Intended for
Viridor Tees Valley Limited

Document type
Report

Date
December 2021

TEES VALLEY ENERGY RECOVERY FACILITY NOISE IMPACT ASSESSMENT

RAMBOLL Bright ideas. Sustainable change.

TEES VALLEY ENERGY RECOVERY FACILITY
NOISE IMPACT ASSESSMENT

Ramboll
Carlton House
Ringwood Road
Woodlands
Southampton
SO40 7HT
United Kingdom
T +44 (0)23 8081 7500
www.ramboll.com

Project number	**1620010534**
Version	**02**
Document type	**Report**
Document number	**1620010534-RAM-XX-XX-RP-EV-00004**
Date	**16/12/2021**
Prepared by	**David Harbon**
Checked by	**Craig Barson**
Approved by	**Rachel Holloway**
Description	**Noise Impact Assessment**

Ramboll UK Limited
Registered in England & Wales
Company No: 03659970
Registered office:
240 Blackfriars Road
London
SE1 8NW

CONTENTS

FIGURES

APPENDICES

1. INTRODUCTION

1.1 Background

Ramboll UK Limited (Ramboll) has been instructed by Viridor Tees Valley Limited (the Client) to provide a Noise and Vibration Assessment for the proposed Tees Valley Energy Recovery Facility at the site located on the former South Tees Eco Park, Grangetown Prairie.

1.2 Objective and Scope of Works

This report considers the likely significant effects with respect to the noise associated with the construction and operation of the proposed development. The specific objectives of the chapter are to:

- Determine the prevailing background noise levels through baseline noise surveys.
- Predict construction noise levels at residential and non-residential receptors.
- Set plant noise limits, based on the measured background noise levels.
- Predict the operational noise impact on residential and non-residential receptors.

1.3 Proposed Development

Tees Valley Authorities, Durham County Council and Newcastle City Council (the Councils) have joined together to create an opportunity for a contractor to design, build, finance and operate a new ERF to be located in the Tees Valley on a mandated site owned by the South Tees Development Corporation (STDC). Redcar & Cleveland Borough Council (RCBC), as the local planning authority, granted outline planning permission for the construction of an ERF and associated development at the site under reference R/2019/0767/OOM on 24 July 2020.

Viridor is applying for reserved matters approval for the details of an ERF pursuant to this outline permission. The outline planning application refers to an ERF with a capacity of approximately 450,000 tonnes of residual waste per year.

1.4 Limitations and Constraints

All reasonable measures have been undertaken to reduce uncertainty in the baseline noise survey data and the calculations detailed in this report.

Uncertainty has been minimised by completing unattended measurements over daytime, evening, weekend and night-time periods. Attended measurements were completed (where possible) at the nearest receptor locations to support the unattended measurements.

Results have been rounded to the nearest A-weighted decibel.

Demolition and construction works would normally take place during standard daytime hours as defined in BS 5228:2009+A1:2014, i.e. 07:00-19:00 Monday-Friday.

The baseline noise prediction model was calibrated to the noise survey results for road traffic noise sources, and accounts for intervening topography and existing building massing. The model uses the calculation method of ISO9613-2:1996.

Plant noise emissions are based on benchmarking measurements from an existing energy recovery facility and based on indicative plant noise emission levels stated by the engineering design team.

The noise emissions from HGVs have been modelled at a height of 2.0m above ground level.

Noise levels at Noise Sensitive Receptors are predicted at heights of 1.5m and 4.0m above ground level, to represent ground floor and first floor levels, respectively.

The assessments and calculations undertaken in this report are based on data and plans of the proposed detailed design development scheme.

2. SITE DETAILS

2.1 Site Location

The site is located on the former South Tees Eco Park, Grangetown Prairie, located to the north of Grangetown approximately 5 miles to the northeast of Middlesbrough Town centre. National Grid Reference NZ 54424 21362 (nearest postcode TS6 6TZ).

The site location is shown in Figure 2.1.

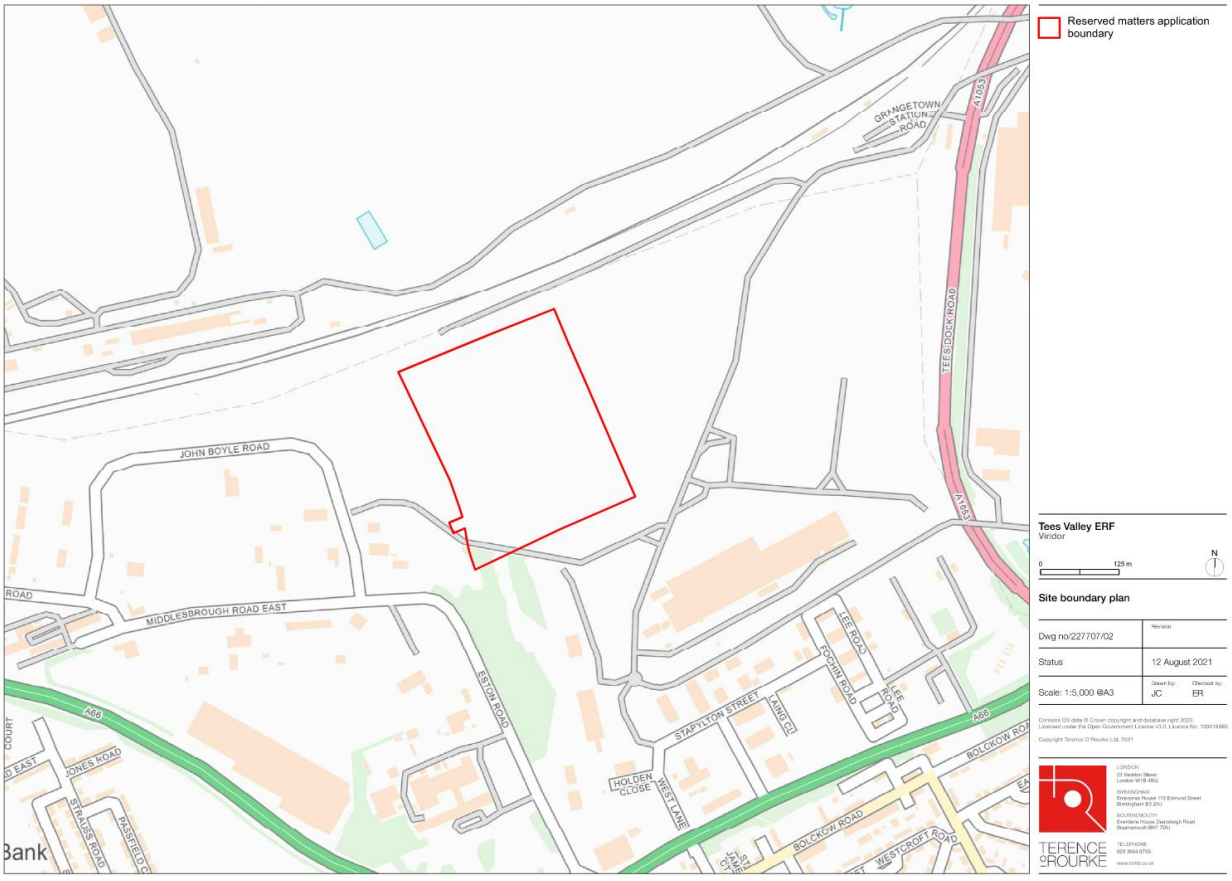


Figure 2.1 Site boundary (source: Terence O'Rourke)

2.1 Site Description

The site lies within the south west corner of the STDC regeneration area within the Grangetown Prairie Zone. The ERF site is a previously developed industrial site that was formerly used for the production of iron and steel (occupied by Eston Iron Works and Cleveland Steel Works). Following the closure of the steel works and cessation of industrial activities, the building complex was cleared in the 1980's and the site is now vacant.

3. PLANNING POLICY CONTEXT

3.0.1 National Planning Policy Framework, 2021

No specific noise criteria are set out in the National Planning Policy Framework (NPPF) or in the Noise Policy Statement for England (NPSE) to which it refers. Regarding noise, the NPPF states that the planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to, or being put at unacceptable risk from, or being adversely affected by, unacceptable levels of noise pollution.

Paragraph 180 of the NPPF states that:

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:

- *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;*
- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason…'*

To achieve these aims, the NPPF refers to the explanatory note to the NPSE.

3.0.2 Noise Policy Statement for England, 2010

The NPSE sets out the long-term vision of Government noise policy which is to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

The NPSE outlines the following three aims for the effective management and control of mental, neighbour and neighbourhood noise:

i. Avoid significant adverse impacts on health and quality of life;
ii. Mitigate and minimise adverse impacts on health and quality of life; and
iii. Where possible, contribute to the improvement of health and quality of life.

3.0.3 Planning Practice Guidance, Updated 2019

Planning Practice Guidance (PPG) is a web-based resource, which includes a section on noise. This resource provides guidance on how to determine the noise impact in terms of whether a significant adverse effect is likely to occur and/or whether a good standard of amenity can be achieved.

In line with the Noise Policy Statement for England, Planning Practice Guidance introduces the following concepts:

i. Significant observed adverse effect level (SOAEL): This is the level of noise exposure above which significant adverse effects on health and quality of life occur;
ii. Lowest observed adverse effect level (LOAEL): this is the level of noise exposure above which adverse effects on health and quality of life can be detected; and
iii. No observed effect level (NOEL): this is the level of noise exposure below which no effect at all on health or quality of life can be detected.

Table 3.1 summarises the noise exposure hierarchy, based on the likely average response.

Table 3-1 Noise Exposure Hierarchy

Perception	Examples of outcome	Increasing effect level	Action
Not noticeable	No effect	No Observed Effect	No specific measures
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. 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			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, 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 perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, 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 the 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
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

3.0.4 Other Guidance

British Standard 5228: 2009+A1: 2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2

BS 5228:2009[1] gives recommendations for basic methods of noise and vibration control relating to construction work. It also provides guidance concerning methods of predicting and measuring noise and vibration and assessing their impacts on those exposed to it. The prediction method considers the noise emission level of proposed plant, the separation distance between the source and the receiver and the effect of the intervening topography and structures.

Part 2 of the standard gives recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration.

[1] British Standards Institution, 2009 and 2014. British Standard 5228: 2009 +A1 2014 Code of practice for noise and vibration control on construction and open sites. BSI

The legislative background to vibration control is described and recommendations are given regarding procedures for the establishment of effective liaison between developers, site operators and local authorities. The standard also provides guidance on measuring vibration and assessing its effects on the environment.

British Standard 4142:2014+A1:2019 Method for rating and assessing industrial and commercial sound

BS 4142:2014+A1:2019[2] provides a method for rating industrial and commercial sound and method for assessing resulting impacts upon people. The method is applicable to fixed plant installations, sound from industrial and manufacturing process and other associated activities.

The basis of BS 4142 is a comparison between the background noise level in the vicinity of residential locations and the rating level of the noise source under consideration. The relevant parameters in this instance are as follows:

i. Background Level, $L_{A90,T}$: defined in the Standard as the 'A' weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, and quoted to the nearest whole number of decibels;
ii. Specific Level, $L_{Aeq,T}$: the equivalent continuous 'A' weighted sound pressure level at the assessment location in the absence of the specific sound source under consideration, over a given time interval, T; and
iii. Rating Level, $L_{Ar,T}$: the specific sound level plus any adjustment made for the characteristic features of the noise.

Potential impacts are predicted from the difference between the representative background level at a noise sensitive receptor and the rating level from the noise source considered. The standard suggests that the greater the difference, the greater the magnitude of impact.

In determining the significance of the impact, BS 4142 requires a consideration of the context of the assessment i.e. the nature of the existing acoustic environment and the new noise source, and the sensitivity of the affected receptors.

3.1 Assessment Methodology and Significance Criteria

The following section outlines the methodology applied to identify and assess the potential noise impacts likely to result from the proposed development.

3.1.1 Receptor Locations

The receptors considered in this assessment are detailed in Table 3.2 and shown in Figure 3.1, along with the approximate red line boundary.

Table 3-2 Receptor Locations

Location	Description	Distance from site (m) at closest point
R1	Residential dwellings along Jones Road	640
R2	Residential dwellings along Bolckow Road	580
R3	Residential dwellings along Bolckow Road/Cresswell Road	790
R4	Non-residential receptors along John Boyle Road	125

[2] British Standards Institute, 2014 and 2019. British Standard BS 4142+A1:2019: Methods for rating and assessing industrial and commercial sound. BSI

Figure 3.1 Receptor locations

The receptor locations have been chosen based on the locations that were selected for the outline planning application. The non-residential receptor (R4) was chosen in addition to the nearest residential receptors (R1-R3) given the proximity of this receptor location to the application site.

3.1.2 Consultation

The Environmental Health Officer at Redcar and Cleveland Borough Council was consulted by email on 21 December 2020 to agree the survey and assessment methodology, and assessment criteria.

A response was received from Mick Gent on 5 January 2021 to confirm that the methodology and assessment criteria were suitable. A copy of this correspondence is included at Appendix B.

3.1.3 Baseline Characterisation

A baseline noise survey was carried out at the nearest NSRs to quantify the prevailing ambient and background noise levels during daytime and night-time periods. The purpose of the baseline survey was to establish thresholds for construction noise effects and operational plant noise effects.

The survey locations that were used to inform the outline planning application were reused for this assessment. The measurements completed for the outline planning application were completed over a 1-day period between 5-6 December 2019. The survey completed for this assessment was completed between Friday 22 January 2021 to Tuesday 26 January 2021 to determine noise levels over a longer period, including daytime, evening, night-time and weekend periods.

Benchmarking measurements from an existing energy from waste facility (i.e. the Lakeside EfW facility at Slough) have been used to inform the operational noise assessment.

Construction Noise Assessment

Construction Noise

The construction works associated with the proposed development will involve the use of a variety of working methods which will change throughout the construction period. Therefore, noise levels from the works are likely to vary significantly over time as the type of construction activities change.

The exact working methodology and plant to be employed during construction has not been established at this stage in the design. However, following best practice, an estimate of the expected noise levels over a representative period had been undertaken using assumed plant items and the associated noise emission data from BS 5228:2009+A1:2014.

The significance criteria for construction noise levels at the residential receptors have been established by reference to ABC method described in BS 5228:2009+A1:2014, as per the methodology adopted in the outline planning application. The thresholds are made relative to the pre-existing ambient noise levels at assessment locations, as shown in Table 3-3.

Table 3-3 BS5228 'ABC' Method for Construction Noise

Assessment period	Threshold values, $L_{Aeq,T}$ (dB)		
	Category A	**Category B**	**Category C**
Daytime (07:00 – 19:00) Saturday (07:00 – 13:00)	65	70	75
Evening (19:00 – 23:00)	55	60	65
Night-time (23:00-07:00)	45	50	55

A potential significant noise effect is indicated when the construction noise exceeds the threshold level for the category appropriate to the ambient noise level:

i. Threshold values of Category A for construction noise should be used when the pre-existing ambient noise level, rounded to the nearest 5 dB, is less than those values shown under Category A;
ii. Threshold values of Category B should be used when pre-existing ambient noise level, rounded to the nearest 5 dB, is equal to values in Category A;
iii. Threshold values of Category C should be used when pre-existing ambient noise level, rounded to the nearest 5 dB, is more than values in Category A.

The ABC method is applicable for residential receptors.

For non-residential receptor R4, the 5dB(A) change method of Annex E.3.3 of BS 5228:2009+A1:2014 has been used to determine likely significant effects. Using this method, noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$ from site noise alone, for the daytime, evening and night-time periods, respectively.

Most construction works are assumed to occur during daytime periods. However, there may be construction activities which are outside of typical construction work patterns due to the nature of some activities such are concrete pours.

Construction Traffic Noise

Noise levels generated by construction traffic on the local highways have been compared to the guidance of DMRB[3] and LA 111[4]. The expected change in road traffic noise levels has been compared to the short-term criteria of LA 111. This assessment was not included in the outline planning application.

Construction Vibration

Vibration levels from piling may be perceptible at distances up to 100m from the works. Of the receptors identified, the closest existing non-residential receptor is 125m away from the western site boundary (R4). Residential receptors are approximately 580-790m from the site boundary.

Therefore, no significant construction vibration effects are expected, and no further assessment of construction vibration is provided in this report. No assessment of vibration was provided in the outline planning application.

Operational Noise Assessment

Operational Noise Limits

Operational noise limits will be set based on the background noise levels measured during the baseline survey, as per the methodology used for setting plant noise limits in the outline planning application. In accordance with BS4142:2014+A1:2019 and as agreed through consultation with Redcar and Cleveland Borough Council, the rating noise level limits will be set equal to the representative background noise levels, allowing for any penalties for acoustic characteristics of the noise.

Noise Emissions from Plant and Site Processes

Using the benchmarking measurement results and data provided by the engineering design team, a noise prediction model of the site has been built to predict noise emissions to the nearest receptor locations. The model uses the calculation method of ISO9613-2:1996 and allows for the effects of building massing, site topography, ground absorption and any screening.

Significance Criteria

Effects that are described as SOAEL are considered to be significant effects.

Construction Noise

Table 3-4 details the significance criteria for construction noise effects at residential receptors.

[3] Design Manual for Roads and Bridges, Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 7 Noise and Vibration (2011)

[4] Design Manual for Roads and Bridges – Sustainability & Environment Appraisal LA111 Noise and vibration Revision 1 (2020)

Table 3-4 Construction Noise Significance Criteria – Residential Receptors

Description	Magnitude of impact	Adverse effect level
Predicted construction noise levels are less than the baseline noise levels at receptor ($L_{Aeq,T}$)	Negligible	NOAEL
Predicted construction noise levels are greater than or equal to the baseline noise levels at receptor ($L_{Aeq,T}$) and below the threshold value	Low	LOAEL
Predicted construction noise levels are equal to or up to 5 dB above the threshold value at receptor	Medium	SOAEL
Predicted construction noise levels are ≥5 dB above the threshold value at receptor	High	SOAEL

Table 3-5 details the significance criteria for construction noise effects at non-residential receptors.

Table 3-5: Construction Noise Significance Criteria – Non-Residential Receptors

Description	Magnitude of impact	Adverse effect level
< 0 dB change in noise level between total level and pre-existing ambient noise level	Negligible	NOAEL
0 - 5 dB change in noise level between total level and pre-existing ambient noise level	Low	LOAEL
6 - 10 dB change in noise level between total level and pre-existing ambient noise level	Medium	SOAEL
> 10 dB change in noise level between total level and pre-existing ambient noise level	High	SOAEL

Construction Traffic Noise Levels

The change in noise levels due to construction heavy goods vehicles (HGVs) have been assessed against the short-term criteria of LA 111[5], as shown in Table 3.6.

Table 3-6: Magnitude of Impact - Road Traffic Noise Changes (short term)

Change in Traffic Basic Noise Level $L_{A10,18h}$ dB	Magnitude of Impact	Adverse Effect Level
≥ 5.0	Substantial	SOAEL
3.0 to 4.9	Moderate	SOAEL
1.0 to 2.9	Slight	LOAEL
< 1.0	Negligible	NOAEL

Operational Noise – Residential receptors

Table 3-7 details the significance of effects for operational noise based on the numerical difference between predicted Rating Level and the prevailing Background Level at a receptor and the criteria from BS 4142:2014+A1:2019.

[5] Design Manual for Roads and Bridges – Sustainability & Environment Appraisal LA111 Noise and vibration Revision 1 (2020)

Table 3-7 Operational Noise Significance Criteria

Description	Magnitude of impact	Adverse effect level
Predicted Rating Level is 10 dB or more below the prevailing Background Level at the receptor.	No Effect	-
Predicted Rating Level is between 10 dB and -0.1 dB below the prevailing Background Level at the receptor.	Negligible	NOAEL
Predicted Rating Level is between 0 dB and 4.9 dB above the prevailing Background Level at the receptor.	Low	LOAEL
Predicted Rating Level is between 5 dB and 9.9 dB above the prevailing Background Level at the receptor.	Medium	SOAEL
Predicted Rating Level is ≥10 dB or more above the prevailing Background Level at the receptor.	High	SOAEL

Operational Noise – Non-residential receptors

For industrial premises to the west of the site, noise levels have been assessed to the worst affected window locations, which are assumed to be office type use.

Guidance is given in BS 8233:2014 in reference to indoor ambient noise levels for office spaces. The recommended guideline levels are detailed in Table 3-8.

Table 3-8 Indoor ambient noise levels in office spaces

Space	Design Range (dB $L_{Aeq,T}$)
Cellular/Executive Office Staff/meeting rooms Training room	35-40

For the purpose of this assessment, the significance criteria of Table 3-9 will apply.

Table 3-9 Non-residential receptor significance criteria

Description	Magnitude of impact	Adverse effect level
Below 35-40 dB $L_{Aeq,T}$ design range	Negligible	NOAEL
Within 35-40 dB $L_{Aeq,T}$ design range	Low	LOAEL
Exceeds 35-40 dB $L_{Aeq,T}$ design range	High	SOAEL

3.1 Baseline Noise Survey

3.1.1 Survey Methodology

Unattended noise monitors were installed at LT1, LT2 and LT3 between 22/01/2021 and 26/01/2021. This period was during a Covid-19 national lockdown. The purpose of the noise survey was to determine ambient noise levels for setting construction noise thresholds, and background noise levels for setting plant noise limits above which significant effects may occur. If road traffic flows were lower due to the restrictions, then the resultant ambient and background noise levels may have been lower. Therefore, the thresholds above which significant effects may occur could be deemed to be worst case as these were set against potentially lower ambient and background noise levels. For these reasons, it was deemed acceptable to complete the baseline noise survey during this period.

The monitoring locations are shown along with the approximate red line boundary in Figure 3.2.

LT1 was installed at a height of 1.5m above local ground level (the microphone was above the wall adjacent to the A66), LT2 was installed at a height of 3m above local ground level, and LT3 was installed at a height of 1.5m above local ground level. All unattended monitoring positions were installed under free-field conditions.

Noise levels were monitored continuously over the survey period and averaged over 15-minute intervals.

The sound level meter calibration was checked upon installation and upon completion of the surveys. No significant drift in calibration was recorded.

Attended measurements of 15 minutes in duration were taken at two positions (as shown on Figure 3.2) on 25/01/2021 and 26/01/2021:

i. ST1: representative of noise levels affecting the nearest noise sensitive receptors on Uvedale Road.
ii. ST2: to capture noise levels from the industrial estate along John Boyle Road.

Each measurement was taken at a height of 1.5m above local ground level and under free-field conditions.

Figure 3.2 Baseline Monitoring Locations

3.1.2 Weather

Start of unattended survey:
Friday 22/01/2021
Dry, sunny, ~5°C, wind speed (average) 5 m/s in an easterly direction, precipitation 0 mm.

Unattended survey:

Temperatures in the range of 1-6°C during daytime hours. Temperature dropped below 0°C during some night-time periods. Winds were in variable directions.

End of unattended survey:
Tuesday 26/01/2021
Dry, partly sunny, ~2°C, wind speed (average) 4 m/s in a northerly direction, no precipitation.

Attended survey:
Monday 25/01/2021
Dry, sunny, ~4°C, wind speed (average) 5 m/s in an easterly direction, precipitation 0 mm.

Tuesday 26/01/2021
Dry, sunny, ~2°C, wind speed (average) 4 m/s in a northerly direction, precipitation 0 mm.

3.1.3 Equipment

The following measurement equipment was used:

Unattended survey:
i. 3 x 01dB FUSION Class 1 Sound Level Meter (serial numbers 12081, 11891 & 11403);
ii. 01dB CAL31 Sound Calibrator (serial number 3189091).

Attended survey
i. Brüel & Kjær 2250 Class 1 Sound Analyser (serial number 3002075) and associated microphone 4189 (serial number 2839798).
ii. Brüel & Kjær 4231 Class 1 Calibrator (serial number 3004168).

Calibration certificates are available upon request.

3.1.4 Attended Noise Survey Results

A summary of the attended survey results is shown in Table 3-10.

Table 3-10 Summary of Attended Noise Survey Results

Measurement position	Measurement Period	Representative $L_{Aeq,T}$ (dB)	Highest L_{AFmax} (dB)	Lowest $L_{A90,15mins}$ (dB)
ST1 (Uvedale Road)	Daytime (07:00-23:00)	51	78	48
	Night-time (23:00-07:00)	40	62	38
ST2 (John Boyle Road)	Daytime (07:00-23:00)	60	81	47

The noise climate at ST1 was dominated by traffic noise from surrounding roads, plant noise coming from an industrial source to the north and barking dogs.

The noise climate at ST2 was dominated by site activity and traffic noise from the industrial park. Road traffic noise from surrounding roads was also audible.

3.1.5 Unattended Noise Survey Results

The unattended survey results for LT1-LT3 are shown in Figures 3.3-3.5. A summary of the results of attended and unattended measurements is provided in Appendix C.

The noise climate at LT1 was dominated by traffic movements along the A66. Traffic movements along Jones Road and pedestrian movements along the public footpath were also audible.

Typical daytime average noise levels ranged from 70-74 dB $L_{Aeq,16hour.}$ Daytime background noise levels ranged from 48-53 dB $L_{A90,\ 16hour.}$ Daytime maximum noise levels were dictated by individual vehicle movements along the A66.

Night-time average noise levels ranged from 64-69 dB $L_{Aeq,8hour}$. Night-time background noise levels ranged from 40-43 dB $L_{A90,8hour}$. Night-time maximum noise levels were expected to be dictated by traffic noise along the A66.

The noise climate at LT2 was dominated by traffic movements along the A66. Traffic along Bolckow Road was also audible.

Typical daytime average noise levels ranged from 53-57 dB $L_{Aeq,16hour}$. Daytime background noise levels ranged from 44-48 dB $L_{A90,16hour.}$ Daytime maximum noise levels were dictated by individual vehicle movements along the A66.

Night-time average noise levels ranged from 49-52 dB $L_{Aeq,8hour}$. Night-time background noise levels ranged from 36-38 dB $L_{A90,8hour}$. Night-time maximum noise levels were expected to be dictated by traffic noise along A66.

The noise climate at LT3 was dominated by traffic along the A66. Traffic along Bolckow Road was also audible.

Typical daytime average noise levels ranged from 53-58 dB $L_{Aeq,16hour}$. Daytime background noise levels ranged from 48-51 dB $L_{A90,16hour.}$ Daytime maximum noise levels were dictated by traffic along the A66 and Bolckow Road.

Night-time average noise levels ranged from 49-52 dB $L_{Aeq,8hour}$. Night-time background noise levels ranged from 42-45 dB $L_{A90,8hour}$. Night-time maximum noise levels were expected to be dictated by traffic along the A66 and Bolckow Road.

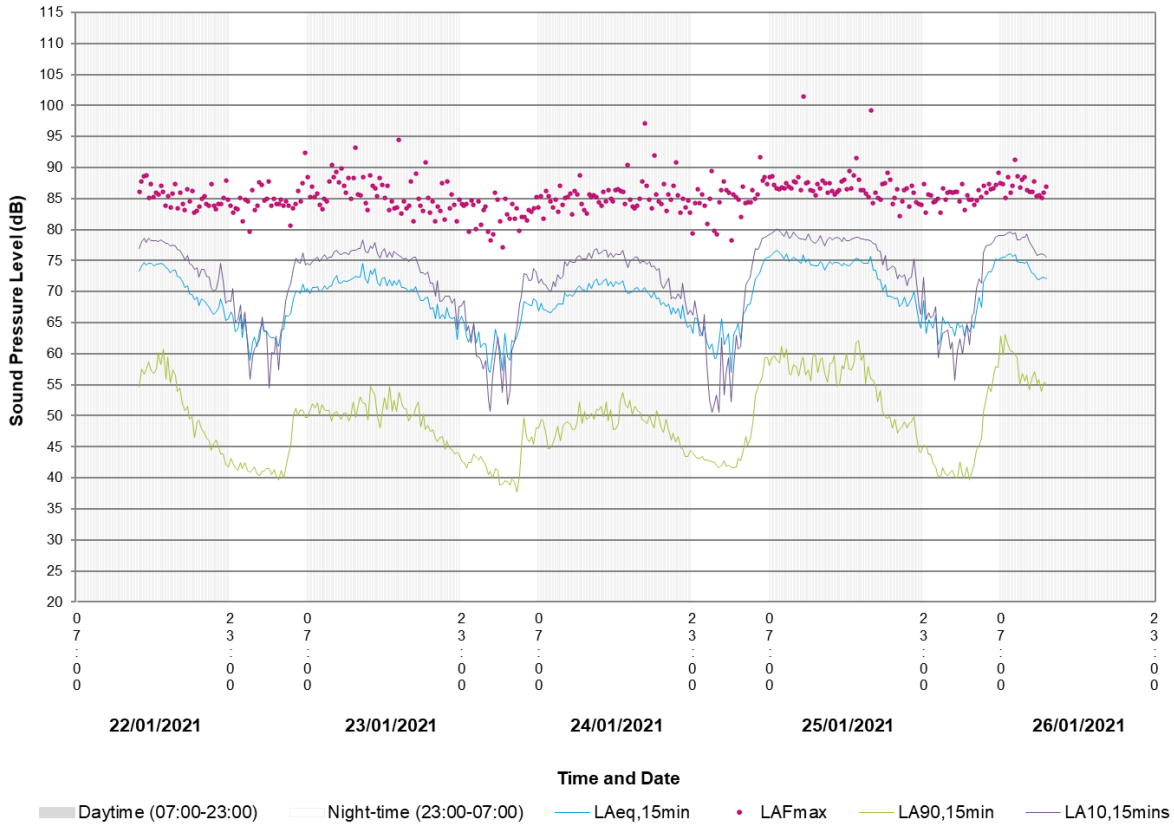


Figure 3.3 Unattended Survey Results at LT1

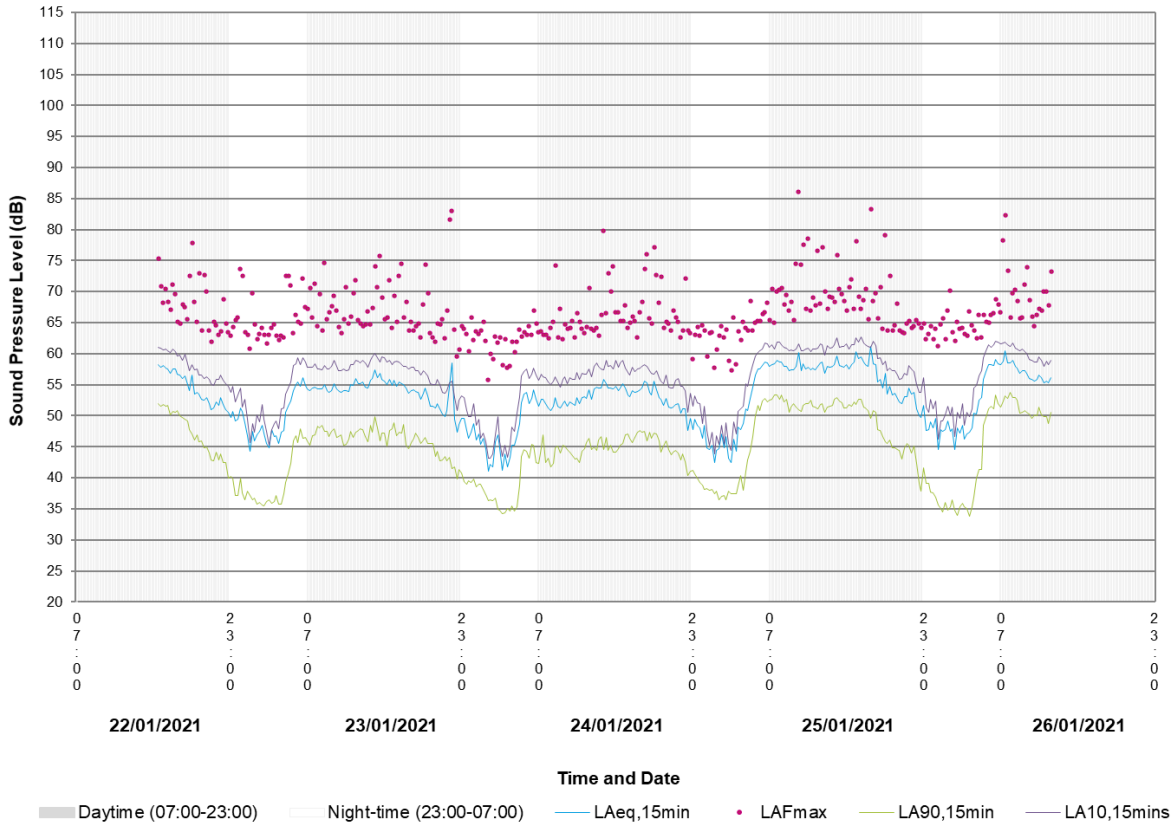


Figure 3.4 Unattended Survey Results at LT2

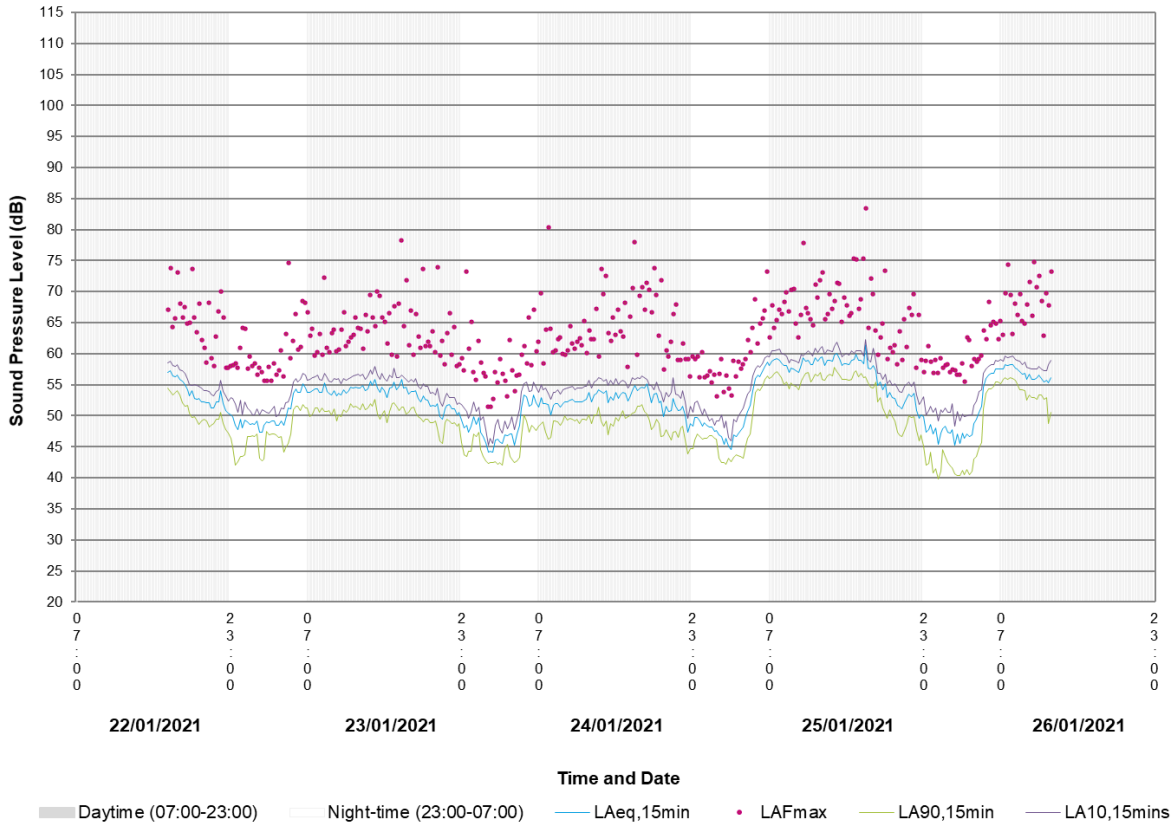


Figure 3.5 Unattended Survey Results at LT3

3.2 Construction Noise Assessment

3.2.1 Construction Noise Emission Thresholds

The residential receptor thresholds are summarised in Table 3-11.

Table 3-11 Construction Noise Thresholds at R1-R3

NSR considered	Prevailing ambient noise level during daytime period, $L_{Aeq,T}$ (dB)	BS5228 noise emission category	Construction noise threshold at NSR, $L_{Aeq,T}$ (dB)
R1: Residential dwellings along Jones Road	72	C	75
R2: Residential dwellings along Bolckow Road	55	A	65
R3: Residential dwellings along Bolckow Road/Cresswell Road	55	A	65

The non-residential receptor threshold is detailed in Table 3-12.

Table 3-12 Construction Noise Threshold at R4

NSR considered	Prevailing ambient noise level during daytime period, $L_{Aeq,T}$ (dB)	Construction noise threshold at NSR, $L_{Aeq,T}$ (dB)

R4: Non-residential/office use	60	65

Noise emissions during construction activities have been calculated at the nearest NSRs. The emissions were calculated based on a number of assumptions relating to construction methods and plant. The actual construction noise levels may vary depending on the type of activity, periods of operation, and distances between source of noise and receivers. However, conservative assumptions have been made regarding these parameters.

Noise emissions from each of the following anticipated construction activities was calculated:

- Substructure
- Superstructure
- Earthworks
- External Works

3.2.2 Construction Noise Assessment

Construction noise emissions levels were calculated following the methodology from BS5228:2009+A1:2014. The total noise levels at 10 m from the construction area for each activity was determined, and propagation calculations are carried out to determine the noise levels at a receptor. Details of the plant items used in our calculations for each activity are shown in Appendix C.

BS 5228:2009+A1:2014 states that calculations performed for receptors over 300 m away from the source should be used with caution because of the increasing importance of meteorological effects. Therefore, conclusions from this construction noise assessment should be used as a guideline only.

Noise levels from substructure and superstructure works have been calculated from the proposed building footprints. Noise levels from earthworks and external works have been assessed from the site boundary.

The noise levels have been predicted using noise prediction modelling software. The total sound power for each construction activity was calculated based on the plant detailed in Appendix D, and input to the noise model as an area source, at 1m above ground level. The model accounts for intervening topography and screening provided by existing buildings.

The results of the construction noise assessment are shown in Table 3-13. A +3 dB façade reflection has been applied to the predicted results for residential receptors.

Table 3-13 Construction Noise Assessment

Activity	**Noise level at 10 m per activity, $L_{Aeq,T}$ (dB)**	**R1, $L_{Aeq,T}$ (dB)**	**R2, $L_{Aeq,T}$ (dB)**	**R3, $L_{Aeq,T}$ (dB)**	**R4, $L_{Aeq,T}$ (dB)***
Min. separating distance (m)		**640**	**580**	**790**	**125**
Substructure	97	46	53	48	43
Superstructure	95	41	45	41	37
Earthworks	93	40	45	39	42
External Works	94	39	48	39	44

*Construction noise levels at receptor R4 do not include a +3dB façade reflection as per the methodology of BS 5228:2009+A1:2014.

The results of the calculations show that the predicted construction noise levels at the residential receptors (R1, R2 and R3) are below the thresholds set in Table 3-11 and below existing ambient noise levels. This is due to the significant distances between the site and the residential receptors. The resulting effect level is NOAEL. Significant effects are not expected for residential receptors.

The noise levels at R4 (non-residential receptor) are predicted to the window location that is predicted to experience the highest construction noise levels. The predicted levels are >10 dB below the existing ambient noise levels and therefore, the total noise level (pre-construction ambient plus site noise) will not exceed 65 dB $L_{Aeq,T}$. The resulting effect level is NOAEL. Significant effects are not expected for non-residential receptors.

The noise levels presented do not allow for mitigation, which is not specifically deemed necessary with respect to the predicted impacts at receptors. However, it is assumed that the Main Contractor would adopt Best Practicable Means (BPM), such as selection of low noise plant and techniques. Therefore, the predicted noise levels are expected to be worst case.

3.2.3 Construction Traffic Assessment

It is understood that site preparation and construction activities will generate, on average, 5 two-way HGV movements per day (i.e. 10 HGV movements in total). Peak HGV movements are anticipated during month 16, when there is likely to be around 40 two-way HGV movements each way per day (i.e. 80 HGV movements in total). It is assumed that HGV movements will be spread over the course of the working day.

Road traffic flows would need to increase by 25% in order to result in a 1 dB change in road traffic noise level, in accordance with the Design Manual for Roads and Bridges[6]. A 1 dB increase would be deemed to be negligible in the short and long term, to LA 111[7]. It is not expected that the additional HGV movements would cause traffic flows to increase by 25%.

Therefore, the addition of the construction HGVs to the road network will give rise to a NOAEL. Significant effects are not expected.

3.3 Operational Noise Assessment

3.3.1 Background Noise Levels

A statistical analysis of the measured background noise levels at monitoring positions LT1-LT3 was completed in accordance with BS 4142:2014+A1:2019. The analyses are provided in Appendix E. The background noise levels used for assessment are detailed in Tables 3.15-3.17.

3.3.2 Plant Noise Assessment

A 3D computer noise model was prepared to calculate the plant and activity noise emissions from the proposed facility at each NSR. Daytime and night-time levels were predicted at heights of 1.5m and 4m to represent ground floor and first floor levels, respectively.

The noise model was done using the proprietary software Cadna-A. The software implements the common European methods of noise prediction. The noise predictions have been undertaken in accordance with ISO9613-2[8].

[6] Design Manual for Roads and Bridges, Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 7 Noise and Vibration (2011)

[7] Design Manual for Roads and Bridges – Sustainability & Environment Appraisal LA 111 Noise and vibration Revision 1 (2020)

[8] International Standards Organisation, 1996. Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation. ISO

The noise sources associated with the facility used in the model are detailed in Table 3-14.

Table 3-14 Operational noise assessment input levels

Area/Plant Item	Noise level	Reference
Process Areas	85 dB L_{Aeq} reverberant level	Benchmarking measurements
Turbine Hall	85 dB L_{Aeq} reverberant level	Benchmarking measurements
Tipping Hall	80 dB L_{Aeq} reverberant level	Benchmarking measurements
Air Cooled Condensers (ACCs)	80 dB L_{wA} per m^2	Benchmarking measurements
Stacks	89 dB L_{wA} at the top of stacks	Assumed from previous schemes
Transformer	95 dB L_{wA} / 106 dB L_W	Assumed from previous schemes
Fin Fan Coolers (FFCs)	80 dB L_{pA} at 1m (design speed) / 85 dB L_{pA} at 1m (maximum speed)	Spectral noise data provided by EPC Contractor.
Emergency Diesel Generator (EDG)	85 dB L_{pA} at 1m from enclosure	Advised by EPC Contractor. Assumed generator noise spectrum adjusted to specified level.
On Site HGVs (lorries)	99 dB L_{wA} moving point sources	Benchmarking measurements at an operational ERF. The lorry was travelling at 9mph on site. Measurement taken at 1.5m above hard ground, and 5m from the lorry noise source.
Access Road HGVs (lorries)	106 dB L_{wA} moving point sources	Benchmarking measurements at an operational ERF. The lorry was travelling at an assumed speed of 30mph. Measurement taken at 1.5m above hard ground, and 5m from the lorry noise source.
Refuse Collection Vehicles (26 t)	107 dB L_{wA} moving point sources	BS 5228:2009+A1:2014 C11.16

The measured noise spectra from the benchmarking measurements were input to the model. For the Process Areas and Turbine Hall, the measured sound pressure levels were 82 dB L_{Aeq}. The reverberant internal noise levels in the model were calibrated to 85 dB L_{Aeq} after consultation with Fichtner Consulting Engineers, to present a worst-case assessment.

It is assumed that attenuators would be fitted in the Stack to reduce noise emissions. Based on experience on similar projects, we have assumed a sound power of 89 dB L_{wA} at the top of the Stack in the noise prediction model.

The following external envelope and inherent mitigation measures were assumed in the model:

- Typical external envelope (including roof) to be a composite cladding panel system (or equivalent) rated at least R_w 23 dB;
- Non-acoustic weather louvres, assumed to provide R_w 4 dB attenuation;

- The screen around the Air Cooled Condensers comprising a minimum density of 10kg/m^2. The noise from the condensers is modelled as emitting from just below the bottom of the screen to provide a worst case assessment; and
- Standard roller shutter doors rated at least R_w 15 dB.

The number of HGVs accessing the site during evening and night-time periods have been input to the model as advised by the transport assessment. However, night-time HGV movements are understood to be confined to the hours of 05:00-07:00.

Four key scenarios have been considered:

- Average hour 09:00-16:00 (the period of the day when most HGVs will occur, typically 20 two-way movements per hour).
- Peak hour 14:00-15:00.
- Night-time without HGVs 23:00-05:00.
- Night-time with HGVs 05:00-07:00.

In addition to this, additional scenarios have been considered for the operation of the Emergency Diesel Generator (EDG).

A separate assessment for weekend periods has not been provided as the measured background noise levels at monitoring positions LT1-LT3 do not significantly vary between weekday and weekend periods. Therefore, the average weekday hour (09:00-16:00) is deemed to be representative of the weekend daytime periods.

Of the HGVs serving the ERF, the model assumes that 65% are lorries and 35% are Refuse Collection Vehicles (RCVs).

The model assumes that all RCVs will enter the tipping hall. Of the total number of lorries, based on values provided by Fichtner Consulting Engineers, 71% of lorries will enter the tipping hall, 3% will be for consumables and 26% will be for ash/residue collection.

Lorry and RCV speeds were assumed to be 15mph on the site access road and 10mph on site. These are conservative assumptions as noise exposure will increase with lower HGV speeds.

The noise emissions from the FFCs have been modelled at maximum speed (85 dB L_{pA} at 1m) to represent a worst case scenario and also for typical operation (design speed) where noise levels are 5 dB lower, i.e. 80 dB L_{pA} at 1m.

Following BS 4142:2014+A1:2019, penalties should be added to the specific noise level at a receptor to account for acoustic features such as tonality, intermittency and impulsivity, if such features are discernible at the receptor.

From the noise input data, no plant items have been deemed to be tonal. Therefore, a tonality penalty has not been applied to the calculated specific noise levels as it is unlikely that there would be residual tonality at the receptors.

Penalties for intermittency, impulsivity due to HGVs, and other sound characteristics (where noise emissions are readily distinctive against the residual acoustic environment) have not been applied, as these noise sources are not expected to be readily audible at residential receptors due to the distance from the site. The ambient noise levels at the unattended monitoring locations were measured to typically be 22 dB, 9 dB and 5 dB over background noise levels, at monitoring positions LT1, LT2 and LT3, respectively.

3.3.3 Residential receptors

Background noise levels have been determined using the noise prediction model that is calibrated to road traffic noise sources and the transformer plant that is adjacent to the A66 (near to receptor location R3). This approach has been taken as it was not possible to measure the background noise levels at the façade locations of the residential receptors. As the dominant noise source was road traffic noise, this approach is deemed to be suitable and is equivalent to applying a distance correction to the receptor locations for road traffic noise sources.

Rating levels are at the receptor façade location and do not include a façade reflection.

The specific and rating noise levels are in terms of daytime 1-hour periods and night-time 15-minute periods.

The average weekday hour (09:00-16:00) noise model results are detailed in Table 3-15.

Table 3-15 Operational noise assessment – Average hour 09:00-16:00 and night-time 23:00-05:00

Receptor	Storey/ Height	Background Level, $L_{A90,T}$ (dB)		Predicted Specific Noise Level, $L_{Aeq,T}$ (dB)		Resulting Rating Level, $L_{Ar,T}$ (dB)		Excess of rating level over background level (dB)	
		Day time	Night-time	Day time	Night-time	Day time	Night-time	Day time	Night-time
R1	Ground floor/ 1.5m	36	32	36	36	36	36	0	4
R1	First floor/ 4.0m	38	34	37	36	37	36	-1	2
R2	Ground floor/ 1.5m	43	34	28	25	28	25	-15	-10
R2	First floor/ 4.0m	46	35	32	26	32	26	-14	-9
R3	Ground floor/ 1.5m	47	42	28	24	28	24	-20	-18
R3	First floor/ 4.0m	49	42	29	25	29	25	-20	-17

For the average weekday hours of 09:00-16:00, the resultant effect levels are:

- NOEL
  - R2 ground and first floors
  - R3 ground and first floors
- NOAEL

  - R1 first floor
- LOAEL
  - R1 ground floor - $L_{A,r}$ +0dB over background

For the night-time hours of 23:00-05:00, the resultant effect levels are:

- NOEL
  - R2 ground floor
  - R3 ground and first floors
- NOAEL
  - R2 first floor
- LOAEL
  - R1 ground and first floors - $L_{A,r}$ up to +4dB over background

The peak hour (14:00-15:00) noise model results are detailed in Table 3-16.

Table 3-16 Operational noise assessment – Peak hour 14:00-15:00

Receptor	Storey/ Height	Background Level, $L_{A90,T}$ (dB)	Predicted Specific Noise Level, $L_{Aeq,T}$ (dB)	Resulting Rating Level, $L_{Ar,T}$ (dB)	Excess of rating level over background level (dB)
R1	Ground floor/1.5m	36	36	36	0
R1	First floor/4.0m	38	37	37	-1
R2	Ground floor/1.5m	43	28	28	-15
R2	First floor/4.0m	46	32	32	-14
R3	Ground floor/1.5m	47	28	28	-19
R3	First floor/4.0m	49	29	29	-20

For the peak hour of 14:00-15:00, the resultant effect levels are:

- NOEL
  - R2 ground and first floors
  - R3 ground and first floors
- NOAEL
  - R1 first floor
- LOAEL
  - R1 ground floor - $L_{A,r}$ +0dB over background

The night-time (05:00-07:00) noise model results are detailed in Table 3-17.

Table 3-17 Operational noise assessment – Night-time 05:00-07:00

Receptor	Storey/ Height	Background Level, $L_{A90,T}$ (dB)	Predicted Specific Noise Level, $L_{Aeq,T}$ (dB)	Resulting Rating Level, $L_{Ar,T}$ (dB)	Excess of rating level over background level (dB)
R1	Ground floor/1.5m	32	36	36	4
R1	First floor/4.0m	34	36	36	2
R2	Ground floor/1.5m	34	25	25	-9
R2	First floor/4.0m	35	27	27	-9
R3	Ground floor/1.5m	42	24	24	-18
R3	First floor/4.0m	42	25	25	-17

For the night-time hours of 05:00-07:00, the resultant effect levels are:

- NOEL
  - R3 ground and first floors
- NOAEL
  - R2 ground and first floors
- LOAEL
  - R1 ground and first floors - $L_{A,r}$ up to +4dB over background

It should be noted that each scenario assumes that the FFCs are operating at maximum speed , i.e. the resulting sound pressure level is 85 dB L_{pA} at 1m. However, the sound pressure level will be 80 dB L_{pA} at 1m when operating at design speed. Based on the design speed, the resultant rating noise levels at receptor R1 reduce by 3 dB for the average daytime hour, night-time (23:00-05:00) and night-time (05:00-07:00) scenarios. The resultant rating noise levels at receptor R1 reduce by 2 dB for the peak hour (14:00-15:00) scenario.

For the FFCs operating at design speed, the R1 resultant effect levels are:

- NOAEL
  - R1 ground and first floors (09:00-16:00)
  - R1 first floor (23:00-05:00)
  - R1 first floor (05:00-07:00)
  - R1 ground and first floors (14:00-15:00)
- LOAEL
  - R1 ground floor (23:00-05:00) – $L_{A,r}$ +1dB over background
  - R1 ground floor (05:00-07:00) – $L_{A,r}$ +1dB over background

Therefore, for the FFCs operating at design duty, the resultant effect levels at R1 are NOAEL to LOAEL ($L_{A,r}$ +1 dB over background noise level). An exceedance of background noise level by +1dB is

considered to be negligible as the background noise levels at receptor R1 are typically 22dB below ambient noise levels at LT1.

Therefore, significant effects are not predicted due to operational noise from the facility. Noise contour plots for each of the assessment scenarios are provided in Appendix F. These are based on site layout Revision L; subsequent revisions do not impact the assessment results.

3.3.4 Emergency Diesel Generator

The operation of the Emergency Diesel Generator (EDG) is expected to be a rare event and would only be used for the safe shut down or start-up of the facility.

The operation of the EDG was input to the noise prediction model (attenuated to 85 dB L_{pA} at 1m from the generator enclosure).

The resultant effect levels for each scenario outlined in Tables 3.15-3.17 above are not expected to change with the EDG operational.

Therefore, significant effects are not predicted due to the operation of the EDG.

3.3.5 Non-residential receptors

The highest predicted operational noise levels at the non-residential receptors (R4) are 51 dB $L_{Aeq,T}$ and 50 dB $L_{Aeq,T}$ during daytime and night-time periods (up to 52 dB $L_{Aeq,T}$ when the EDG is operational). These levels apply at the southern elevation of Evergreen House, at an assumed window height of 5.5m (approximately 126m from the western site boundary at the nearest point).

Allowing for a minimum of 25 dB of attenuation of external noise levels through a glazed window, the resultant noise levels inside the building would be 25-26 dB $L_{Aeq,T}$.

Assuming that the building is office use behind the window at the assessment location, these noise levels would be below the BS 8233:2014 guideline internal noise levels for all office types. Whilst an assessment has been made against internal noise levels for offices, it has not been possible to confirm the internal layout of the non-residential units.

If the window needed to open to provide ventilation to the office behind, allowing for 13 dB of attenuation through an open window, the resultant internal noise levels would be 37-38 dB $L_{Aeq,T}$. These noise levels would be within the BS 8233:2014 guideline levels for staff/meeting rooms, training rooms and executive offices.

The predicted operational ERF noise levels are 6-10 dB below the measured ambient noise levels and 3-4 dB above background noise levels at survey location ST2.

Therefore, whilst the resultant internal noise levels may be increased due to the operation of the ERF facility when compared to the existing noise levels, the resultant internal noise levels will be within guideline internal noise levels for offices. The context of the noise will be industrial, with the arrival and departure of HGVs. This context is expected to be similar to the current noise environment.

Therefore, the resultant internal noise levels in offices (if applicable) are expected to constitute a NOAEL with windows closed, and LOAEL with windows open. Significant effects are not predicted.

4. CONCLUSIONS

Significant effects are not expected during the construction and operational phases of the proposed Tees Valley ERF.

APPENDIX A
ACOUSTIC TERMINOLOGY

Term	Definition
$L_{eq,T}$ or Ambient noise	A noise level index called the equivalent continuous noise level over the time period T. Often described as the average.
$L_{90,T}$ or Background Noise Level	A noise level index defined as the noise level exceeded for 90% of the time over the time period T. L_{90} is used to describe the background noise.
Vibration	The periodic movements of structures transferred by ground and parts of the building, due to events such as train pass-by, piling, blasting or use of heavy machinery.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1/s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Rating Level ($L_{Ar,Tr}$)	To BS 4142:2014+A1:2019, the rating level is defined as the equivalent continuous A-weighted sound pressure level produced by the specific sound source over a given reference time interval, Tr plus any adjustment for the characteristic features of the sound (tonality, impulsivity, etc.).
NSR	A Noise Sensitive Receiver is any receiver that is classed as being sensitive to noise sources, (residential properties, churches, music studios etc.)

APPENDIX B
CONSULTATION WITH REDCAR AND CLEVELAND BOROUGH COUNCIL

From: Mick Gent
Sent: 05 January 2021 10:55
To: David Harbon

Subject: RE: Grangetown Prairie Energy Recovery Facility - Noise Assessment Consultation

Hi David,
I am happy with your methodology
Regards
Mick Gent
Contaminated Land Officer
Redcar & Cleveland Borough Council
Environmental Protection Team
Public Health
Belmont House
Rectory Lane
Guisborough
Yorkshire
TS14 7FD

From: David Harbon
Sent: 21 December 2020 16:27
To: Mick Gent
Cc: Emma Robinson; Steve Molnar; Andrew Short; Adrian Miller; Alec Higgins; Craig Barson; Michael Pantling-Skeet; Tom Smith; Zoe Woodland

Subject: Grangetown Prairie Energy Recovery Facility - Noise Assessment Consultation

Good afternoon Michael,

Ramboll have been appointed to complete a noise impact assessment for the proposed Grangetown Prairie Energy Recovery Facility.

I have been passed your contact details and I would be grateful if you could please review and comment on the proposed survey and assessment methodology below.

Survey

We will complete a noise survey in line with BS 7445-1:2003 Description and measurement of environmental noise - Guide to quantities and procedures. We hope to complete our noise survey during January 2021.

The approximate site location is outlined in red on the attached image. Our outline survey locations are also indicated. Our survey will comprise unattended and attended measurements.

- Unattended measurements will be completed at up to three locations, during daytime and night-time periods. Survey locations will be chosen to measure noise levels that are representative of the residential receptors at locations 1 (Jones Road), 2 (St James and St Nicholas Closes) and 3 (Bolckow Road) on the attached.
- Attended measurements will be completed at positions 4 (Uvedale Road) and 5 (John Boyle Road), to supplement the unattended measurements. Attended measurements at position 5 will be completed during daytime periods, only.

It should be noted that our survey locations are subject to change and access arrangements.

Assessment methodology and criteria

We will:

- Assess the demolition and construction noise and vibration in outline terms, in accordance with the methodology in BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Using the baseline noise survey data, we will set

construction noise thresholds to the 'ABC Method' contained in Annex E of BS 5228:2009+A1:2014. Construction vibration will only be considered for non-residential receptors, next to the proposed development site.

- Assess the predicted changes in traffic noise levels on the nearby road network at notional receptor locations, using the methodology set out in the Calculation of Road Traffic Noise (1988) and the magnitudes of impact contained in DMRB LA 111 Noise and Vibration (2020). The changes in noise levels due to construction HGVs will be assessed to this methodology also.
- Set noise emission limits from proposed fixed plant and site activity noise to the methodology of BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound. We will set the rating noise level limit equal to the existing typical (and not necessarily lowest) background noise levels at the nearest residential receptors.
- Complete noise prediction modelling of the proposed development to predict the likely impacts against the rating noise level limits.

Please let me know if you have any questions. We hope to start our surveys in early January 2021, and so your earliest response would be appreciated.

Thank you for your time and I hope to hear from you shortly.

Kind regards
David Harbon
MSc CEng MIOA
Principal Consultant
Acoustics

Attachment

APPENDIX C
BASELINE NOISE SURVEY RESULTS

The results of the baseline attended measurements are shown in the table below.

Location of measurement	Start time	Duration, mm:ss	L_{AFmax} (dB)	$L_{Aeq,T}$ (dB)	$L_{A90,T}$ (dB)
Daytime (07:00-23:00)					
ST1 – Uvedale Road	25/01/2021 16:10	15:00	64	50	48
	25/01/2021 17:15	15:00	65	51	48
	25/01/2021 18:12	15:00	78	55	46
ST2 – John Boyle Road	25/01/2021 16:44	15:00	81	57	47
	25/01/2021 17:42	15:00	79	60	47
	26/01/2021 11:15	15:00	77	60	56
Night-time (23:00-07:00)					
ST1 – Uvedale Road	26/01/2021 01:28	15:00	62	40	38
	26/01/2021 01:47	15:00	59	40	39
	26/01/2021 02:06	15:00	55	40	38
	26/01/2021 02:22	15:00	49	39	37

The results of the baseline unattended measurements are shown in the table below:

Location of measurement	Period	Highest L_{AFmax} (dB)	Average $L_{Aeq,T}$ (dB)	Typical $L_{A90,T}$ (dB)
Daytime Period (07:00-23:00)				
LT1 – Jones Road	22/01/2021*	89	72	49
	23/01/2021	94	71	49
	24/02/2021	97	70	48
	25/01/2021	102	74	53
	26/01/2021*	91	75	57
LT2 – South east of A66	22/01/2021*	78	55	45
	23/01/2021	83	54	45
	24/01/2021	80	53	44
	25/01/2021	86	57	48
	26/01/2021*	75	57	51
LT3 – Bolckow Road	22/01/2021*	74	54	49
	23/01/2021	78	54	50
	24/01/2021	73	53	48
	25/01/2021	84	58	51
	26/01/2021*	75	57	54
Night-time Period (23:00-07:00)				
LT1 – Jones Road	22/01/2021	92	66	41
	23/01/2021	86	64	40
	24/01/2021	92	69	43
	25/01/2021	89	69	41
LT2 – South east of A66	22/01/2021	74	51	37
	23/01/2021	67	49	36
	24/01/2021	86	52	38
	25/01/2021	70	53	36
LT3 – Bolckow Road	22/01/2021	75	51	45
	23/01/2021	73	49	43
	24/01/2021	73	52	44
	25/01/2021	68	52	42

* Not full daytime measurements

APPENDIX D
CONSTRUCTION PLANT

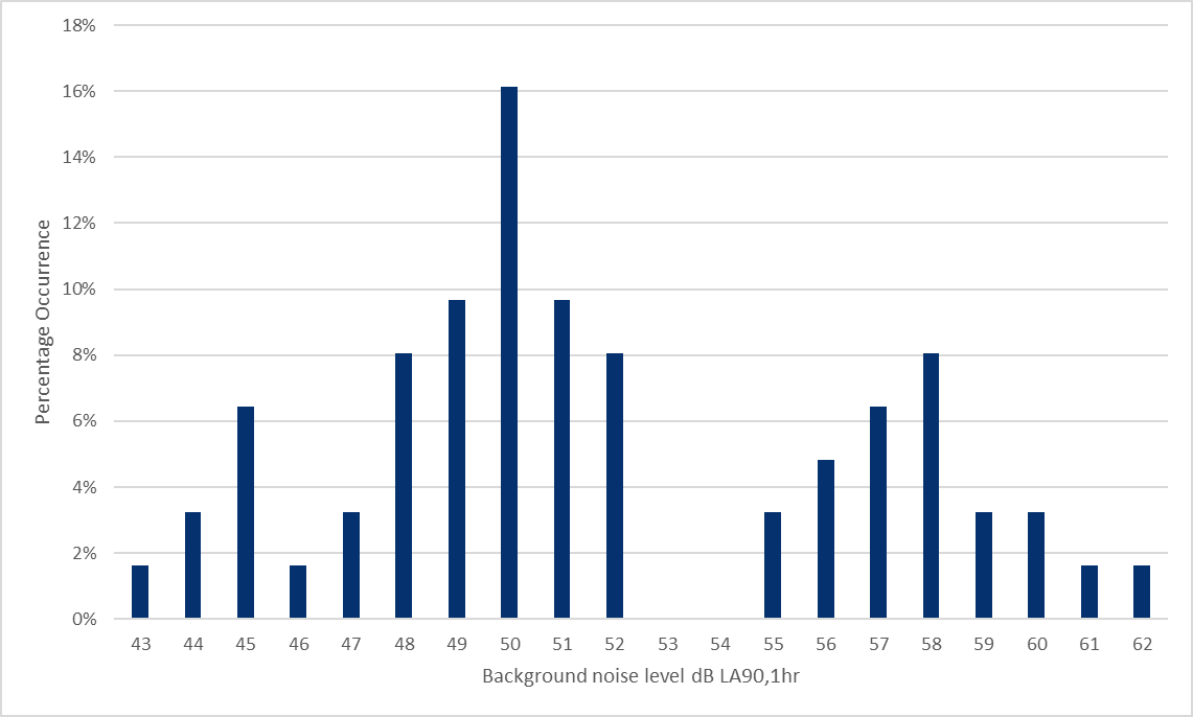
Input Plant

Activity	Plant	BS5228 Source Data	No	Typical Noise Level at 10 m for One Plant Item dB(A)	% On Time	Noise Level per Activity dB(A) at 10 m
Substructure	Mobile crane	C4.38	1	84	50	**97**
	Generator	C4.84	2	80	100	
	Small excavator	C2.24	2	80	60	
	Hammer	C1.19	2	74	50	
	Dozer	C2.10	1	93	60	
	Tracked excavator	C2.3	2	86	60	
	Wheeled loader	C2.27	2	88	50	
	Nail gun	C4.95	2	74	30	
	Dump truck	C2.30	2	87	40	
	Hydraulic hammer piling rig	C3.1	1	92	80	
	Handheld breaker	C1.7	1	95	30	
Super-structure	Mobile crane	C4.38	2	84	50	**95**
	Small excavator	C2.24	2	80	60	
	Dozer	C2.10	1	93	60	
	Tracked excavator	C2.3	2	86	60	
	Wheeled loader	C2.27	1	88	50	
	Dump truck	C2.30	1	87	40	
	Lifting platform	C4.57	2	80	40	
	Concrete pump	C4.32	1	82	20	
	Concrete mixer	C4.27	1	86	20	
	Poker vibrator	C4.33	1	86	30	
	Generator	C4.76	2	81	100	
Earthworks	Mobile crane	C4.46	2	79	50	**93**
	Small excavator	C2.24	2	80	60	
	Dozer	C2.10	1	93	60	

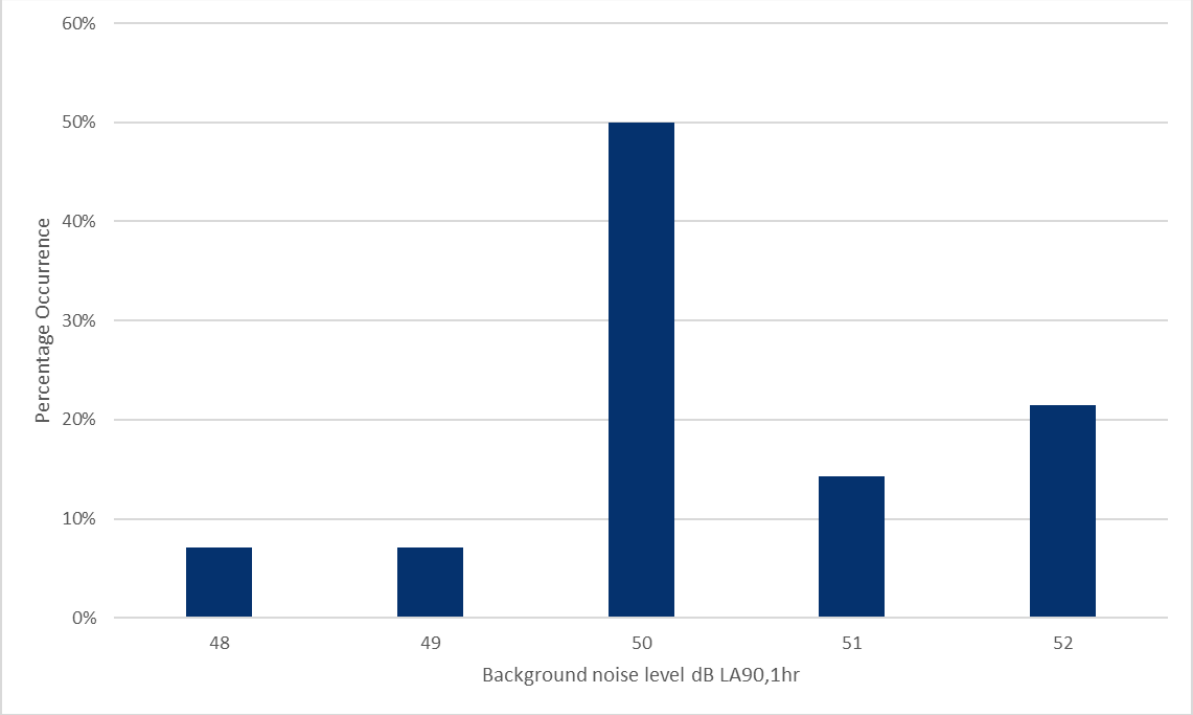
Activity	Plant	BS5228 Source Data	No	Typical Noise Level at 10 m for One Plant Item dB(A)	% On Time	Noise Level per Activity dB(A) at 10 m
	Tracked excavator	C2.3	1	86	60	
	Wheeled loader	C2.27	1	88	50	
	Dump truck	C2.30	1	87	40	
External Works	Mobile telescopic crane	C4.46	2	79	50	**94**
	Lifting platform	C4.57	2	80	40	
	Tracked excavator	C2.3	1	82	50	
	Generator	C4.76	2	81	100	
	Compressor	C5.5	2	84	40	
	Asphalt paver & tipper lorry	C5.31	1	81	70	
	Vibratory roller	C5.25	1	83	70	
	Hand-held circular saw	C4.73	1	84	20	
	Dozer	C2.10	1	93	60	
	Dump truck	C2.30	1	87	40	

APPENDIX E
BACKGROUND NOISE LEVEL STATISICAL ANALYSES

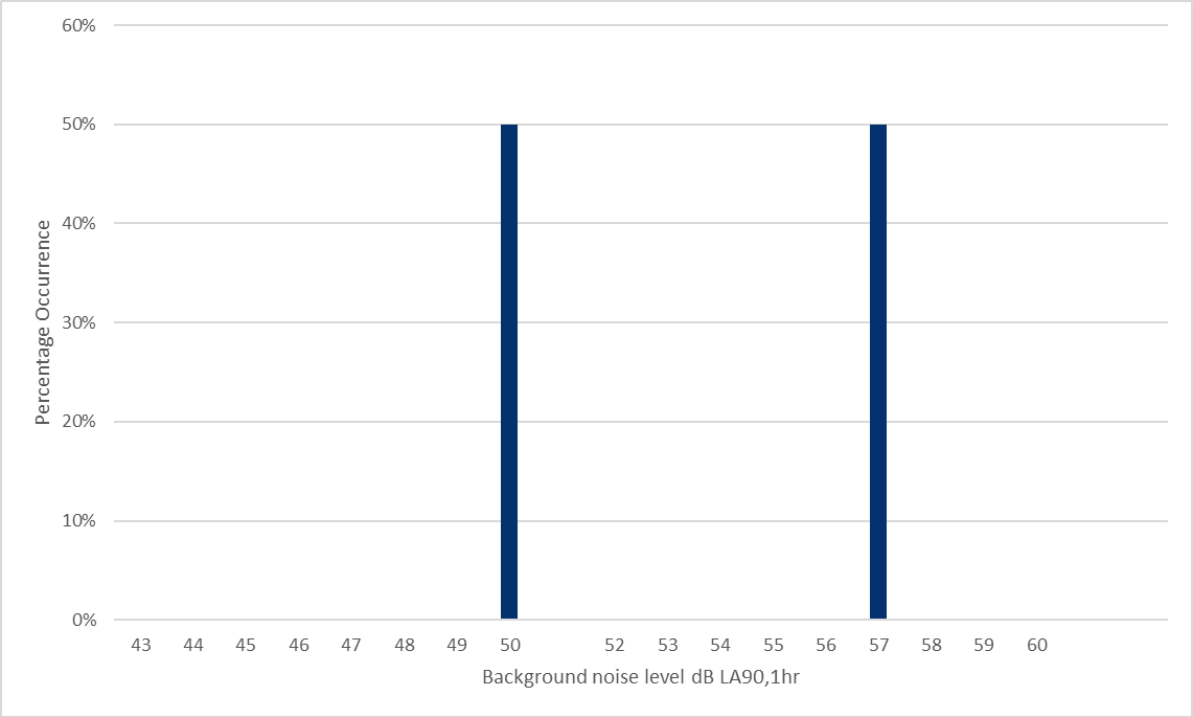
LT1 All daytime periods (07:00-23:00)



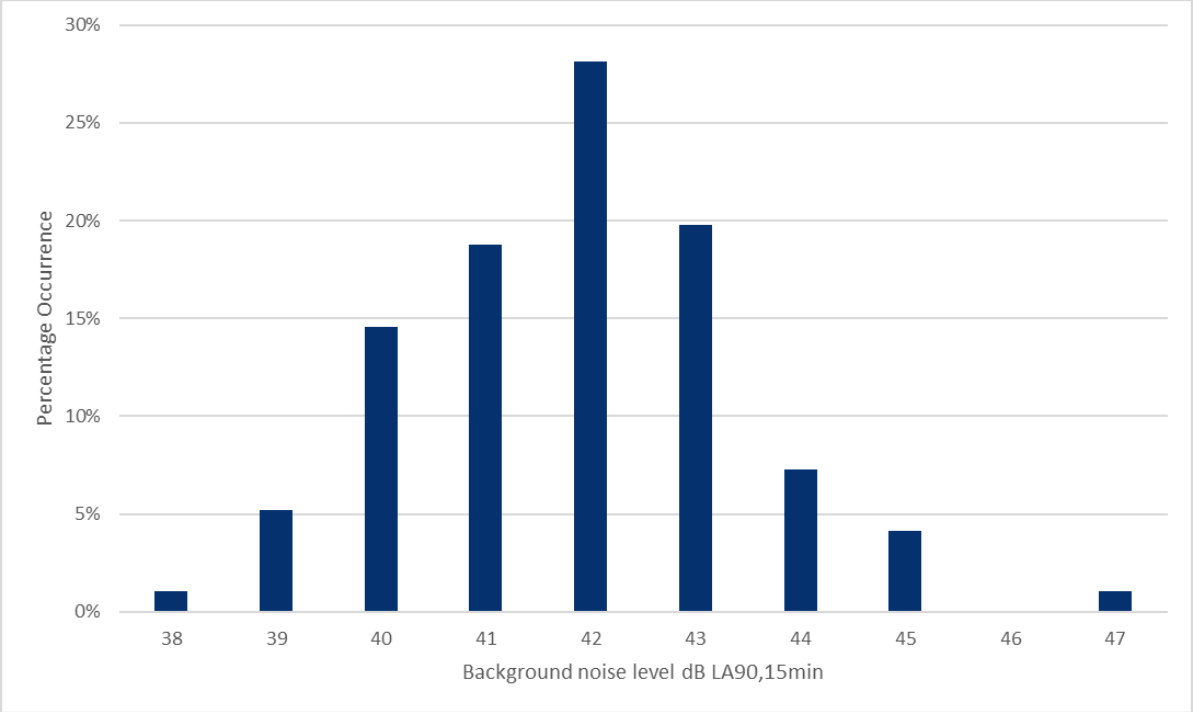
LT1 Daytime (09:00-16:00) for Average Hour assessment



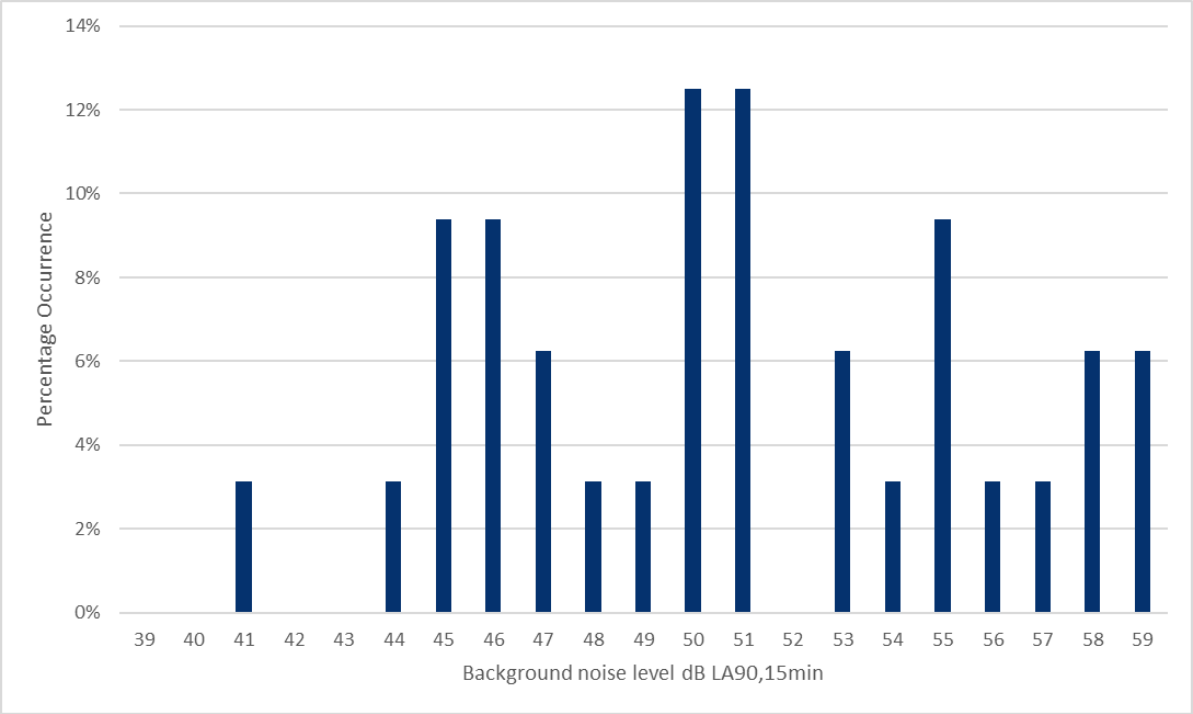
LT1 Daytime (14:00-15:00) for Peak Hour assessment



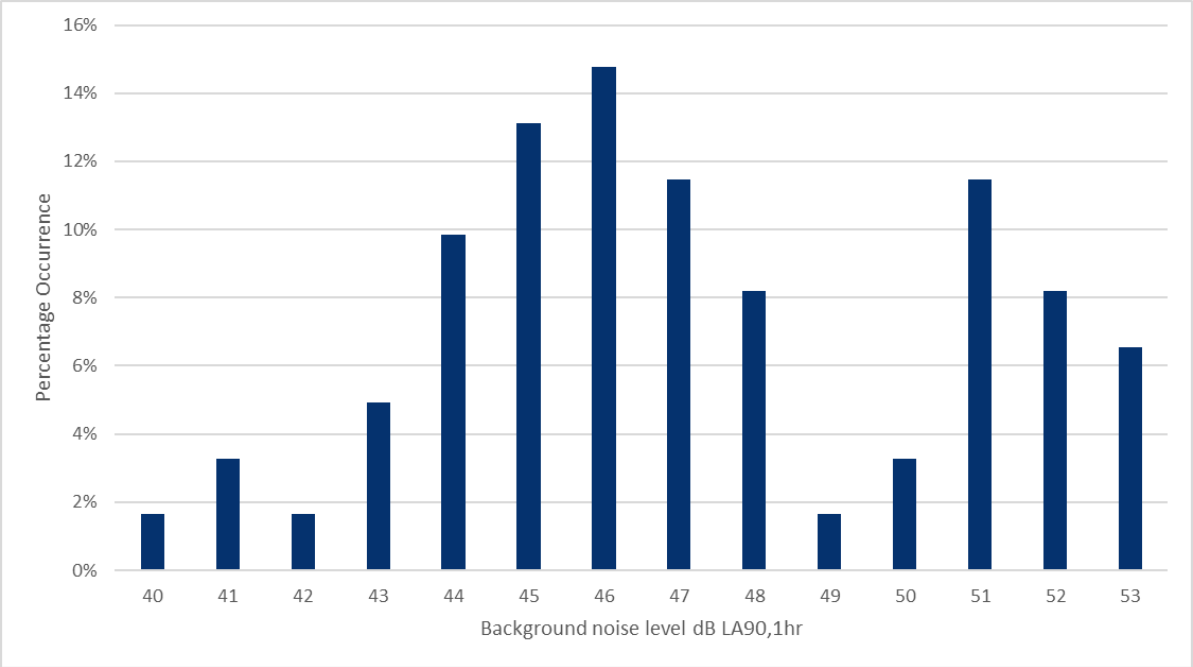
LT1 Night-time (23:00-05:00) for night-time assessment



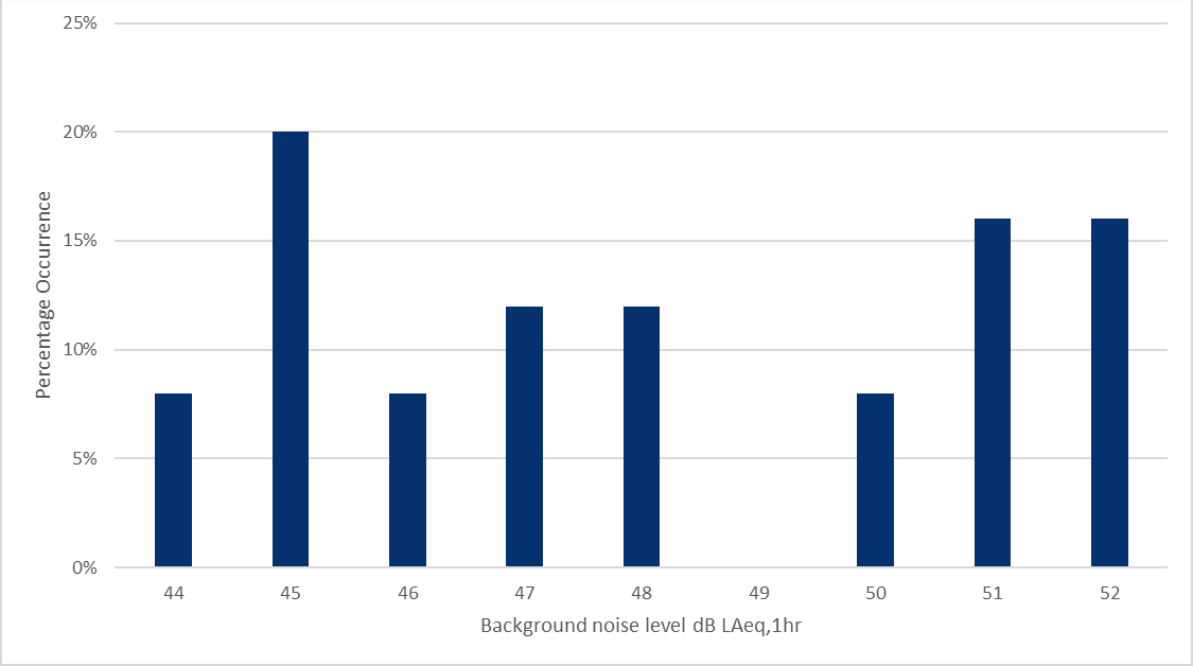
LT1 Night-time (05:00-07:00) for night-time assessment with HGVs



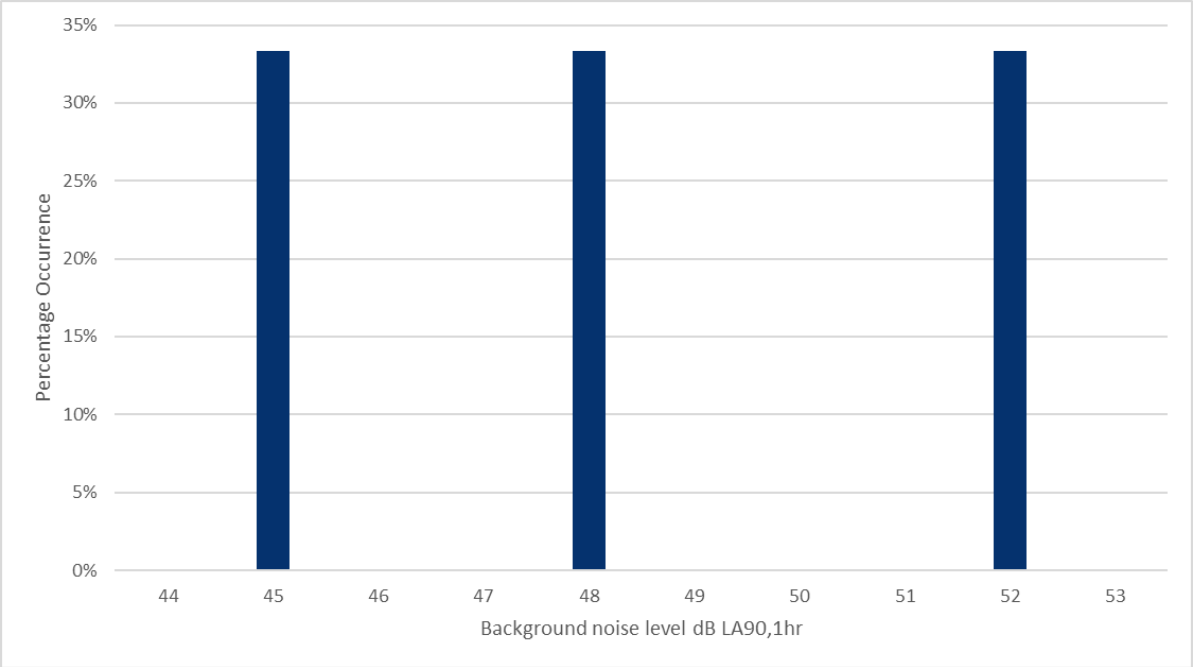
LT2 All daytime periods (07:00-23:00)



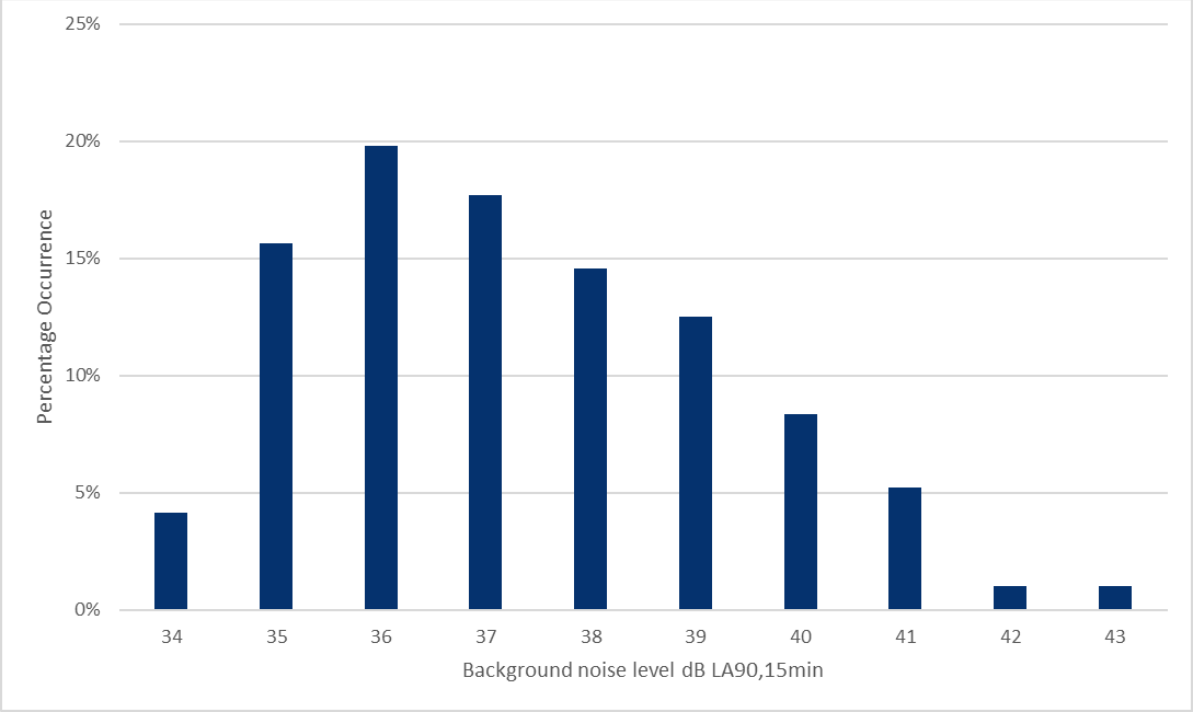
LT2 Daytime (09:00-16:00) for Average Hour assessment



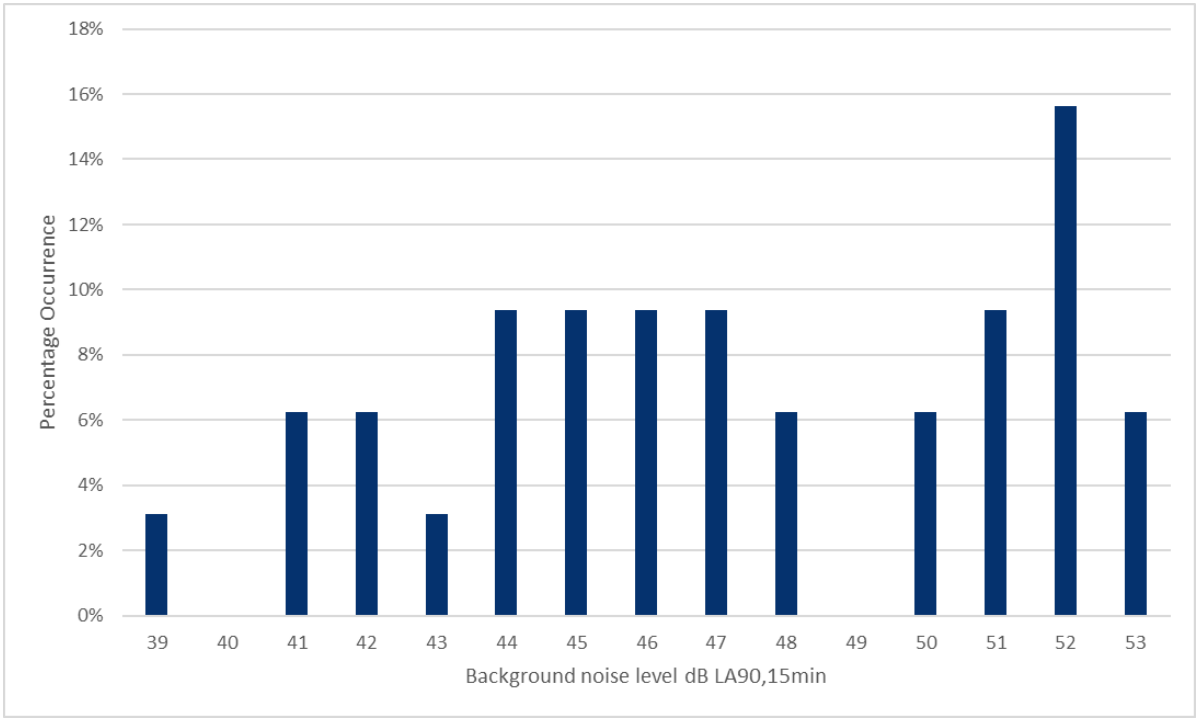
LT2 Daytime (14:00-15:00) for Peak Hour assessment



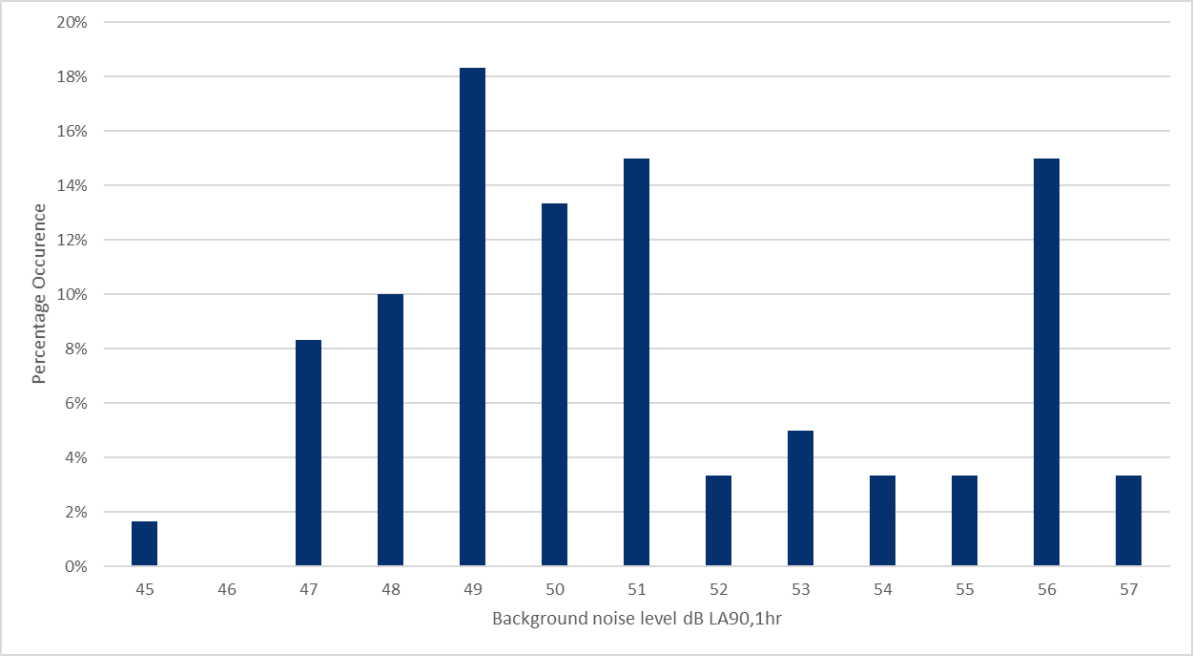
LT2 Night-time (23:00-05:00) for night-time assessment



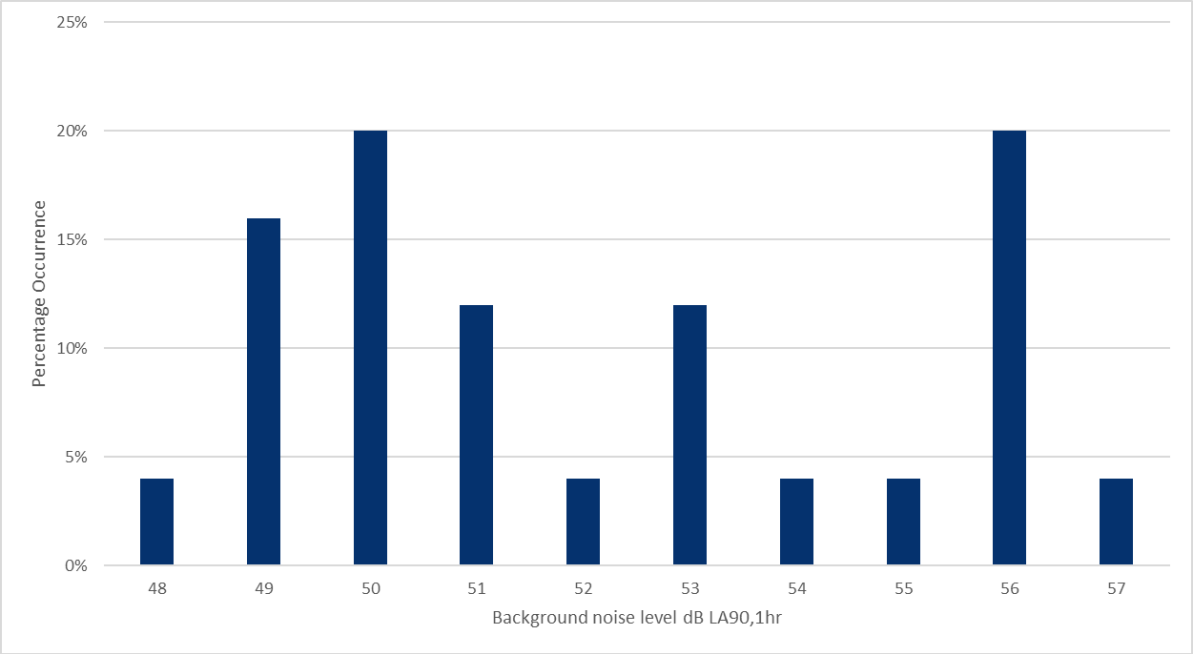
LT2 Night-time (05:00-07:00) for night-time assessment with HGVs



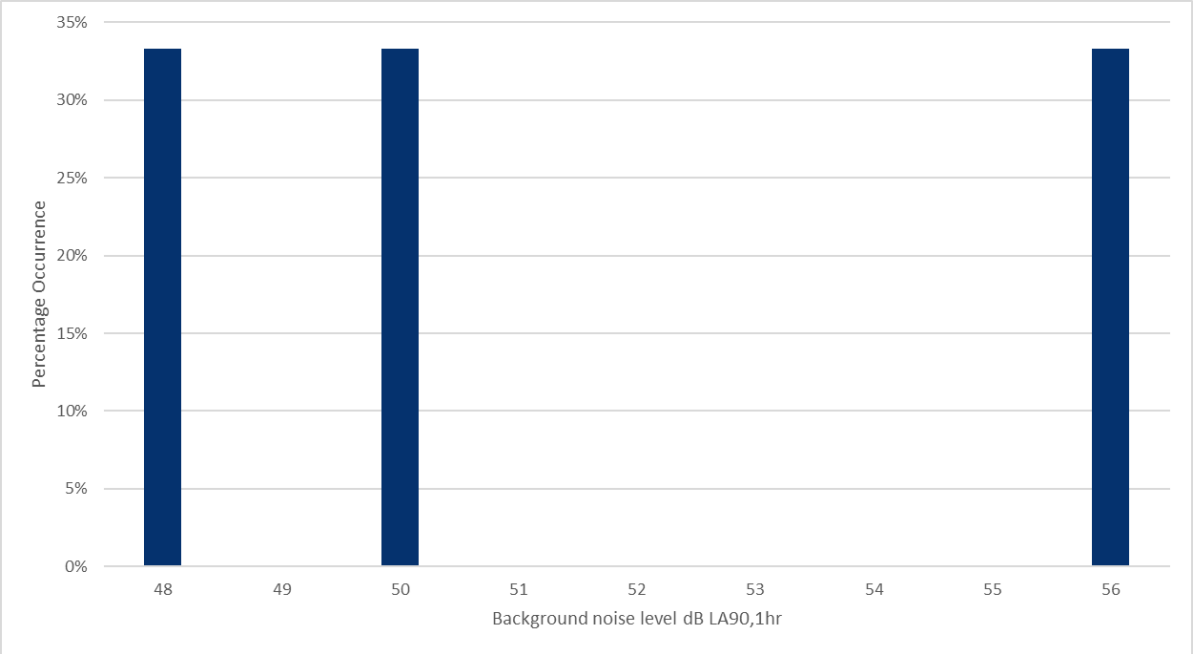
LT3 All daytime periods (07:00-23:00)



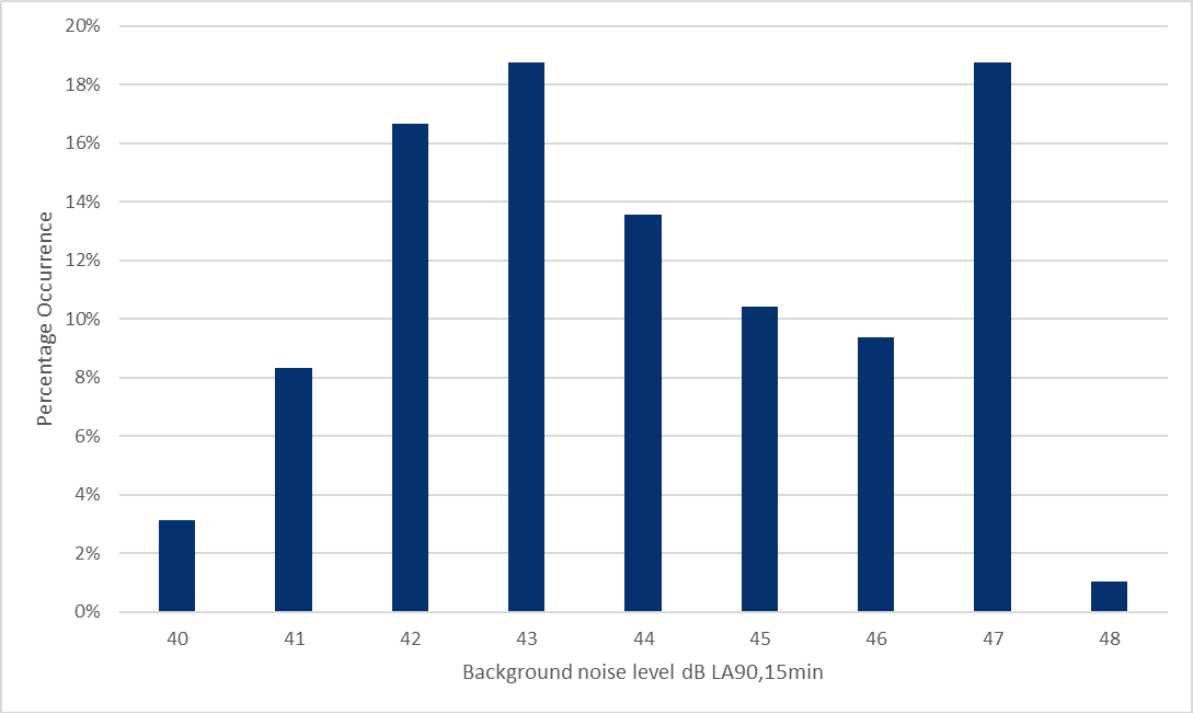
LT3 Daytime (09:00-16:00) for Average Hour assessment



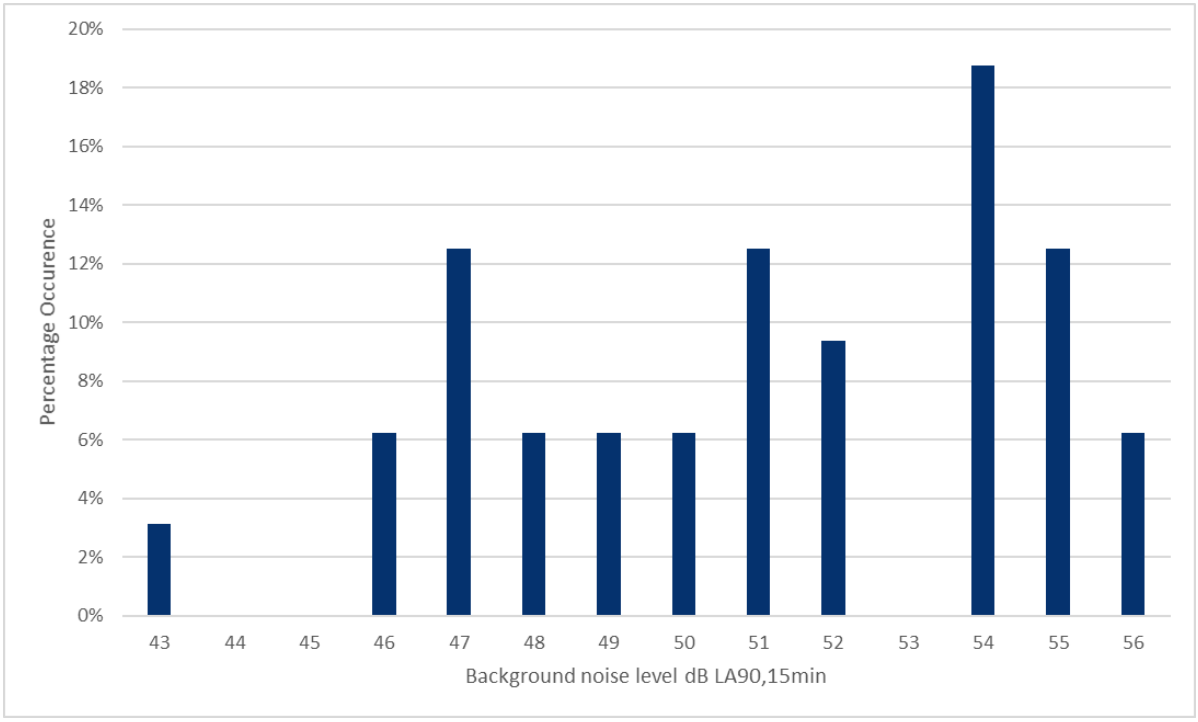
LT3 Daytime (14:00-15:00) for Peak Hour assessment



LT3 Night-time (23:00-05:00) for night-time assessment

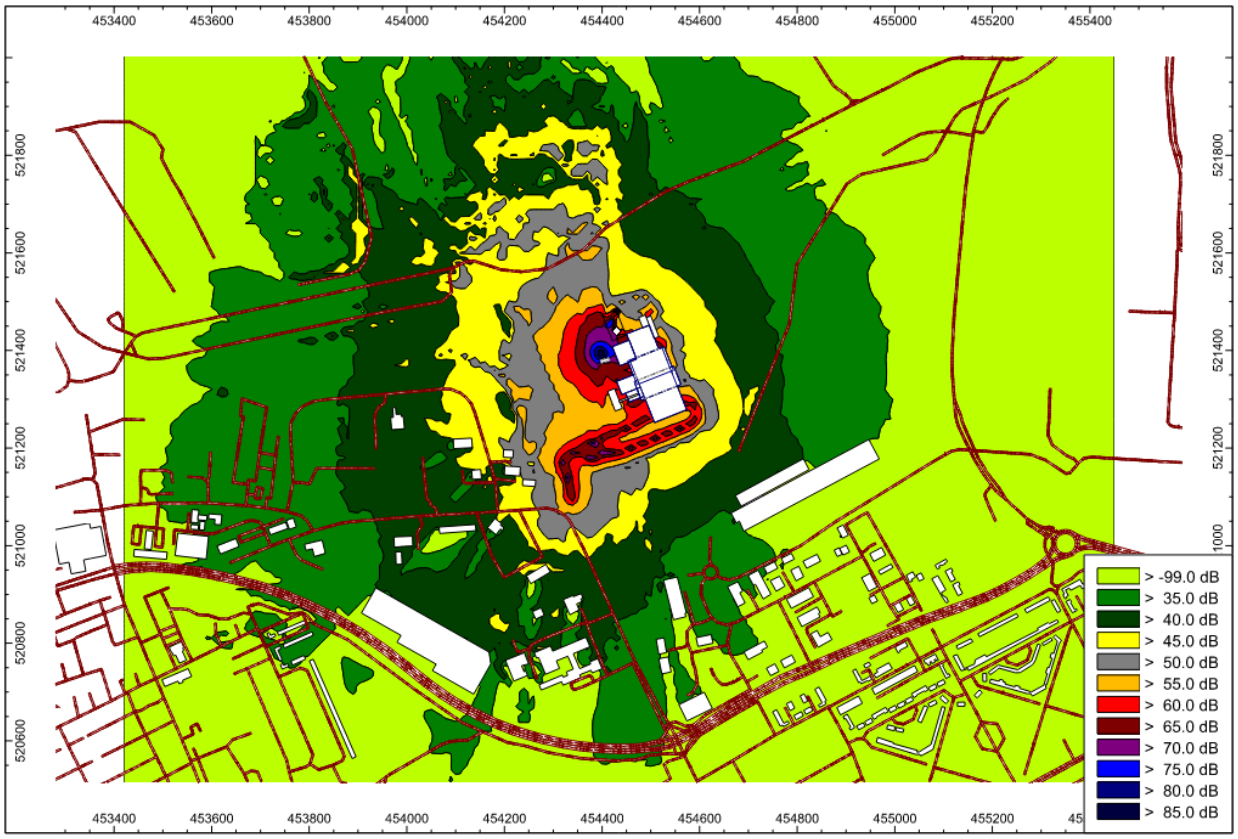


LT3 Night-time (05:00-07:00) for night-time assessment with HGVs

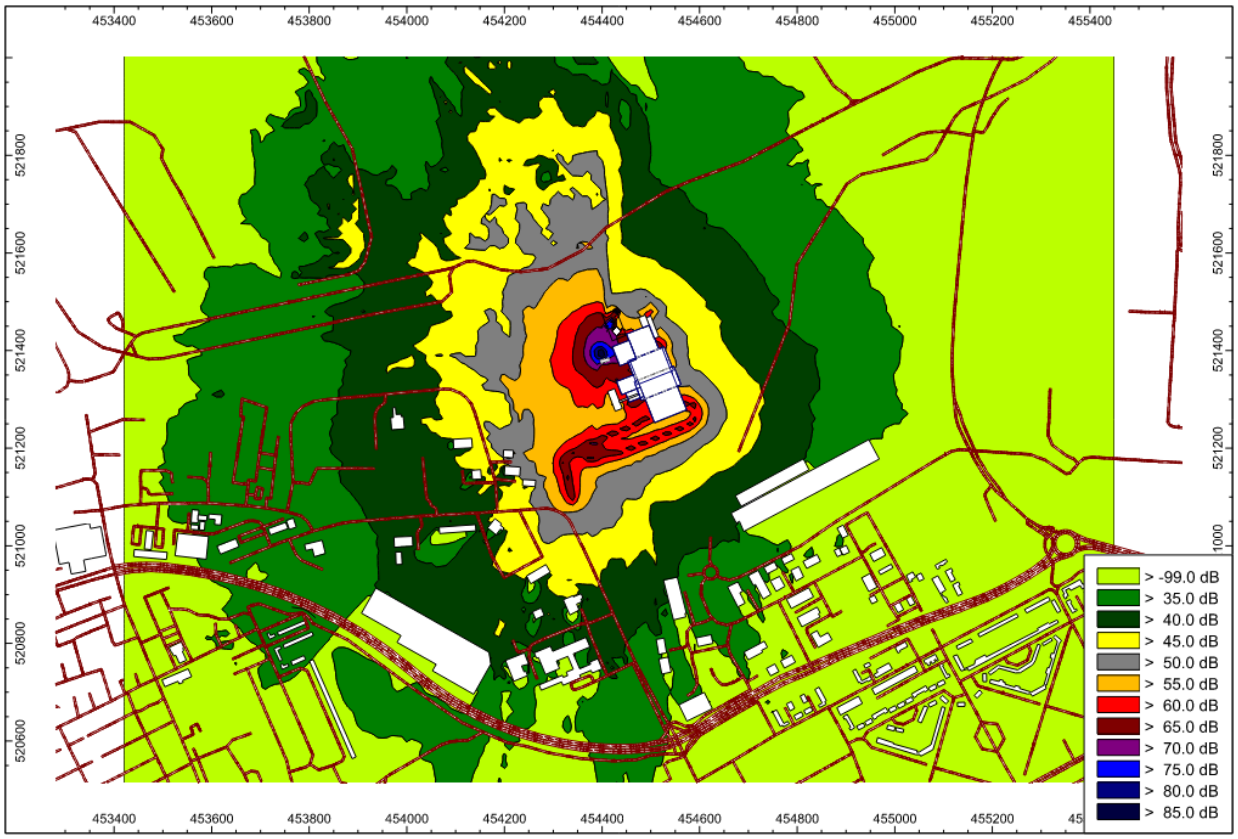


APPENDIX F
NOISE CONTOUR PLOTS

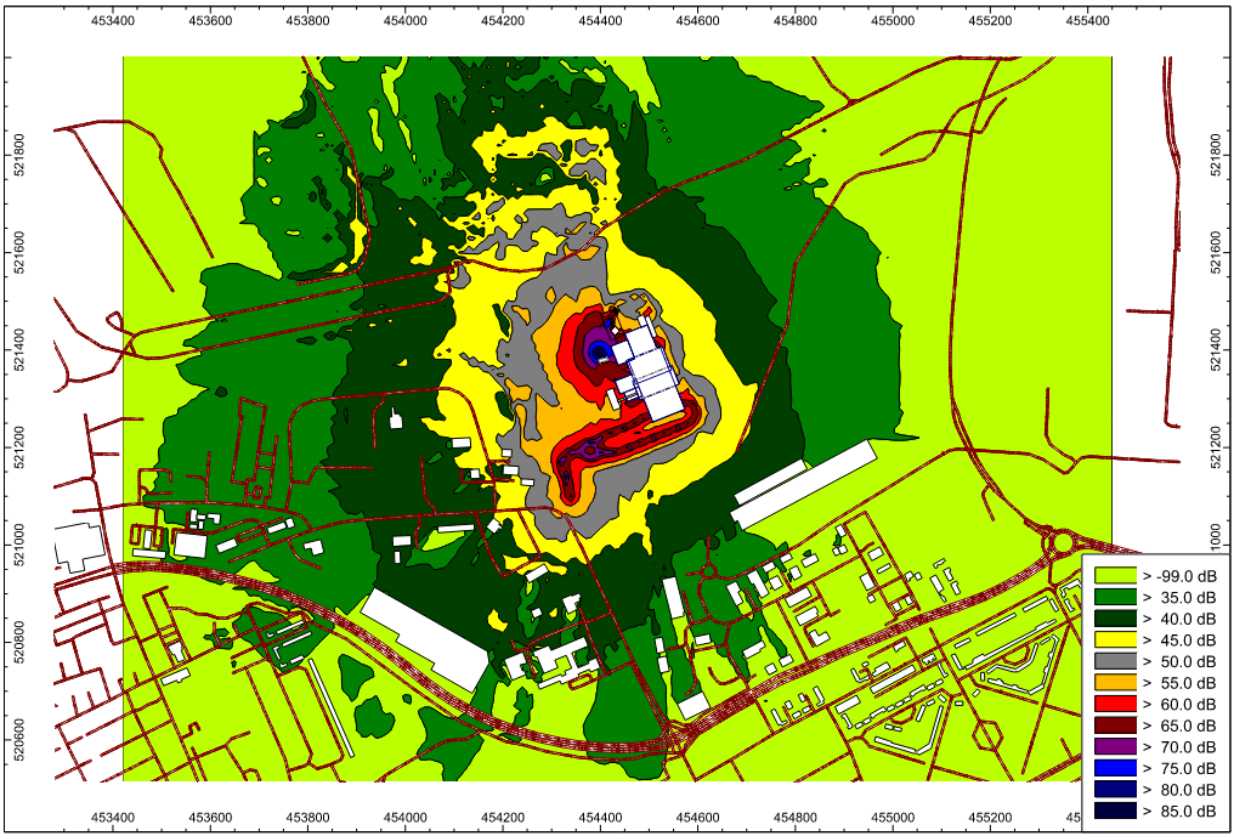
Average hour (09:00-16:00) 1.5m height



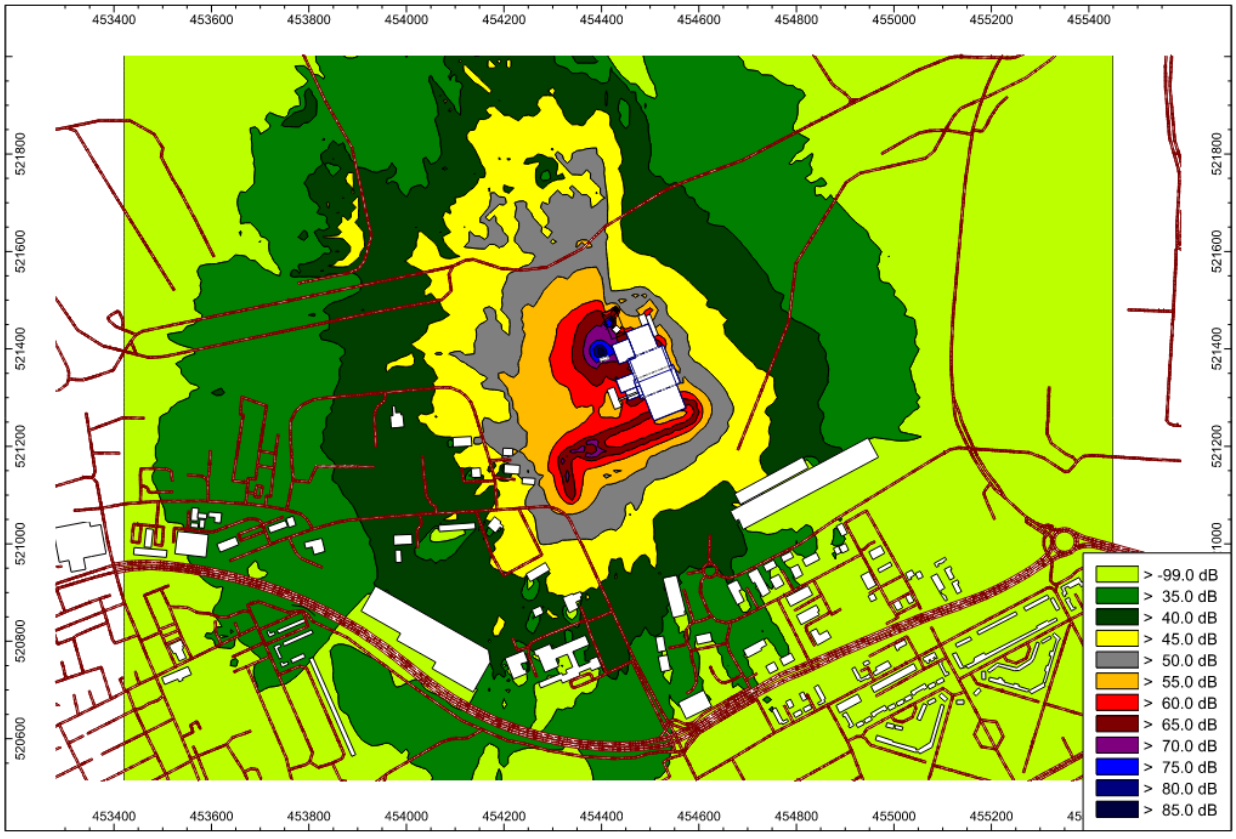
Average hour (09:00-16:00) 4.0m height



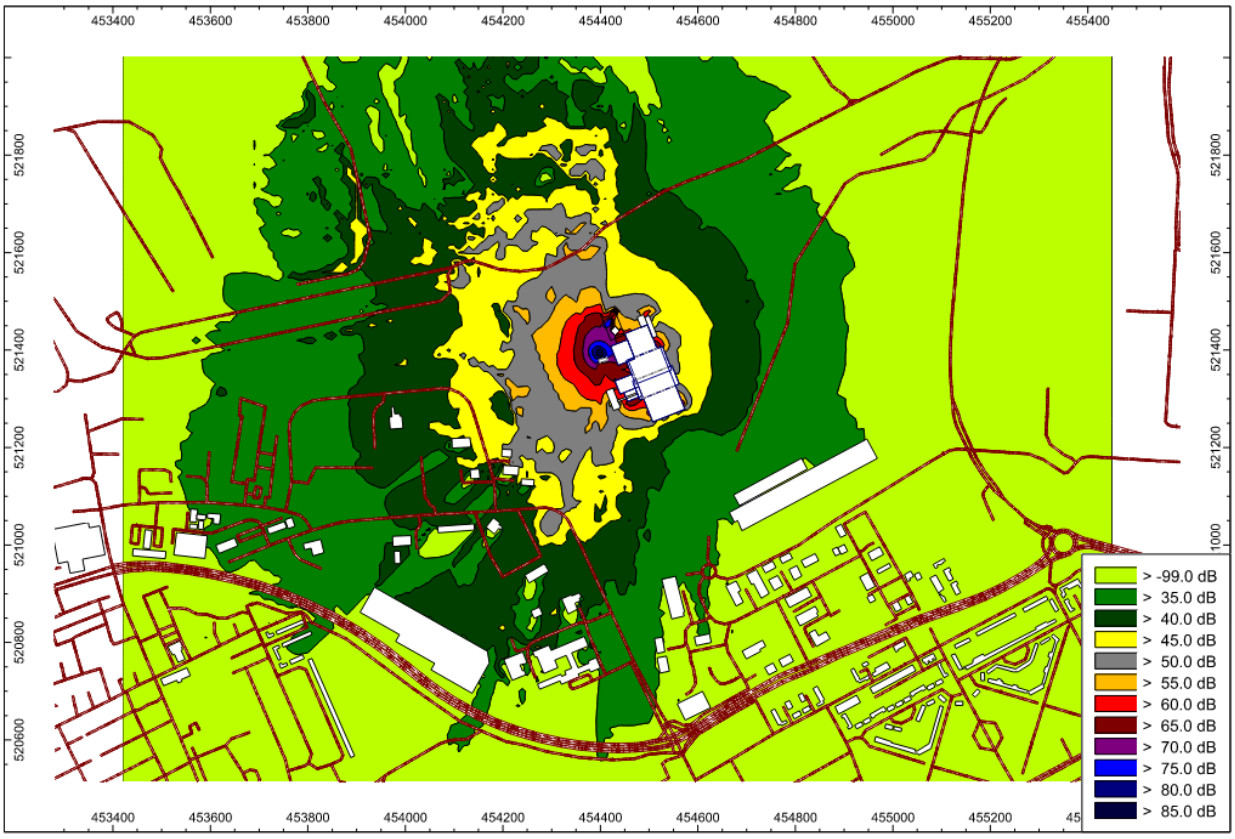
Peak hour (14:00-15:00) 1.5m height



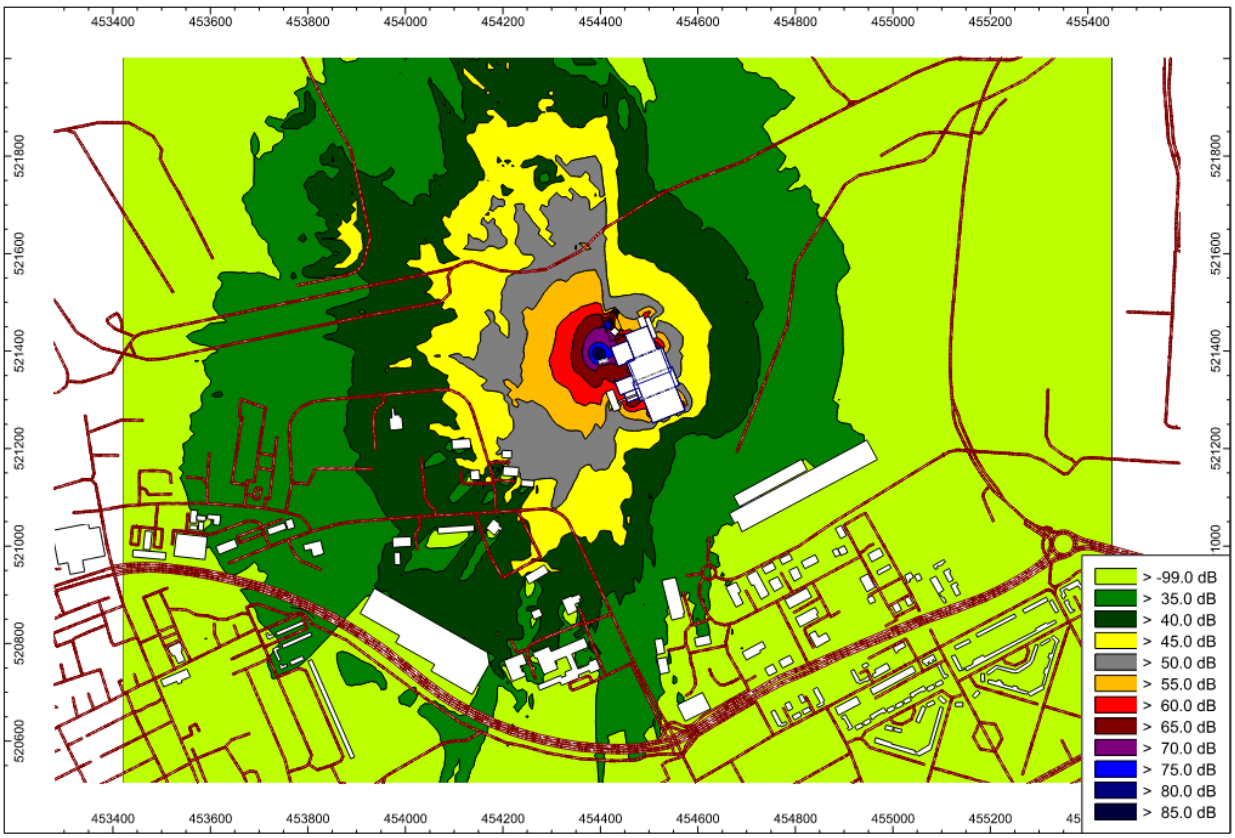
Peak hour (14:00-15:00) 4.0m height



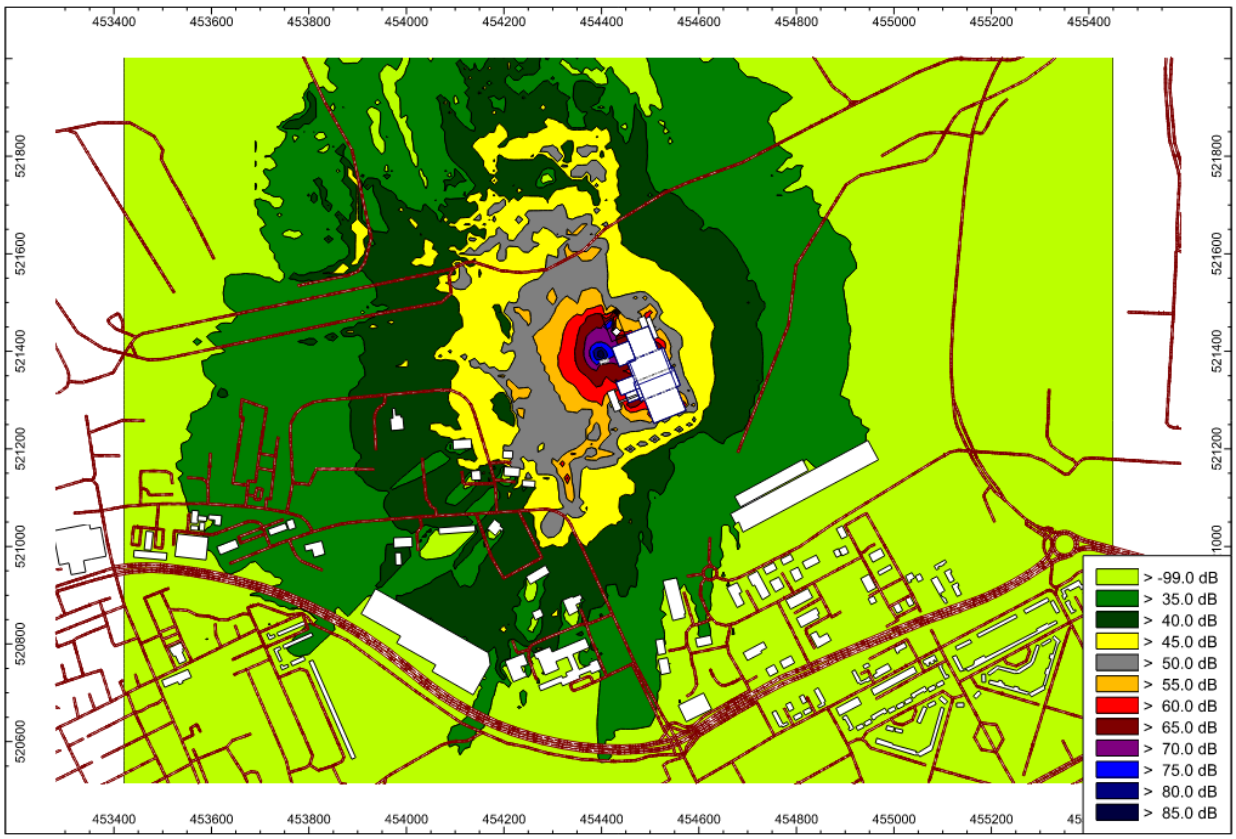
Night-time (23:00-05:00) 1.5m height



Night-time (23:00-05:00) 4.0m height



Night-time (05:00-07:00) 1.5m height



Night-time (05:00-07:00) 4.0m height