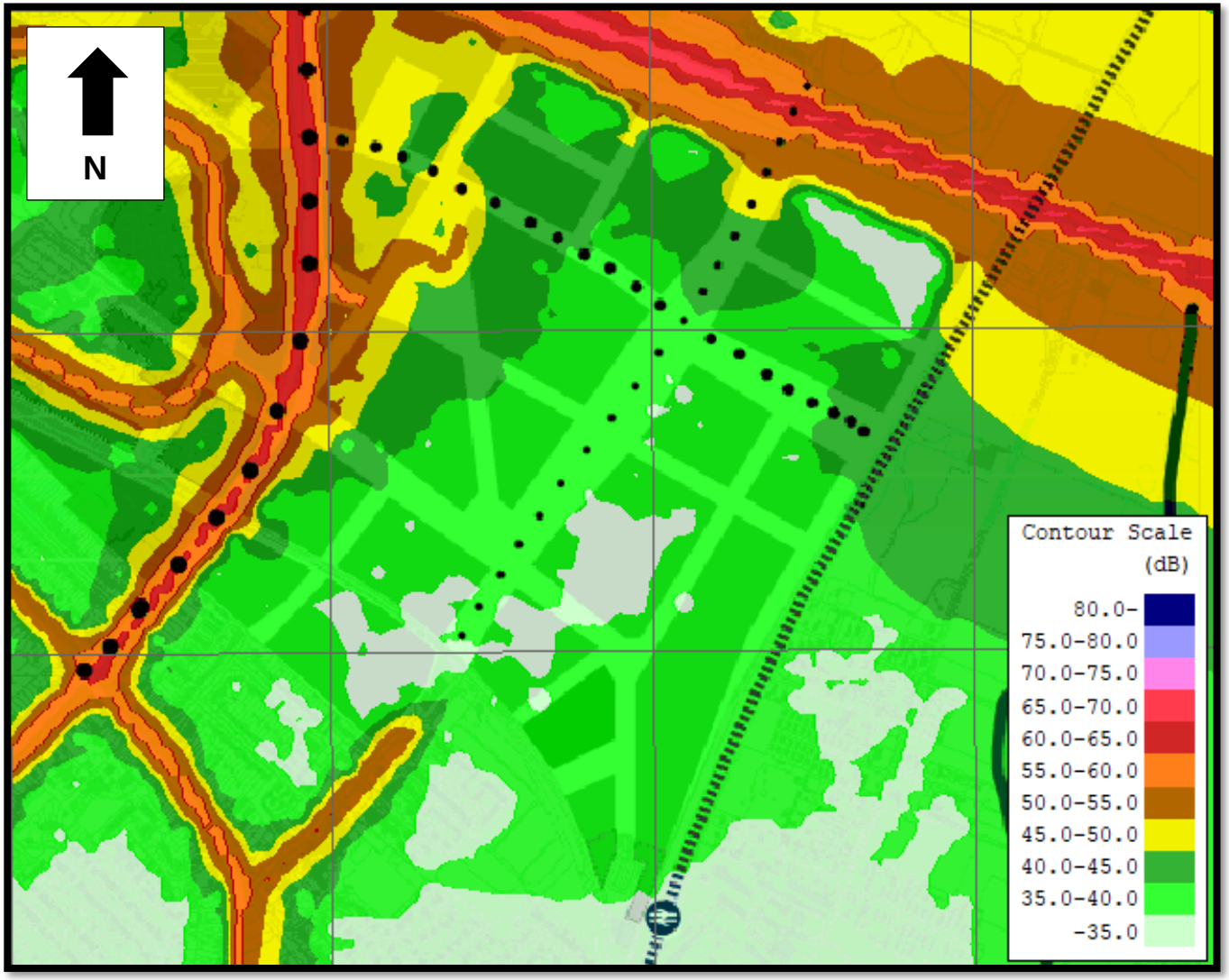


Figure 4-59 - 8 Storey Barrier Block – Daytime $L_{Aeq, 16hr}$ – Ground Floor

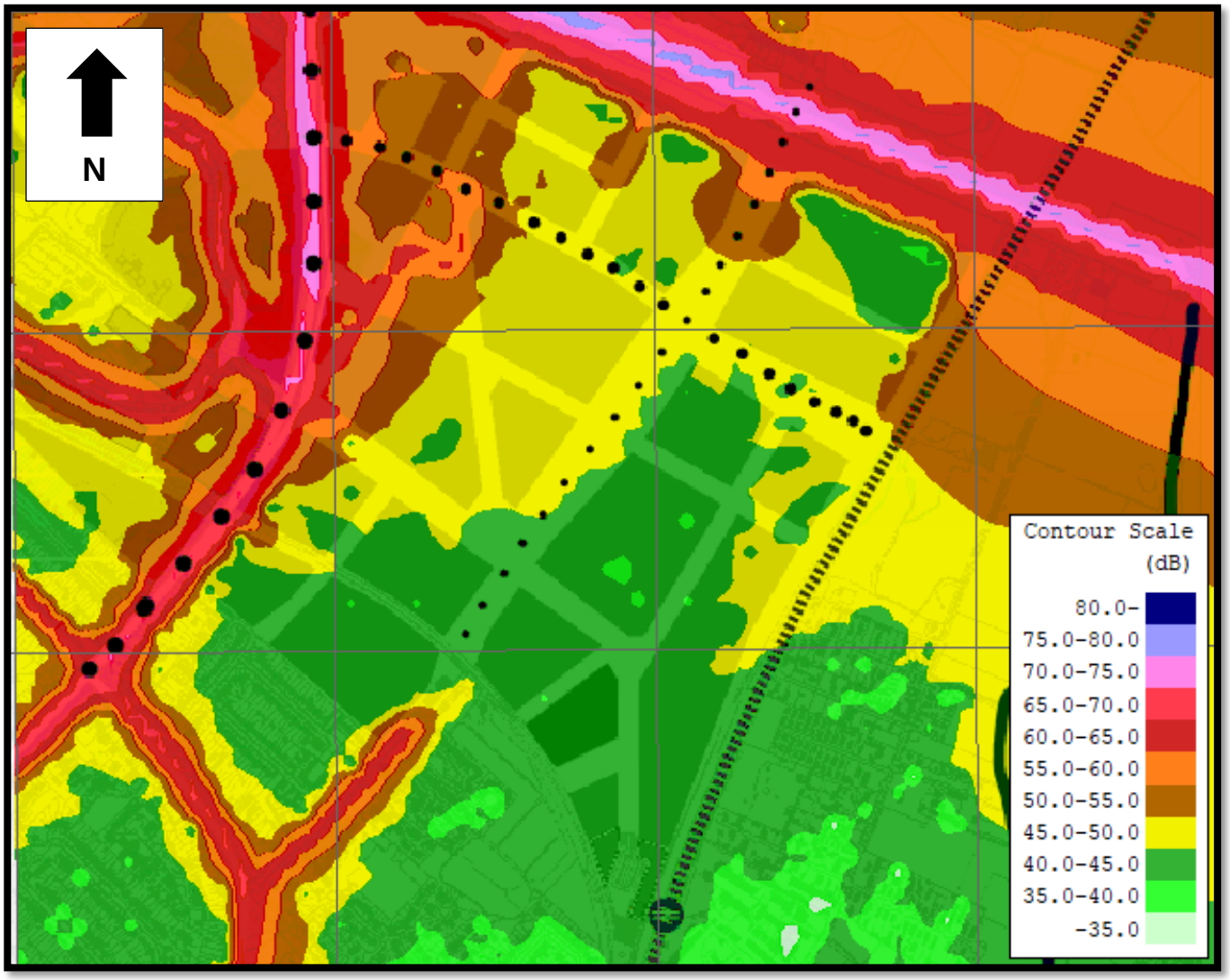
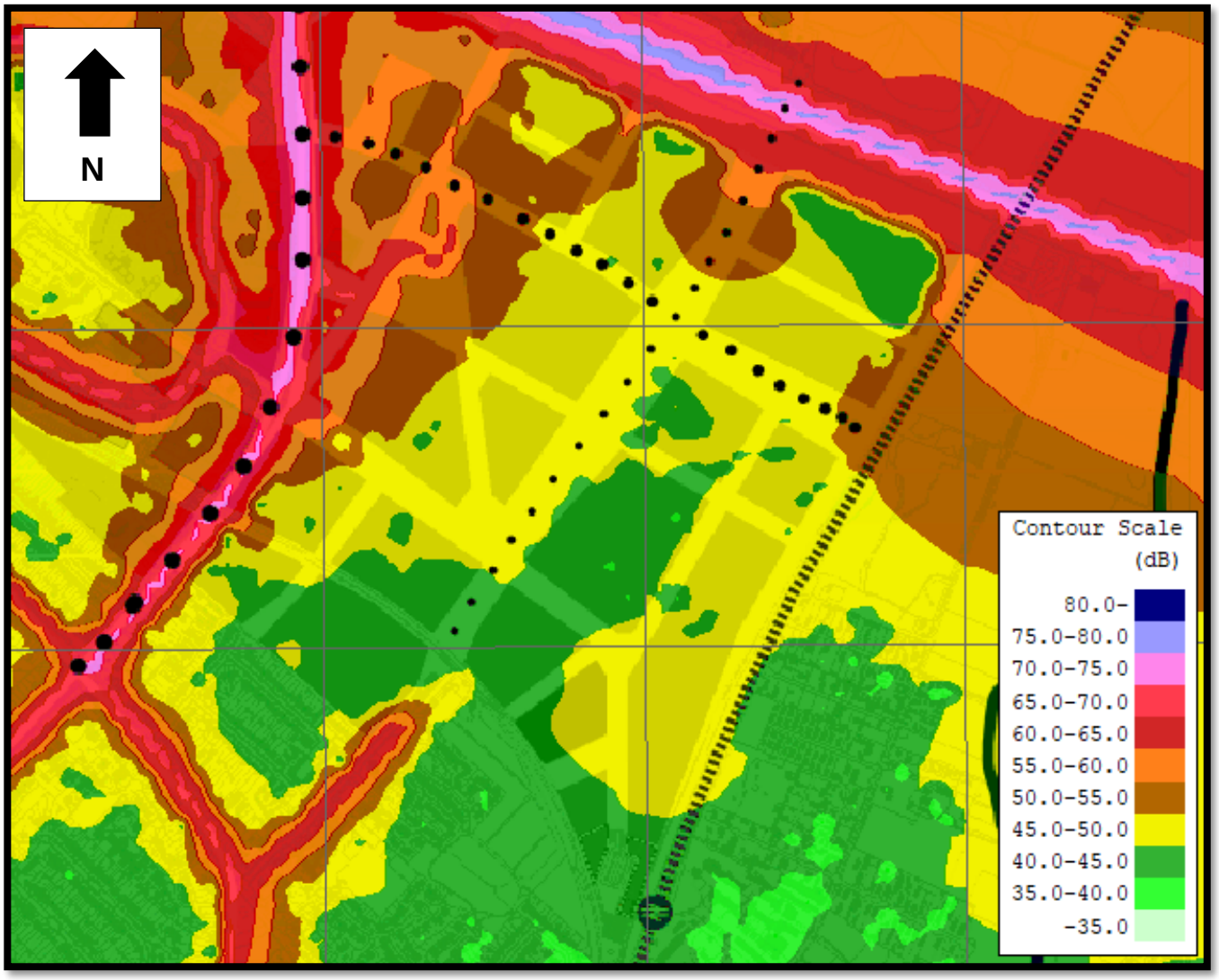


Figure 4-60 - 8 Storey Barrier Block- L_{den} – Day, Evening and Night L_{den} – Ground Floor



4 Storey Barrier Block and 4m High Roadside Barrier

Figure 4-61 - 4 Storey Barrier Block and 4m High Barrier – Night Time $L_{Aeq, 8hr}$ – Ground Floor

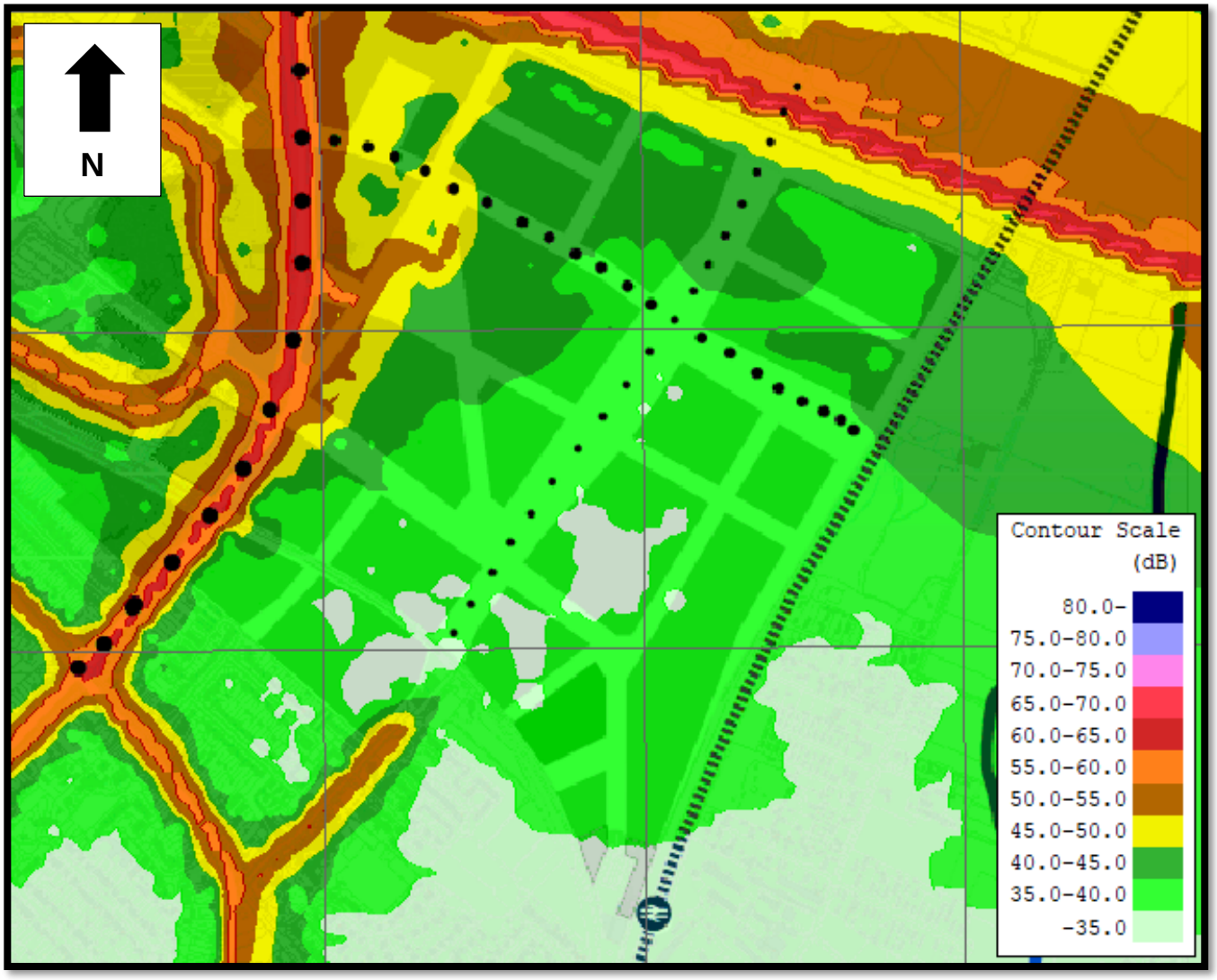


Figure 4-62 - 4 Storey Barrier Block and 4m High Barrier – Daytime $L_{Aeq, 16hr}$ – Ground Floor

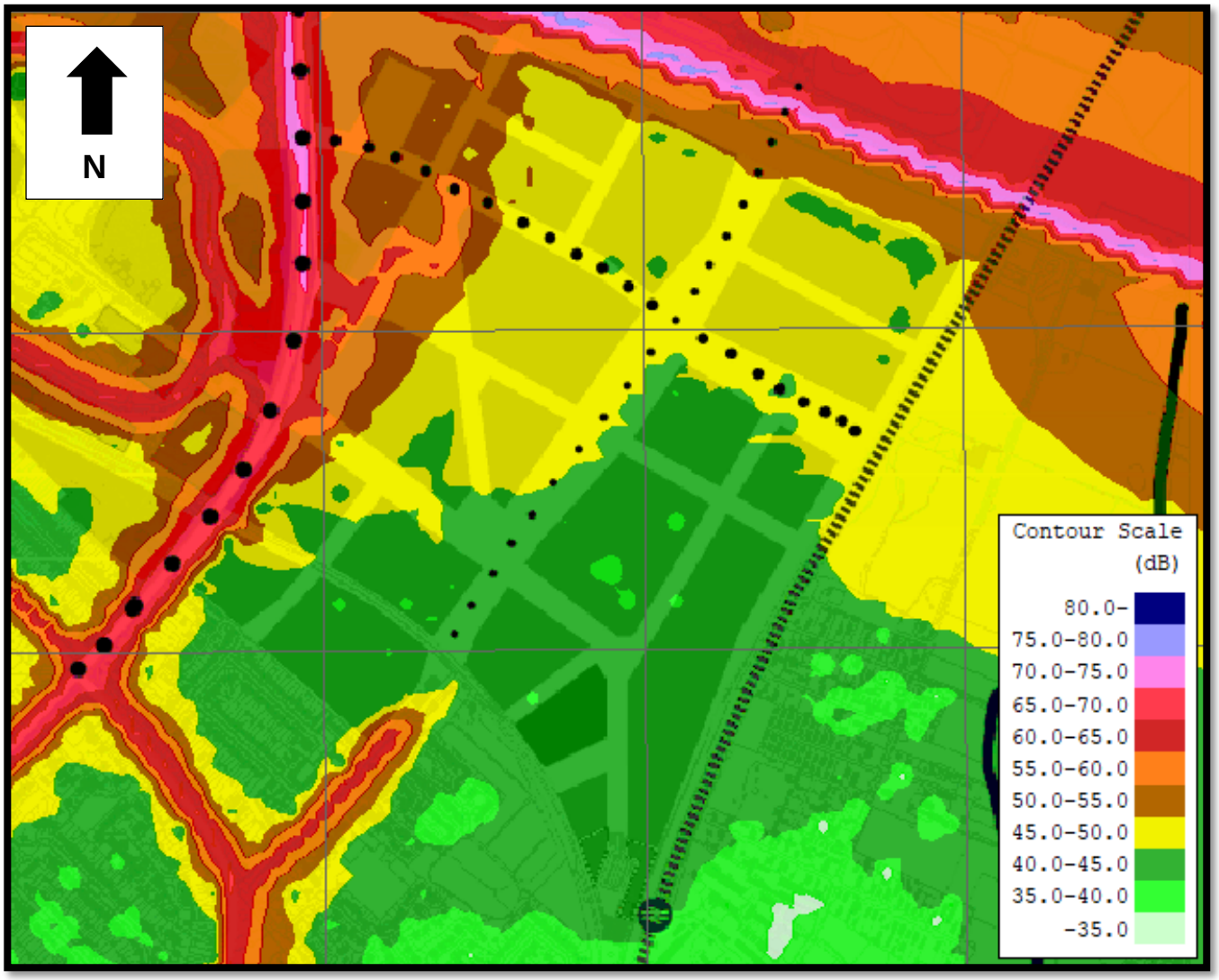
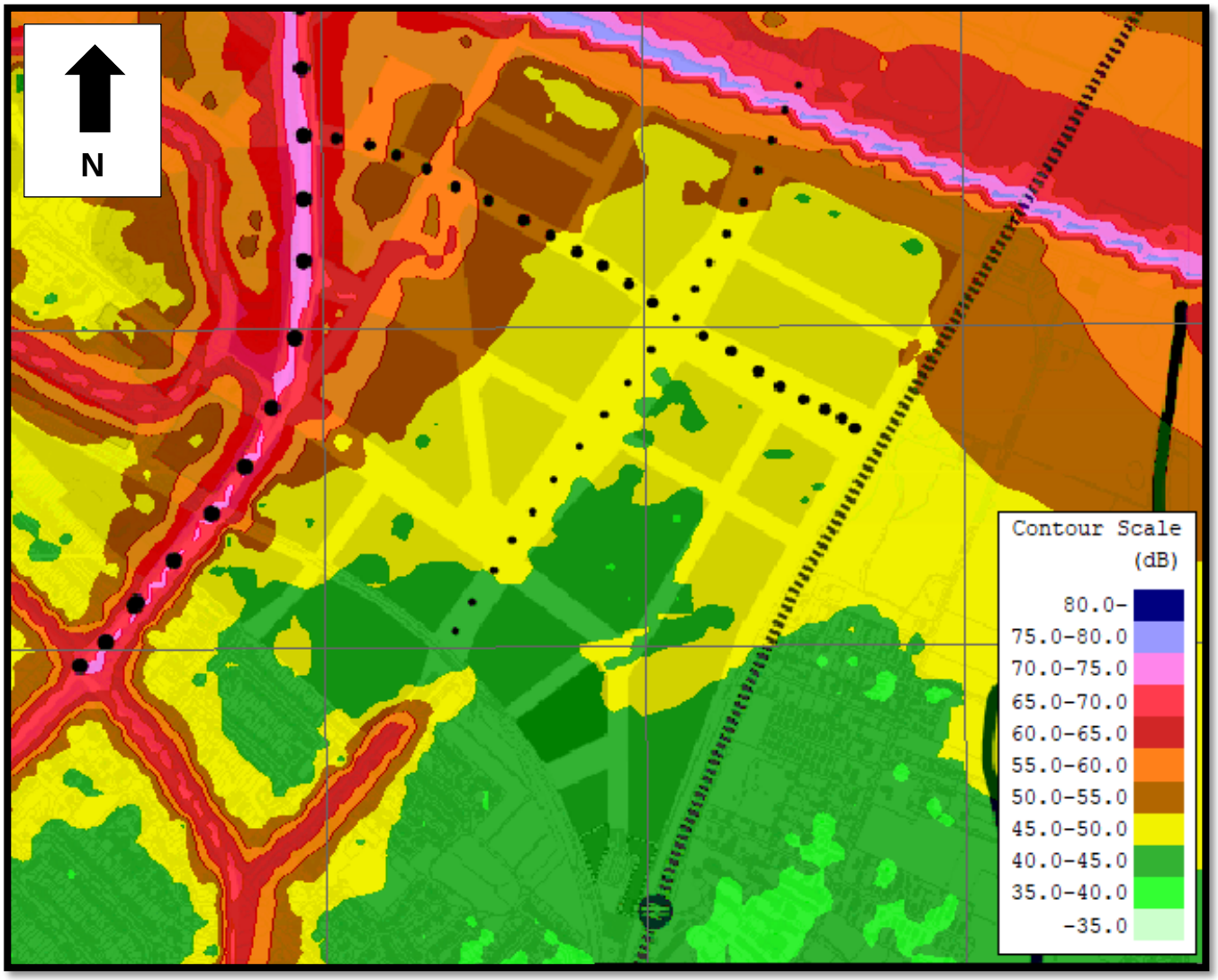


Figure 4-63 - 4 Storey Barrier Block and 4m High Barrier – Day, Evening and Night L_{den} – Ground Floor



5. Railway Noise

This section provides the results of the 'no mitigation' scenario, as shown in Table 5-1

Table 5-1 - Railway Noise Mitigation Scenarios and Prediction Height

Mitigation Scenario	Mitigation Options	Prediction Heights (Above Ground)
No Mitigation	None	Ground Floor (1.5m) 1st Floor (4m)

The source data used in this noise model is provided in Table 5-2

Table 5-2 - Railway Noise Modelling Source Data

Train Route	*Average Number of Cars*	*Daytime and Evening flow per hour (both directions)*	*Night time total flow (both directions)*	*Rail Company*	*Train Class*
London Liverpool Street to Cambridge North	12	2	4	West Anglia Mainline	Class 317 and 379
London Kings Cross to Kings Lynn	8	4	10	Great Northern	Class 313, 365, 387 and 700
London Kings Cross to Cambridge North	12	2	5	Thameslink	Class 313, 365, 387 and 700
Stanstead to Birmingham	3	2	3	Cross Country	Diesel 170
Cambridge to Norwich	4	2	6	Greater Anglia	Stadler bi-mode train (Assumed operating as Electric)

5.1. Railway Noise Modelling Results

The noise model was used to predict railway noise levels within the study area, with no additional mitigation in place.

- The night time $L_{Aeq,\ 8hr}$ noise contours are shown in Figure 5-1 and Figure 5-2,
- The daytime $L_{Aeq,\ 16hr}$ noise contours are shown in Figure 5-3 and Figure 5-4, and
- The day, evening and night, L_{den}, contours are shown in Figure 5-5 and Figure 5-6. .

No Mitigation - Railway Noise

Figure 5-1 - Railway – Night Time $L_{Aeq, 8hr}$ – Ground Floor

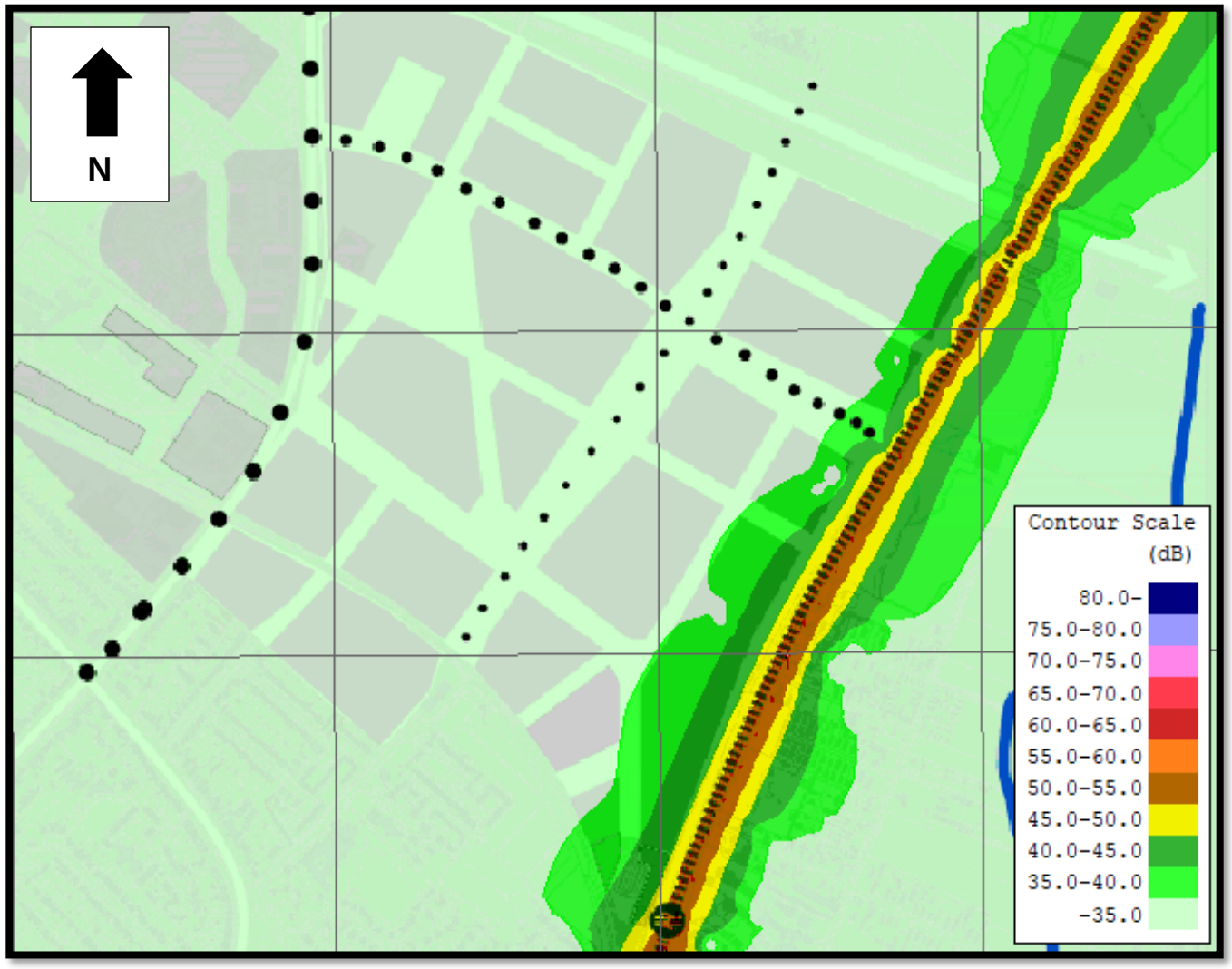


Figure 5-2 - Railway – Night Time $L_{Aeq, 8hr}$ – First Floor

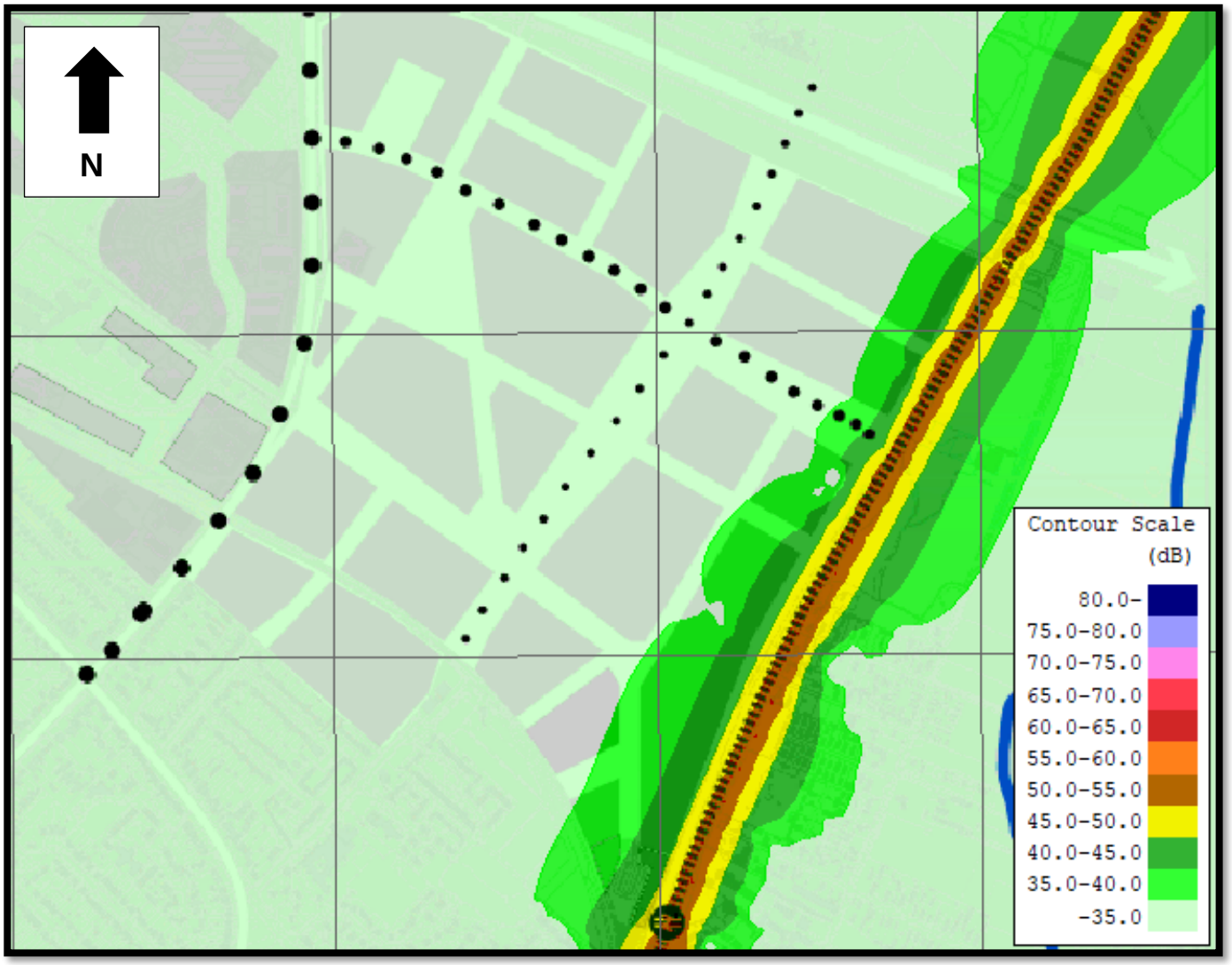


Figure 5-3 - Railway – Daytime $L_{Aeq, 16hr}$ – Ground Floor

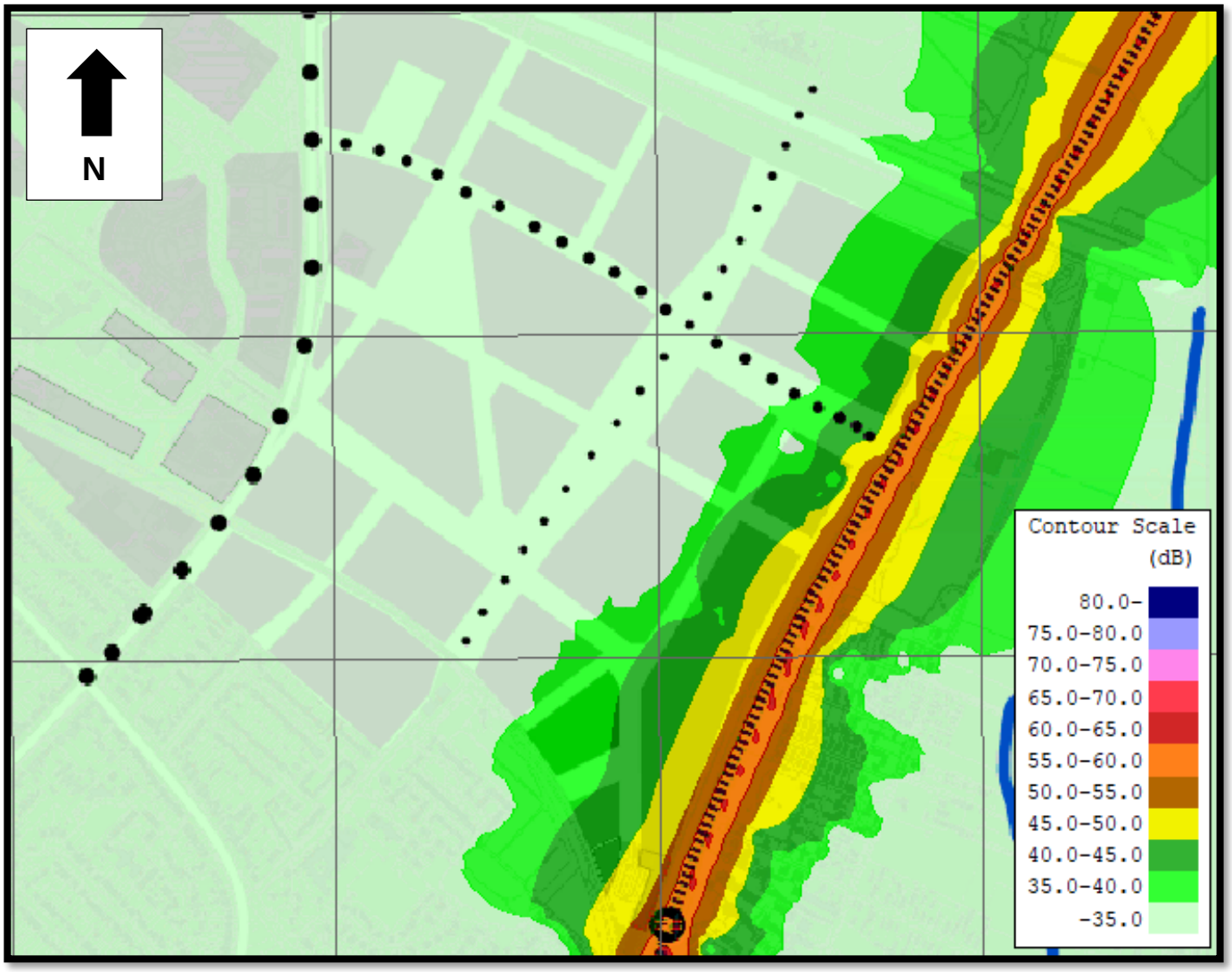


Figure 5-4 - Railway – Daytime $L_{Aeq, 16hr}$ – First Floor

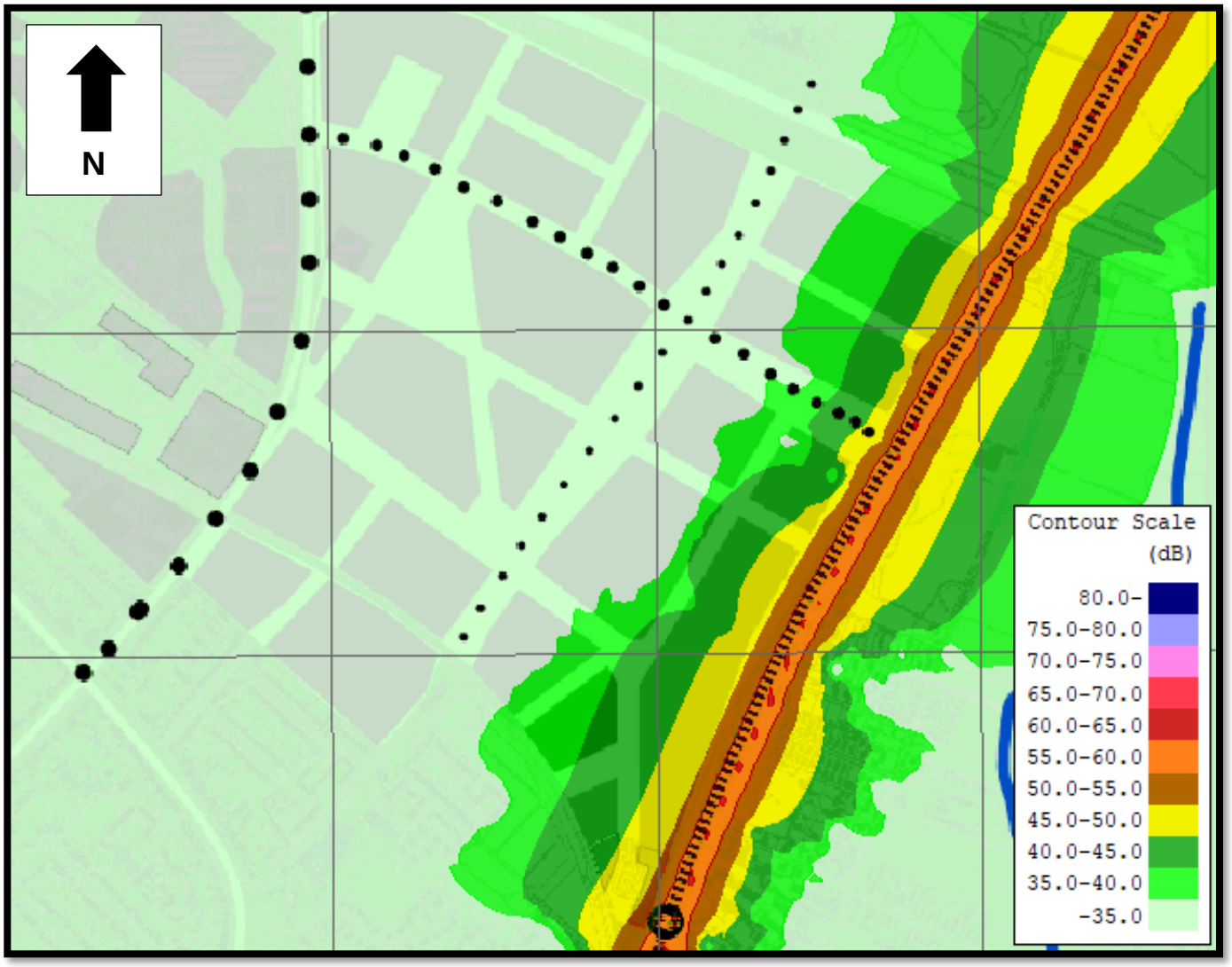


Figure 5-5 - Railway – Day, Evening and Night L_{den} – Ground Floor

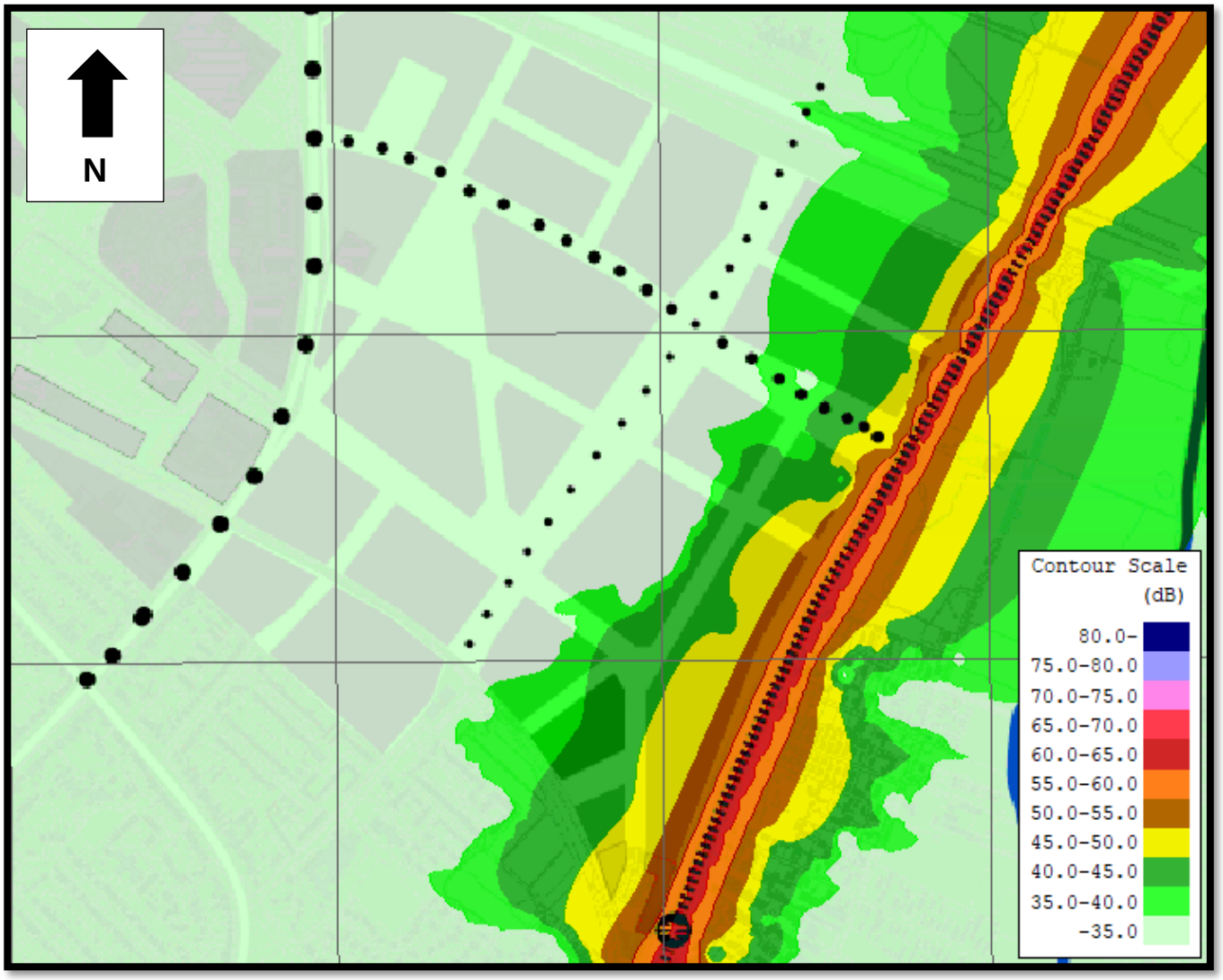
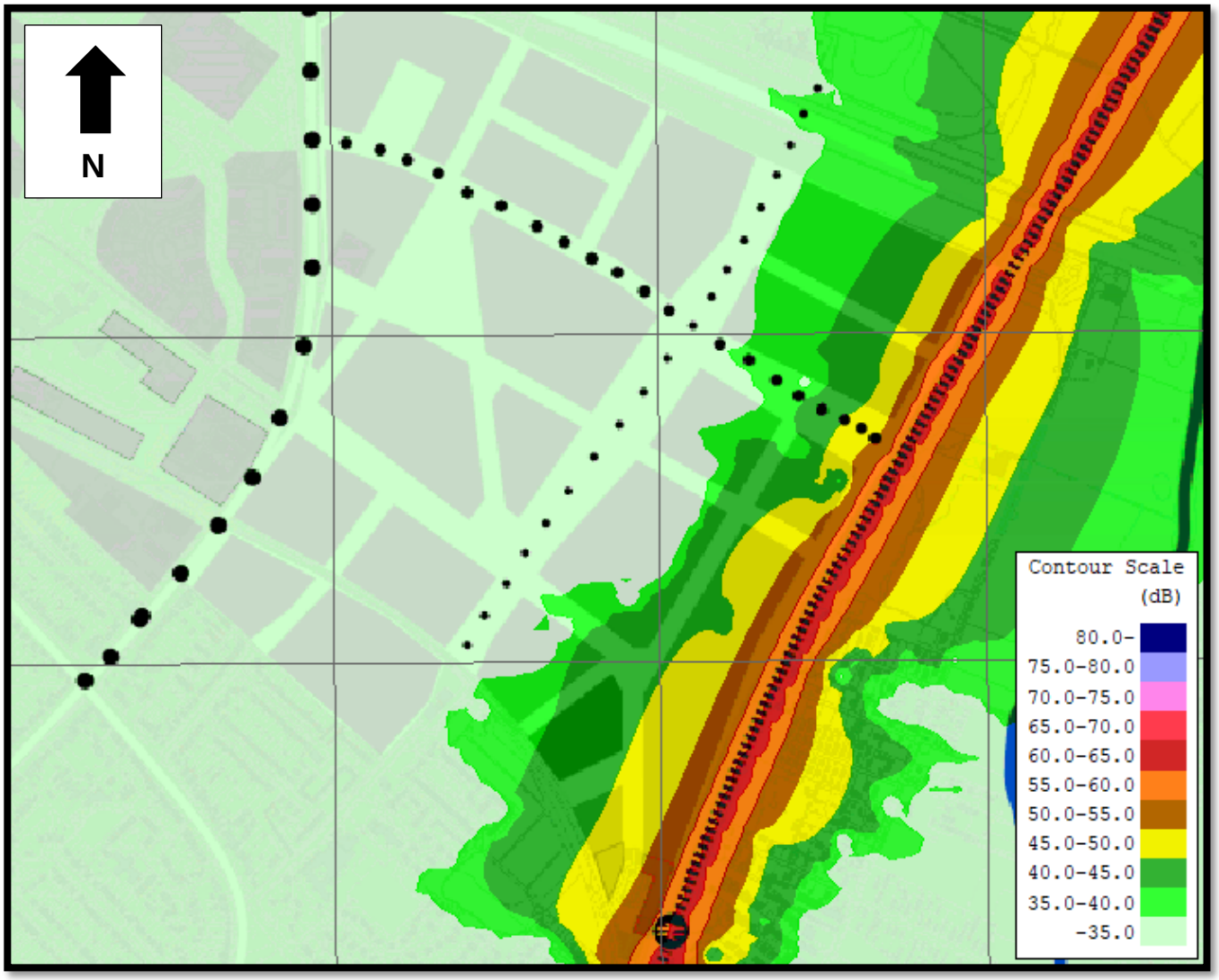


Figure 5-6 - Railway - L_{den} – Day, Evening and Night L_{den} – First Floor



6. Summary

The Greater Cambridge Planning Service have plans to develop a new residential area south of the A14, Cambridge Northern Bypass.

A series of noise contour maps were created for road traffic noise, including an investigation of mitigation such as roadside barriers, bunds and barrier apartment blocks, and railway noise.

This report provides the noise contour maps for all modelled situations, as well as a series of indicative noise threshold values that can be used in this assessment to determine a low risk of adverse effect, as shown in Table 2-4 - Summary of Threshold Values on page 12

The mitigation suggestions in this report assume that the measures suggested are possible, buildable, safe and built on land that is owned by the developer. Further investigations by other specialists, such as structural engineers and landscape architects would be required before any option is finalised.