BORGARLÍNAN

Borgarlínan

Acoustic study

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ARTELIA

16 rue Simone Veil
93400 Saint-Ouen-sur-Seine
France
www.arteliagroup.com

ARTELIA DK
Buddingevej 272
2860 Søborg
Denmark

HNIT
Háaleitisbraut 58-60
105 Reykjavík
Iceland
www.hnit.is

GOTTLIEB PALUDAN ARCHITECTS

Orientkaj 4

2150 Nordhavn Copenhagen, Danmark

www.gottliebpaludan.com

YRKI ARKITEKTAR EHF

Mýrargötu 26

101 ReykjavíkIceland

www yrki.is

Made by:	MMD
Inspected by:	ERY
Approved by:	ERY
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1 Introduction

This study focuses on the noise impact of Borgarlínan Lota 1.

To reach the Paris Agreement's objective of carbon neutrality by 2040, Iceland wants to reduce its CO_2 emissions from road transport. To this end, Borgarlínan ("The City Line" in Icelandic), a project for the greater Reykjavík area, aims at creating a Bus Rapid Transit (BRT) infrastructure serving the entire city. This is a realistic and environmentally friendly solution to improve the efficiency, reliability, and accessibility of transport and thus meet the needs of users. It will be the main axis of the Capital region's public transport infrastructure, with the ambition to create one of the most sustainable transport networks in the world.

Borgarlínan Lota 1 consists of 14.5 km of infrastructure and about 25 stations.

The study aims at defining the acoustic contribution of the development of the BRT (Lota 1). The analysis is based on Inception phase layouts. It includes the following steps:

- Analysis of impacts during the construction phase
- Baseline:
    - The baseline noise (year 2019) is calculated in the areas through which Borgarlínan will run, based on a numerical acoustic model (itself based on the traffic data provided), according to the NORDIC PREDICTION METHOD of 1996.
- Definition of the effects of the project on the noise environment:
    - Calculations will be made on changes to noise levels in areas Borgarlínan will run through when it is operational in 2027 (BRT or Borgarlínan scenario).
    - Calculations on zero alternatives will also be made. This scenario has all the same land use changes as in the Borgarlínan scenario planned for 2027. This scenario also includes all the same road projects as in the Borgarlínan scenario. The only change is that this scenario does not include Borgarlínan. The main purpose of this scenario is to be able to filter noise changes due to the Borgarlínan project.

To do this, the following actions will be made:

- Mapping of the noise contribution of the BRT and 0-incident scenarios ;
- Assessment in front of the houses that are closest to the project (first row of houses immediately adjacent to the street) ;

2 Terminology

- **Decibel**

The decibel is a logarithmic scale of measurement in acoustics, it is a dimensionless term. It is noted dB. The sound levels do not add up arithmetically: 80 dB + 80 dB = 83 dB and 80 dB + 90 dB = 90 dB.

The table below shows the increase in sound level as a function of the number of sources (source: BruitParif).

Table 1 Operation on decibels

Multiplying the sound energy by	Leads to an increase of noise levels by	Affects sound perception	Observation
2	3 dB	Very slightly	It is difficult to tell the difference.
4	6 dB	Significantly	There is a worsening.
10	10 dB	Apparent	The noise seems to be twice as loud.
100	20 dB	As if the noise was 4 times as loud	A sudden change of 20 dB can distract the attention.
100 000	50 dB	As if the noise was 30 times louder	A sudden change of 50 dB startles.

- **Decibel A: dB(A)**

The letter 'A' means that the decibel is weighted to consider the difference in sensitivity of the ear to each frequency. It attenuates low frequencies.

To better interpret the mapping of contributions, the table below gives an example of concrete and usual indicative values of sound levels.

Table 2 Sensitive dB(A) scale

Outdoor noise	Sound levels dB(A)	Indoor noise	Vehicle noise	Conversation / Auditory sensation
Aircraft on take-off	130	Drop hammer	Nearby aircraft engines	Impossible / Pain threshold
Jackhammer	120	Engine test bench		
Riveting at 10 m	110	Boiler making workshop	Train passing through a station	Having to shout to be heard / Very difficult to bear
Concert	105	Planer		
Jackhammer within 5 m	100	Band saw	Motorbike without silencer at 2 m	
Heavy traffic street	95	Forge workshop	Car horns	Difficult/painful to hear
Heavy traffic at 1 m	85	Very powerful radio		
Heavy traffic	75	Medium-sized plant	Underground on tires	Quite loud / Noisy but bearable
	70	Noisy open space		
	65	Noisy flat	Motorboat	
Residential street	60	Large shops / Normal conversation		Quite loud / Common noise
Very quiet street	50	Quiet restaurant / Office	Silent auto	

Outdoor noise	Sound levels dB(A)	Indoor noise	Vehicle noise	Conversation / Auditory sensation
Minimum daytime street noise	45	Normal flat / Library		Normal voice / Quite calm
	30	Flat in a quiet area		Whispered voice / Very quiet
The rustle of a leaf	25	Conversation in a low voice		
	20	Radio studio		
	0	Acoustics Laboratory		Whispered voice / Hearing threshold

- **Octave bands and overall level**

The ear's sensation of frequency is not linear. The higher the frequency, the greater the variation required to keep the impression of variation constant. Frequency values in Hertz are standardized to express this sensation:

L31,5 L63 L125 L250 L500 L1k L2k L4k L8k

Here, as in music, we will use octaves.

The overall level is the sum of the energy of all the octave bands. It is noted L.

- **A-weighted equivalent continuous sound pressure level**

The A-weighted sound pressure level of a stable continuous sound which, over a specified period T, has the same root mean square sound pressure as a sound of interest whose level varies with time. This estimator is commonly used to represent noise annoyance and to define exposure limits. Thus, it characterizes the "dose" received during a given time T.

It is defined by the formula:

$$L_{Aeq,T} = 10 \times \log\left[\frac{1}{t_2 - t_1}\int_{t_1}^{t_2}\frac{P_A^2(t)}{P_0^2}dt\right]$$

With:

- LAeq, T the equivalent continuous A-weighted sound pressure level, in decibels, determined for a time interval T that starts at t1 and ends at t2. In the measurements presented here, T = 10 minutes;
- Po is the reference sound pressure (20 μPa);
- PA (t) is the instantaneous A-weighted sound pressure of the signal.

The equivalent level is used to reflect the average intensity of noise over a given period with phases of noise interspersed with phases of silence.

3 Noise regulation

There are national regulations aimed at preventing or reducing noise pollution.

In Iceland, regulation 724/2008 sets permissible noise thresholds for various activities, including motor traffic.

Sound levels outside house facades in the tables below are free-field values. Sound levels in residential areas are also free-field values.

Boundaries outside the facade apply to the outside of an openable window. The standard height, unless otherwise stated, is 2 m.

Indoor limits are based on closed windows. Indoor limits are 5 dB(A) higher in kitchens, bathrooms, storage rooms, and similar spaces. The limit is reduced by 5 dB(A) when the measured sound contains a dominant tone or a regular impact noise.

When a residential area is defined on a plot of land, it must also be ensured that the sound level is below 55 dB(A).

The data below is taken from Table I in the annex to Regulation 724/2008.

Table 3 Limits Due to vehicle traffic

Type of building	**Leq 24h**	**Leq 24h**
	facade	**Inside**
Residential buildings in residential areas	55	30
Residential buildings in commercial, service, and central areas	65	30
Accommodation in service institutions where patients and residents stay for longer periods	55*	30
Industrial area and activities		35
Leisure settlement	45	
Kindergartens and elementary schools	55*	30
Secondary school teaching space		35
Low-noise workplaces, such as offices and similar		40

* Noise outside the facade may be higher if direct ventilation of outside air is guaranteed (sound traps)

The regulations do not set strict noise limits (between the initial and altered situation) for modifications to existing streets. However, article 5 of the 724/2008 law states that projects should try not to degrade the situation. If an increase is foreseen, explanations must be provided and mitigation measures suggested.

The regulations do not set sound level limit values for construction activities, only restrictions relating to the time of day when activities are permissible. These are set out in the table below.

Table 4 Limits for construction noise

			Beginning implemented	End implemented
Residential area, living area where patients or residents stay over longer time	Noisier construction	Weekdays	7:00	21:00
		Weekends and public holidays	10:00	19:00
		Special holidays (e.g. Christmas day)	Not allowed	
	Especially noisy construction	Weekdays	7:00 am	19:00
		Special holidays	Not allowed	

4 Calculation assumptions

As part of this study, 3 scenarios were modelled:

- Baseline: the reference noise is described (calculated) in the areas through which Borgarlínan will drive, as well as in adjacent streets and open-air recreational areas. These calculations are made for the year 2019.
- 0-incident: zero alternative calculations have been carried out, this scenario includes the same land use changes as the Borgarlínan scenario planned for 2027, but without the Borgalínan project.
- Project: the changes in noise levels in the areas through which Borgarlínan will drive (when it becomes operational in 2027) have been calculated.

Noise levels are modelled with the reference acoustic prediction software CadnaA developed by the German company DATAKUSTIK. CadnaA implements most of the calculation modules standard in various European countries. The calculations are carried out by the Nordic Prediction Method 1996 calculation standard.

The numerical model is made up of several input data:

- Topography of the site,
- Significant built elements that can modify the propagation of sound (buildings in particular, but also embankments and excavations, any acoustic screens, etc.),
- Groundcover properties,
- Roads and traffic conditions, constituting the acoustic sources.

The objective of the simulations is to obtain the traffic contribution and then to determine the current state of road noise levels. 24 hours averages were calculated to comply with Icelandic regulations.

Topography

Most of the areas on and along Borgarlínan's Lota 1 route are flat, nevertheless differences in topography are occasionally recorded (e.g. in Artúnshöfði or in the center of Reykjavík). These variations do not affect the perception of noise levels for the front row of houses, as they are placed on the same level as the street.

Due to the mostly flat topography of the site and the fact that noise levels are modelled for the first row of buildings along the street topography has not been taken into account.

Soil absorption

The model takes into account attenuation due to the ground effect. For operational calculation purposes, the sound absorption of the ground is represented by a dimensionless coefficient G, ranging from 0 (reflective) to 1 (absorptive).

In the model, the absorption capacity of the ground is taken to be constant and equal to 0.9 (i.e. an absorbent ground). Roads and car parks, buildings (including roofs), as well as sea areas and waterways are considered reflective (and therefore with an absorption coefficient of 0).

Building

The buildings are modelled in 3D, using Lidar scans. The data were retrieved by the IDA team.

Roads and traffics

Input variables in the calculation model are traffic assumptions and the geometric position of the road.

The traffic data used was provided by PMO and published in August 2023. These data concern the 3 scenarios: base year scenario, Borgarlínan scenario and 0 incident scenario.

The road noise sources are modelled based on the average annual daily traffic (ADT) defined by the counts, for light vehicles and heavy goods vehicles. The annual average daily traffic (AADT) is used for noise calculations. The model gives the annual weekly traffic (AWDT), so the average daily traffic is estimated by multiplying AWDT by 0.85.

The inserted drawings used are from the BL100-IDD-IDA-PV-01000.pdf file. The insertion plans used are from the file BL100-IDD-IDA-PV-01000.pdf, gathering plan views from the Inception phase.

Sound level calculation

The calculation index used is the LAeq 24h.

The calculations are carried out at a height of 4 m for the noise maps, in accordance with European Directive 2002/49/CE. Evaluations at 2 m in front of the neighbouring residential buildings and on different floors are also carried out.

5 Noise during construction

The construction of a Bus Rapid Transit (BRT) system can have noise impacts during the construction phase. The potential noise impacts associated with the construction of a BRT are outlined below.

- Noise from site equipment: during the construction phase of the BRT, site equipments such as excavators, bulldozers, lorries transporting materials, etc. will in all probability be used. These machines can generate high noise levels, particularly during earthmoving and demolition operations.
- Noise from roadworks: the implementation of a BRT may require major roadworks, such as the modification of traffic lanes, the laying of new road surfaces, the installation of bus stations, and so on. This work may generate noise due to the use of construction tools, paving machines, etc.
- Noise from diverted traffic: during the work, traffic may be diverted, which may increase traffic on other nearby roads. This may lead to an increase in noise generated by vehicles, particularly if the alternative roads are not designed to absorb an increase in traffic.

Measures can be taken to mitigate these noise impacts, such as the use of less noisy site machinery, the application of strict rules on working hours to limit noise pollution during sensitive hours, the use of noise-reducing road surfaces, etc.

6 Noise map

Base year

The noise map of the initial state (2019) within the study area is presented in the figure below.

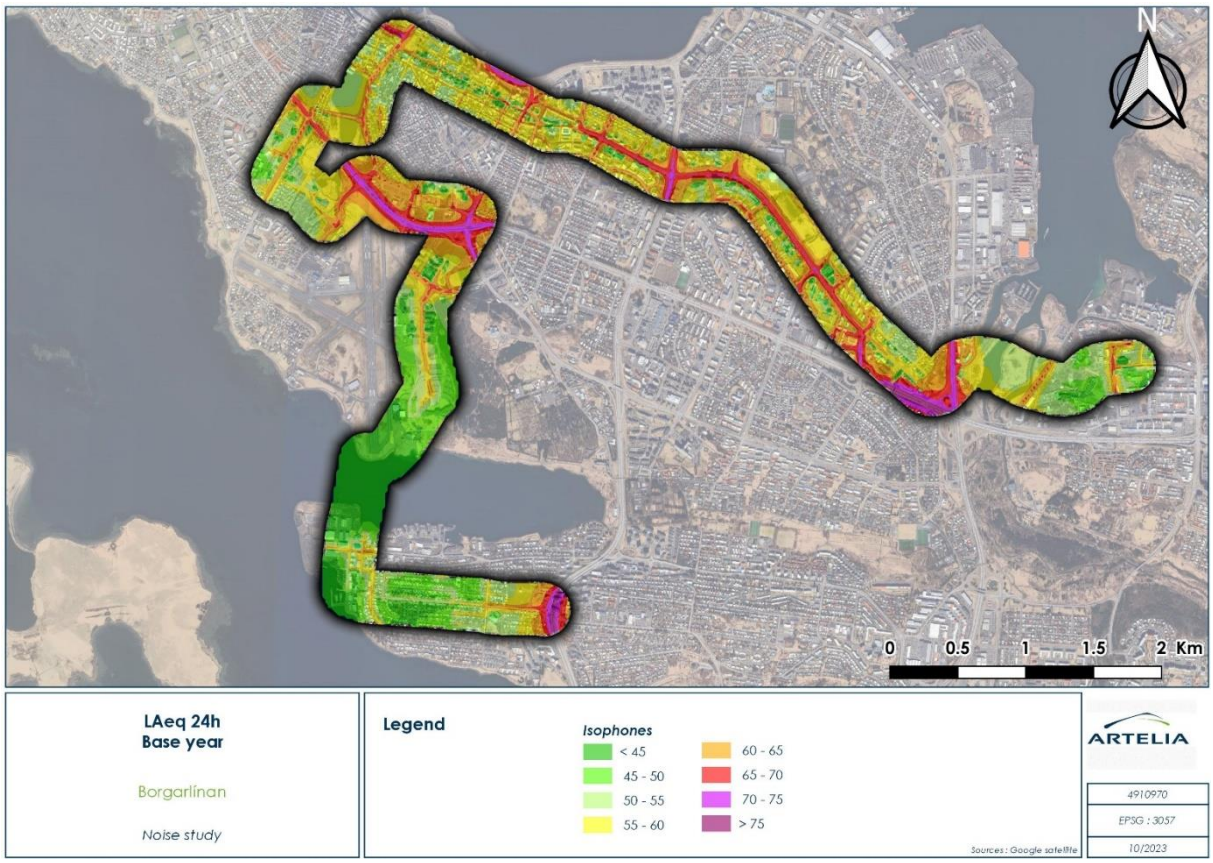


Figure 1 LAeq 24h – Base year

The results of the modelling show a higher noise contribution in the heavily trafficked sections. Also, noise levels decrease as the distance from their source increases.

0-incident scenario

The noise map of the 0-incident scenario within the study area is presented in the figure below.

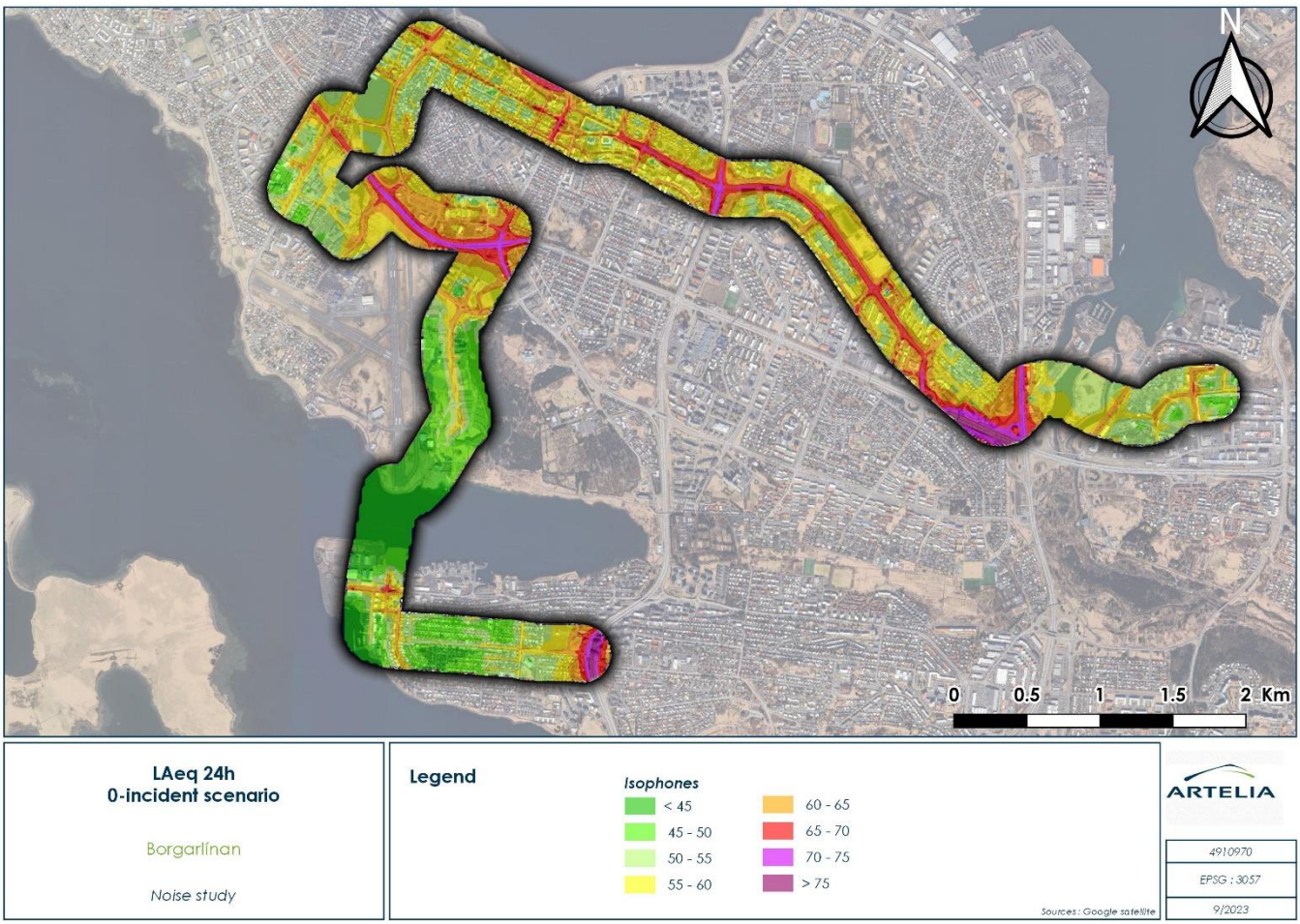


Figure 2 LAeq 24h – 0-incident

The noise map appears similar between the 0-incident scenario and the base year scenario. Indeed, the traffic study shows no significant variation between these two states.

Borgarlínan scenario

The noise map of the Borgarlínan scenario within the study area is presented in the figure below.

Figure 3 LAeq 24h– Borgarlínan

For information, the map below provides an estimate of the difference in noise levels correlated with the difference in traffic between the 0-incidence scenario and the Borgarlínan scenario.

The map is based on the equation below : 10*log(Borgarlínan traffic/0-incident traffic).

In particular, this formula does not take into account the proportion of light vehicles and heavy vehicles. For more precise estimates, please refer to the tables below. They are based on the modelling, which takes precise parameters such as vehicle types, weather, sound dispersion… into account.

Note that roads for which it is not possible to make a preliminary assumption are shown in green, since traffic (whether with the project or in the 0-incident scenario) is equal to 0. The calculation method used is therefore not applicable, because log(0) does not exist.

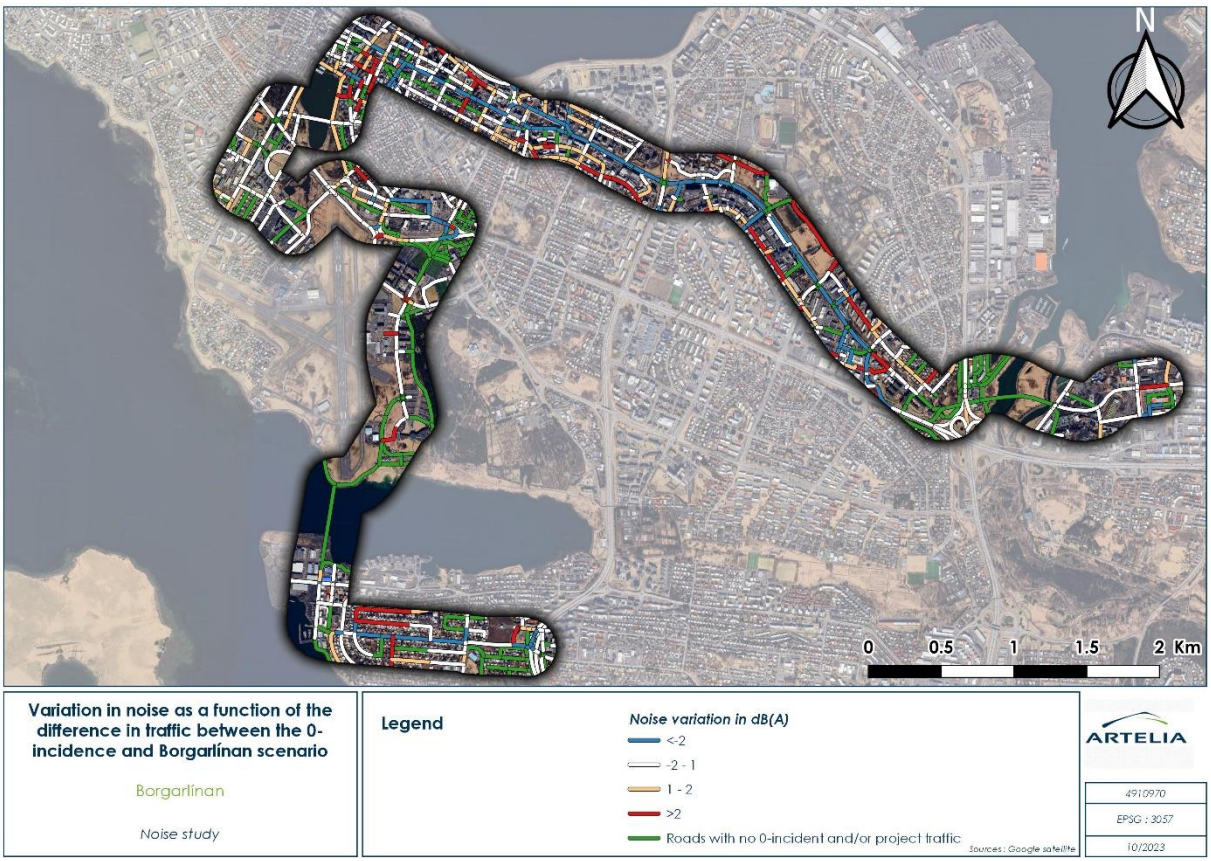


Figure 4 Noise variations

7 Evaluation in front of buildings

The following maps and tables present the evaluations of noise levels at the building's facades for the base year, 0-incident, and Borgarlínan scenarios.

Base year levels vary from 43.4 dB(A) to 67.8 dB(A). 89% of the receptors assessed exceed 55 dB(A). Only 12% exceed 65 dB(A).

For the 0-incident scenario, levels vary from 43.5 dB(A) to 68.2 dB(A). 89% of the receptors assessed exceed 55 dB(A), and 20% exceed 65 dB(A).

Finally, for the Borgarlínan scenario, levels vary from 50.6 dB(A) to 66.8 dB(A). 95% of receptors exceed 55 dB(A) and 3% exceed 65 dB(A).

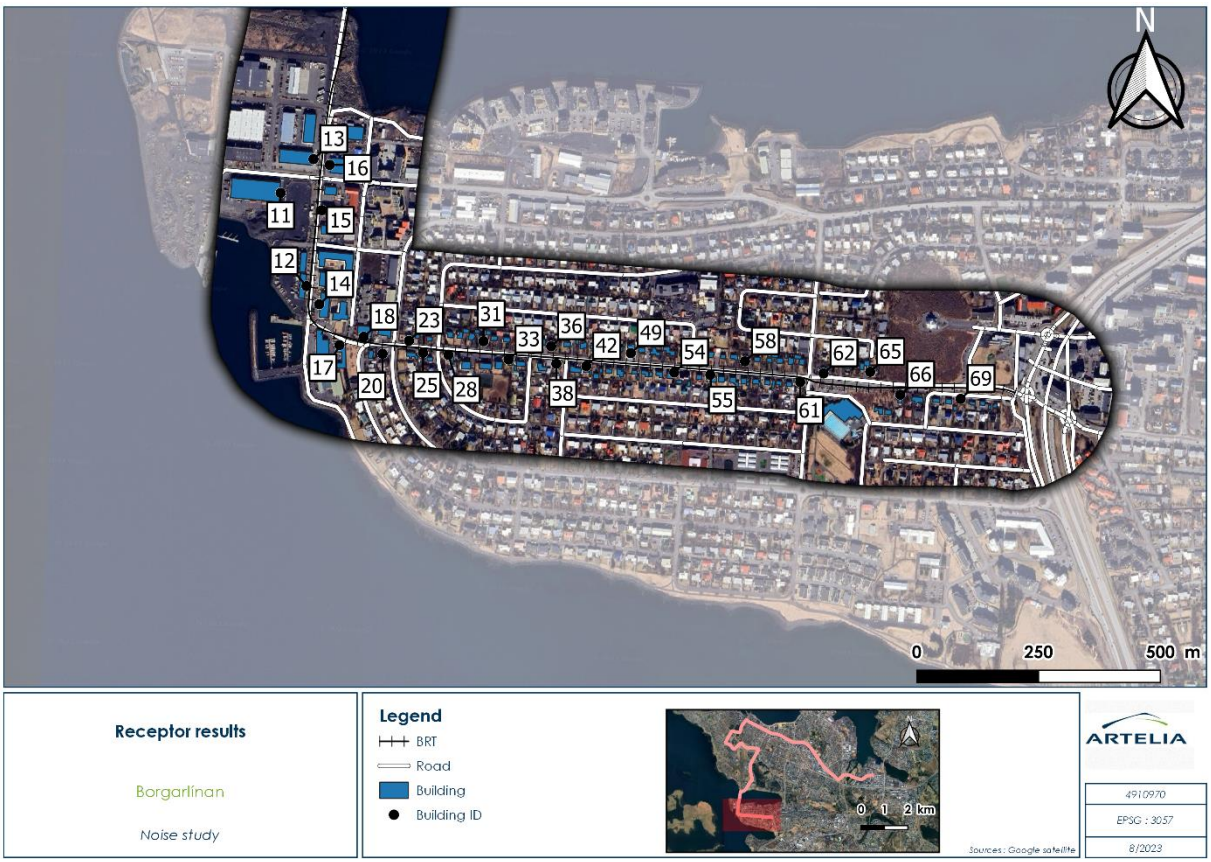
Between the 0-incident scenario and Borgarlínan scenario, levels vary from -6.2 dB(A) to 8.8 dB(A). 58% of receptors see their noise level fall in the project scenario.

There is no specific location experiencing a significant increase. However, certain buildings, due to traffic diversions or increased traffic resulting from the BRT system, are experiencing an increase.

On the other hand, Laugavegur, Suðurlandsbraut and Hverfisgata are the areas where noise levels have overall decreased.

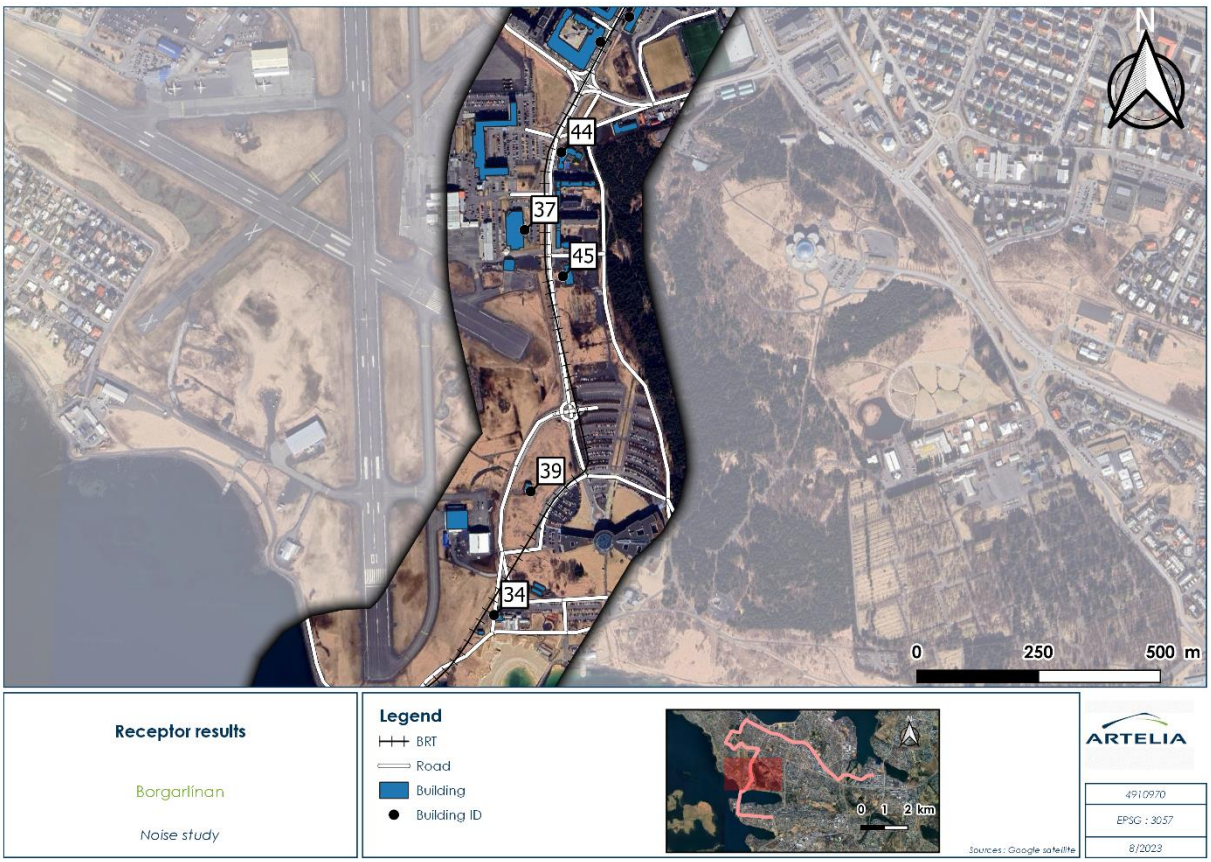
In the tables below, the levels in red for the Borgarlínan scenario are those exceeding 55 dB(A).

For the comparison between the 0-incident scenario and the Borgarlínan scenario, differences of less than 0 dB(A) are displayed in green, differences between 0 and 2 dB(A) are shown in black, and differences exceeding 2 dB(A) are highlighted in orange (due to the threshold beyond which noise variations may be slightly perceptible).



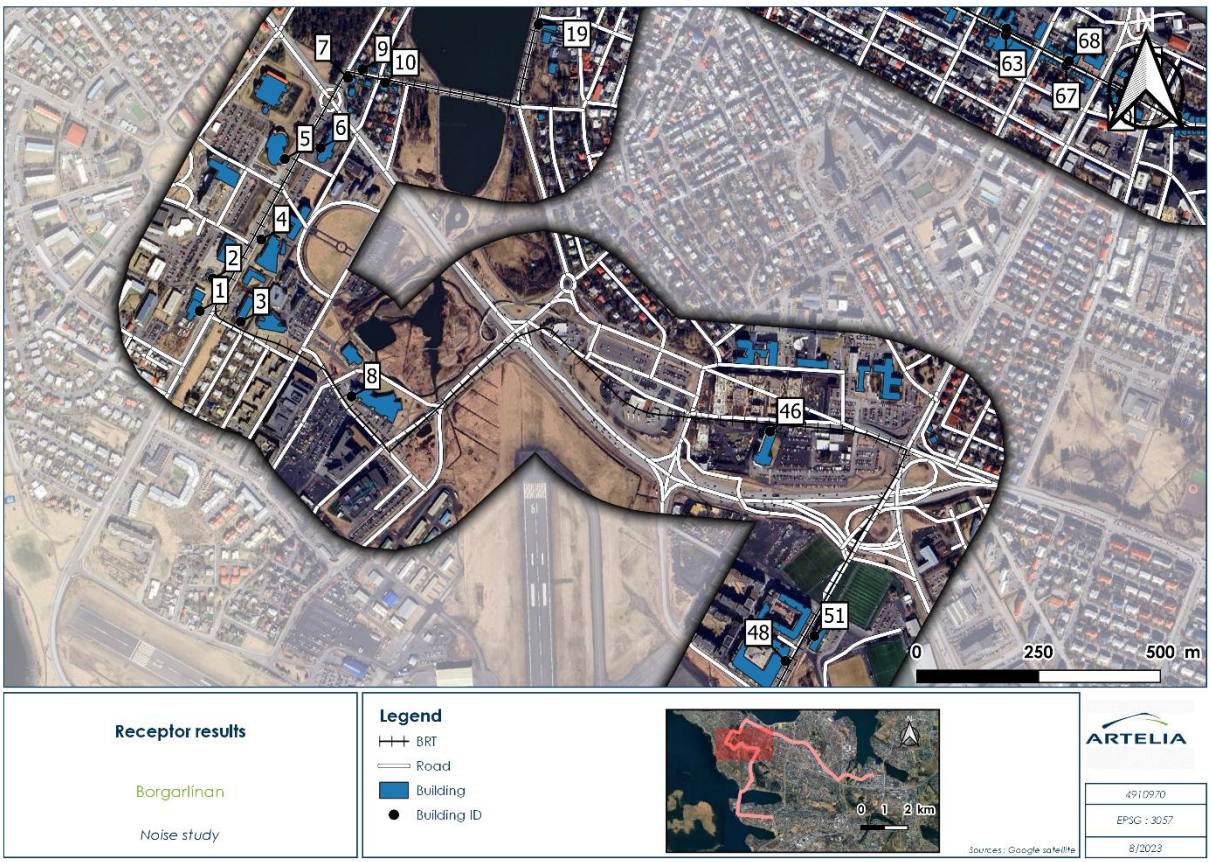
ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
11	Ground floor	51,2	53,5	53,3	-0,2
12	Ground floor	54,4	55,6	56,6	1
13	Ground floor	53,9	54,9	57,3	2,4
14	Ground floor	50,5	52,2	53,2	1
15	Ground floor	55,4	57,7	58,1	0,4
16	Ground floor	54,9	56	58,3	2,3
17	Ground floor	43,4	45,3	54,1	8,8
18	Ground floor	47,5	49,6	54	4,4
20	Ground floor	53,4	55,9	56,3	0,4

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
23	Ground floor	52,8	55	56,9	1,9
25	Ground floor	50,2	51,8	55,2	3,4
28	Ground floor	53,2	53,7	55,1	1,4
31	Ground floor	48,5	48,8	50,8	2
33	Ground floor	52	52,3	54,2	1,9
36	Ground floor	48,3	48,7	50,6	1,9
38	Ground floor	52	52,3	54,2	1,9
42	Ground floor	52,3	52,6	54,5	1,9
49	Ground floor	49,7	49,8	51,6	1,8
54	Ground floor	53,5	53,7	55,2	1,5
55	Ground floor	56,3	56,3	56,2	-0,1
58	Ground floor	52,6	52,3	52,3	0
61	Ground floor	59,3	58,1	57,8	-0,3
62	Ground floor	63,7	60	59,9	-0,1
65	Ground floor	59,8	56,5	56,4	-0,1
66	Ground floor	59,6	57	56,9	-0,1
69	Ground floor	60,8	59,9	60	0,1



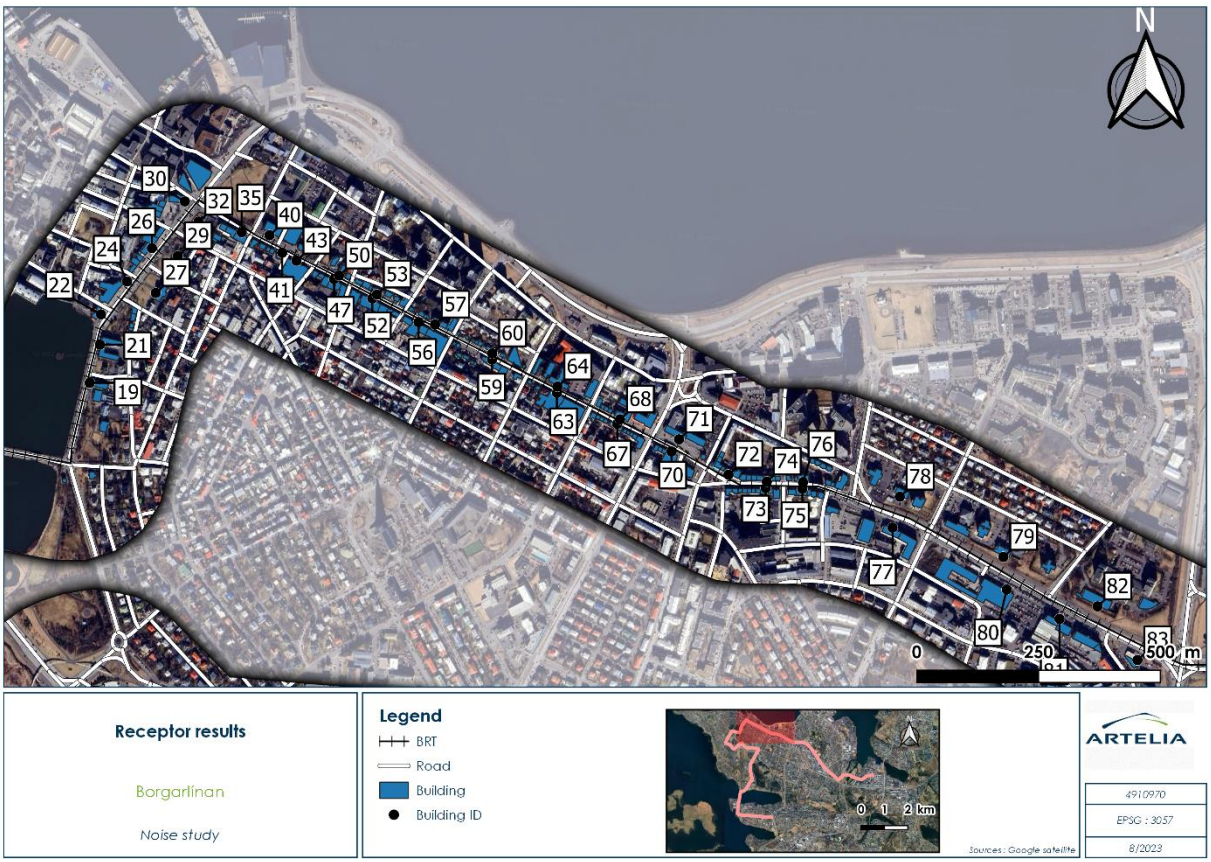
ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-inci-dent	Laeq 24h Borgar-lina	0-incident/Bor-garlina
37	Ground floor	54,5	52,6	53,7	1,1
37	1st floor	56,5	54,6	55,6	1
37	2nd floor	57,6	55,7	56,7	1
37	3rd floor	57,8	55,9	56,9	1
39	Ground floor	49,8	49,2	51,2	2
39	1st floor	51,6	51,1	53,1	2
39	2nd floor	52,4	51,8	53,9	2,1
44	Ground floor	62,1	60,3	60,8	0,5
44	1st floor	62,2	60,5	61	0,5
44	2nd floor	62,1	60,3	60,8	0,5
44	3rd floor	61,8	60	60,6	0,6
44	4th floor	61,5	59,8	60,3	0,5
45	Ground floor	56,7	54,4	55,8	1,4

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
45	1st floor	58,3	56,1	57,5	1,4
45	2nd floor	58,3	56	57,4	1,4
45	3rd floor	58,2	55,9	57,3	1,4



ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-inci-dent	Laeq 24h Borgar-lina	0-incident/Bor-garlina
1	Ground floor	59,1	56,3	58	1,7
1	1st floor	59,5	56,8	58,7	1,9
1	2nd floor	59,5	56,7	58,6	1,9
1	3rd floor	59,3	56,6	58,5	1,9
2	Ground floor	58,3	55,7	56	0,3
2	1st floor	59	56,4	57,9	1,5
2	2nd floor	59,1	56,5	58,3	1,8
2	3rd floor	59,1	56,6	58,3	1,7
3	Ground floor	54,2	52,9	56,4	3,5
3	1st floor	54,8	53,5	57	3,5
3	2nd floor	55,3	53,8	57,2	3,4
4	Ground floor	62	59,9	60,3	0,4
4	1st floor	62	59,9	60,7	0,8

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
4	2nd floor	61,8	59,7	60,6	0,9
5	Ground floor	61,7	59,6	59,8	0,2
5	1st floor	61,8	59,8	60,5	0,7
5	2nd floor	61,7	59,7	60,5	0,8
6	Ground floor	59,6	57,8	58,2	0,4
6	1st floor	60,4	58,5	59,7	1,2
6	2nd floor	60,5	58,6	59,8	1,2
7	Ground floor	64,8	63,9	64,6	0,7
7	1st floor	64,7	63,8	64,5	0,7
7	2nd floor	64,3	63,4	64,1	0,7
9	Ground floor	60,8	60,6	61	0,4
9	1st floor	60,8	60,6	61,1	0,5
9	2nd floor	60,6	60,4	60,9	0,5
10	Ground floor	62,1	62	62,7	0,7
10	1st floor	61,9	61,8	62,5	0,7
19	Ground floor	67,1	64,2	65,7	1,5
46	Ground floor	56,1	58,3	59,3	1
46	1st floor	56,6	59,3	60,4	1,1
46	2nd floor	57,3	59,4	60,4	1
48	Ground floor	61,5	62,5	63,2	0,7
48	1st floor	61,5	62,4	63,1	0,7
48	2nd floor	61,3	62,1	62,7	0,6
51	Ground floor	56,2	56,3	59,4	3,1
51	1st floor	56,5	56,5	60	3,5
51	2nd floor	56,7	56,8	60,1	3,3
51	3rd floor	57	57	60,1	3,1
51	4th floor	57,4	57,3	60,1	2,8



ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-inci-dent	Laeq 24h Borgar-lina	0-incident/Bor-garlina
19	Ground floor	67,1	64,2	65,7	1,5
21	Ground floor	66,6	63,5	65,2	1,7
22	Ground floor	65	62,3	63,9	1,6
24	Ground floor	63,6	61,8	63,3	1,5
26	Ground floor	63,3	61,5	62,5	1
27	Ground floor	55,6	53,7	54,3	0,6
27	1st floor	57,5	55,8	56,9	1,1
27	2nd floor	58,5	56,9	58,2	1,3
29	Ground floor	58,2	56,5	56,4	-0,1
29	1st floor	59,5	57,8	58,9	1,1

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-inci-dent	Laeq 24h Borgar-lina	0-incident/Bor-garlina
30	Ground floor	62,1	61,8	62,2	0,4
32	Ground floor	60,3	59,2	59,4	0,2
32	1st floor	61,3	60,2	61	0,8
35	Ground floor	63,8	64,8	63,8	-1
35	1st floor	63,6	64,6	63,6	-1
35	2nd floor	63,1	64	63	-1
40	Ground floor	60,8	62	60,7	-1,3
40	1st floor	61,2	62,4	61	-1,4
40	2nd floor	61	62,2	60,9	-1,3
40	3rd floor	60,7	61,9	60,6	-1,3
41	Ground floor	64,4	65,6	64,1	-1,5
41	1st floor	64	65,1	63,6	-1,5
41	2nd floor	63,2	64,3	62,9	-1,4
41	3rd floor	62,4	63,4	62	-1,4
43	Ground floor	63,6	64,8	63,2	-1,6
43	1st floor	63,2	64,4	62,8	-1,6
43	2nd floor	62,5	63,6	62	-1,6
43	3rd floor	61,7	62,8	61,3	-1,5
43	4th floor	60,9	62,1	60,5	-1,6
47	Ground floor	64,3	65,1	64,1	-1
47	2nd floor	63,3	64,1	63,1	-1
47	3rd floor	62,5	63,4	62,3	-1,1
47	4th floor	61,8	62,7	61,6	-1,1
50	Ground floor	66,3	67,2	66,2	-1
50	1st floor	65,5	66,3	65,3	-1
50	2nd floor	64,3	65,1	64,1	-1
50	3rd floor	63,2	64	63	-1
50	4th floor	62,3	63,2	62,1	-1,1
52	Ground floor	64,6	65,8	64,4	-1,4
52	2nd floor	62,4	63,4	62,1	-1,3

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
52	1st floor	64,4	65,5	64,1	-1,4
52	2nd floor	63,7	64,8	63,5	-1,3
52	3rd floor	63	64,1	62,7	-1,4
52	5th floor	61,8	62,8	61,5	-1,3
53	Ground floor	65,5	66,7	65,3	-1,4
53	1st floor	65	66,1	64,7	-1,4
53	2nd floor	64,1	65,2	63,8	-1,4
53	3rd floor	63,2	64,3	62,9	-1,4
53	4th floor	62,4	63,5	62,1	-1,4
56	Ground floor	65	66	64,9	-1,1
56	1st floor	64,8	65,7	64,7	-1
56	2nd floor	64,1	65	64	-1
56	3rd floor	63,3	64,3	63,2	-1,1
56	4th floor	62,7	63,6	62,6	-1
57	Ground floor	66,4	67,3	66,3	-1
57	1st floor	65,9	66,8	65,8	-1
57	2nd floor	64,9	65,8	64,8	-1
57	3rd floor	64	64,9	63,9	-1
59	Ground floor	66,3	67,2	66,7	-0,5
59	1st floor	65,5	66,4	65,9	-0,5
59	2nd floor	64,4	65,2	64,8	-0,4
59	3rd floor	63,4	64,2	63,8	-0,4
60	Ground floor	64,8	65,7	65,3	-0,4
60	1st floor	64,5	65,4	64,9	-0,5
60	2nd floor	63,8	64,6	64,2	-0,4
60	3rd floor	63	63,9	63,4	-0,5
63	Ground floor	65,3	66,4	64,8	-1,6
63	1st floor	65	66,1	64,5	-1,6
63	2nd floor	64,3	65,4	63,8	-1,6
63	3rd floor	63,7	64,7	63,1	-1,6
64	Ground floor	65,5	66,6	65	-1,6
64	1st floor	65,2	66,3	64,7	-1,6
64	2nd floor	64,5	65,6	64,1	-1,5

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-inci-dent	Laeq 24h Borgar-lina	0-incident/Bor-garlina
64	3rd floor	63,9	64,9	63,4	-1,5
67	Ground floor	66,4	67,1	64,6	-2,5
67	1st floor	65,8	66,5	64	-2,5
68	Ground floor	65,9	66,6	64,2	-2,4
68	1st floor	65,5	66,2	63,8	-2,4
68	2nd floor	64,7	65,4	63	-2,4
70	Ground floor	63,4	63,5	63	-0,5
70	1st floor	63,5	63,5	63	-0,5
70	2nd floor	63,2	63,2	62,7	-0,5
71	Ground floor	59,5	59,9	59,3	-0,6
71	1st floor	60,6	61	60,4	-0,6
71	2nd floor	60,7	61,2	60,6	-0,6
72	Ground floor	61	62,5	60	-2,5
72	1st floor	61,4	62,9	60,3	-2,6
72	2nd floor	61,3	62,7	60,2	-2,5
72	3rd floor	61,2	62,5	60	-2,5
73	Ground floor	63,3	65,6	62	-3,6
73	1st floor	63,3	65,5	62	-3,5
73	2nd floor	62,7	65	61,4	-3,6
73	3rd floor	62	64,3	60,7	-3,6
73	4th floor	61,4	63,7	60,1	-3,6
74	Ground floor	64,7	67	63,5	-3,5
74	1st floor	64,2	66,5	63	-3,5
74	2nd floor	63,3	65,6	62	-3,6
74	3rd floor	62,4	64,7	61,1	-3,6
74	4th floor	61,7	63,9	60,4	-3,5
75	Ground floor	62,9	65,4	61,5	-3,9
75	1st floor	62,9	65,4	61,5	-3,9
75	2nd floor	62,5	64,9	61	-3,9
75	3rd floor	61,9	64,3	60,4	-3,9
75	4th floor	61,3	63,7	59,8	-3,9

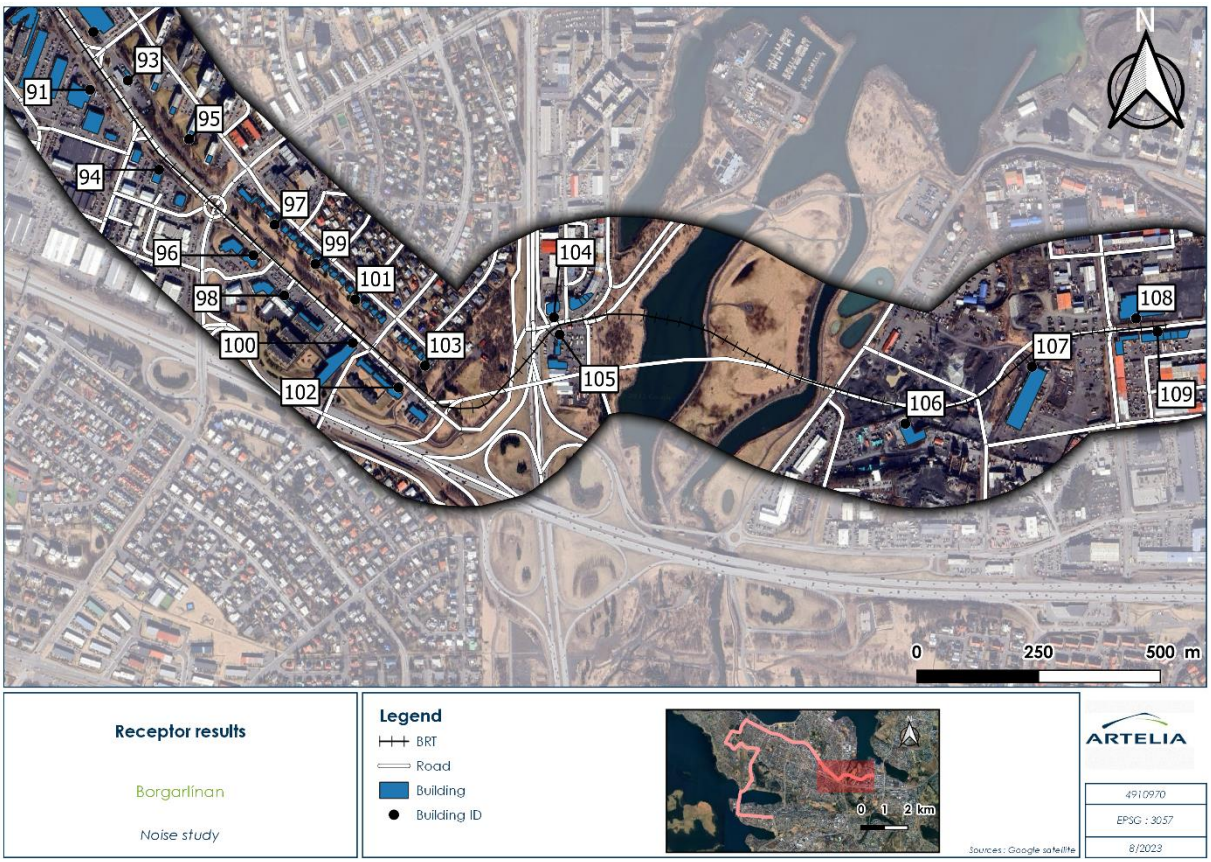
ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
75	5th floor	60,7	63,1	59,2	-3,9
75	6th floor	60,6	62,7	59	-3,7
76	Ground floor	65,7	68,1	64,2	-3,9
76	1st floor	65,1	67,5	63,5	-4
76	2nd floor	64,2	66,5	62,5	-4
76	3rd floor	63,3	65,6	61,7	-3,9
76	4th floor	62,6	64,9	60,9	-4
77	Ground floor	67,8	68,2	63,5	-4,7
77	1st floor	67,7	68,1	63,3	-4,8
77	4th floor	67,6	67,9	63,5	-4,4
77	5th floor	67,4	67,8	63,3	-4,5
77	6th floor	67,2	67,6	63,1	-4,5
78	Ground floor	62	62,5	56,7	-5,8
78	1st floor	63	63,4	58,5	-4,9
78	2nd floor	63,3	63,7	59,2	-4,5
78	3rd floor	63,5	63,9	59,5	-4,4
78	4th floor	63,5	63,9	59,5	-4,4
79	Ground floor	65,1	65,9	61	-4,9
80	Ground floor	64,8	65,7	60	-5,7
80	1st floor	65,4	66,2	61,2	-5
80	3rd floor	65,2	66,1	61,2	-4,9
80	4th floor	65,1	65,9	61	-4,9
82	Ground floor	65,2	65,6	60,3	-5,3
82	1st floor	65,9	66,3	61,5	-4,8
82	2nd floor	66,1	66,4	61,9	-4,5
82	3rd floor	66,1	66,5	62,1	-4,4
82	4th floor	66,1	66,5	62,1	-4,4
82	5th floor	66	66,4	62,1	-4,3

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-inci-dent	Laeq 24h Borgar-lina	0-incident/Bor-garlina
79	Ground floor	65,1	65,9	61	-4,9
80	Ground floor	64,8	65,7	60	-5,7
80	1st floor	65,4	66,2	61,2	-5
80	3rd floor	65,2	66,1	61,2	-4,9
80	4th floor	65,1	65,9	61	-4,9
81	Ground floor	65	65,4	60,3	-5,1
81	1st floor	65,6	65,9	61,3	-4,6
81	2nd floor	65,6	65,9	61,4	-4,5
81	3rd floor	65,5	65,8	61,4	-4,4
81	4th floor	65,4	65,7	61,3	-4,4
81	5th floor	65,2	65,6	61,2	-4,4
81	6th floor	65	65,4	61,1	-4,3
82	Ground floor	65,2	65,6	60,3	-5,3

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
82	1st floor	65,9	66,3	61,5	-4,8
82	2nd floor	66,1	66,4	61,9	-4,5
82	3rd floor	66,1	66,5	62,1	-4,4
82	4th floor	66,1	66,5	62,1	-4,4
82	5th floor	66	66,4	62,1	-4,3
83	Ground floor	65,5	66	62	-4
83	1st floor	66,1	66,6	63,2	-3,4
83	2nd floor	66,2	66,7	63,4	-3,3
83	3rd floor	66,1	66,7	63,5	-3,2
83	4th floor	66	66,6	63,5	-3,1
83	5th floor	65,8	66,4	63,3	-3,1
83	6th floor	65,7	66,2	63,2	-3
84	Ground floor	63,4	64,1	60,2	-3,9
84	2nd floor	63,3	64,1	60,2	-3,9
84	4th floor	63,4	64,1	60,3	-3,8
84	5th floor	63,3	64	60,3	-3,7
84	6th floor	63,3	64	60,3	-3,7
84	7th floor	63,2	63,9	60,3	-3,6
85	Ground floor	64	64,1	60	-4,1
85	1st floor	64,9	65	61,3	-3,7
85	2nd floor	65	65,1	61,4	-3,7
85	3rd floor	65	65	61,4	-3,6
85	4th floor	64,9	64,9	61,3	-3,6
85	5th floor	64,8	64,7	61,2	-3,5
86	Ground floor	63,8	63,7	58,7	-5
86	1st floor	64,7	64,7	61	-3,7
86	2nd floor	64,8	64,7	61,3	-3,4
86	3rd floor	64,7	64,6	61,2	-3,4
86	4th floor	64,6	64,5	61,1	-3,4
86	5th floor	64,4	64,3	61	-3,3
86	6th floor	64,3	64,2	60,8	-3,4
86	7th floor	64,1	64	60,7	-3,3
86	8th floor	63,9	63,8	60,5	-3,3
86	9th floor	63,7	63,6	60,3	-3,3

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
87	Ground floor	61,1	61	57,7	-3,3
87	1st floor	60,2	60,2	55,9	-4,3
87	2nd floor	60,8	60,8	57,1	-3,7
87	3rd floor	61	60,9	57,6	-3,3
87	5th floor	61,1	61	57,8	-3,2
88	Ground floor	64,2	64,8	61,3	-3,5
88	1st floor	64,8	65,4	62,3	-3,1
88	2nd floor	64,7	65,3	62,2	-3,1
88	3rd floor	64,6	65,1	62	-3,1
88	4th floor	64,4	64,9	61,7	-3,2
88	5th floor	64,2	64,7	61,5	-3,2
88	6th floor	64	64,5	61,3	-3,2
88	7th floor	63,8	64,3	61	-3,3
88	8th floor	63,6	64	60,8	-3,2
88	9th floor	63,4	63,8	60,6	-3,2
89	Ground floor	64,5	64,4	61,2	-3,2
89	1st floor	64,5	64,4	61,1	-3,3
89	4th floor	64,3	64,2	61	-3,2
90	Ground floor	64	63,4	60,9	-2,5
90	1st floor	64,6	63,9	61,5	-2,4
90	2nd floor	64,6	63,9	61,5	-2,4
90	3rd floor	64,6	63,9	61,5	-2,4
90	4th floor	64,5	63,8	61,4	-2,4
90	5th floor	64,3	63,7	61,3	-2,4
90	6th floor	64,2	63,5	61,1	-2,4
90	7th floor	64	63,4	61	-2,4
91	Ground floor	62	61,6	57,3	-4,3
91	1st floor	62,8	62,5	58,6	-3,9
91	2nd floor	63	62,6	58,9	-3,7
91	3rd floor	63	62,6	58,9	-3,7
91	4th floor	62,9	62,6	58,9	-3,7
91	5th floor	62,9	62,5	58,9	-3,6

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
91	6th floor	62,8	62,5	58,8	-3,7
91	7th floor	62,7	62,4	58,7	-3,7
92	Ground floor	64,1	63,5	59,8	-3,7
92	1st floor	64,9	64,3	60,7	-3,6
92	2nd floor	64,9	64,2	60,7	-3,5
92	3rd floor	64,8	64,1	60,6	-3,5
92	4th floor	64,6	64	60,5	-3,5
92	5th floor	64,5	63,9	60,4	-3,5
92	6th floor	64,3	63,7	60,3	-3,4
92	7th floor	64,2	63,6	60,2	-3,4
93	Ground floor	63	62,9	58,3	-4,6
93	1st floor	63,8	63,8	60	-3,8
93	2nd floor	63,8	63,7	60	-3,7
93	3rd floor	63,7	63,6	60	-3,6
93	4th floor	63,6	63,5	59,9	-3,6
93	5th floor	63,4	63,4	59,7	-3,7
93	6th floor	63,3	63,2	59,6	-3,6
93	7th floor	63,1	63	59,4	-3,6



ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-inci-dent	Laeq 24h Borgar-lina	0-incident/Bor-garlina
91	Ground floor	62	61,6	57,3	-4,3
91	1st floor	62,8	62,5	58,6	-3,9
91	2nd floor	63	62,6	58,9	-3,7
91	3rd floor	63	62,6	58,9	-3,7
91	4th floor	62,9	62,6	58,9	-3,7
91	5th floor	62,9	62,5	58,9	-3,6
91	6th floor	62,8	62,5	58,8	-3,7
91	7th floor	62,7	62,4	58,7	-3,7
93	Ground floor	63	62,9	58,3	-4,6
93	1st floor	63,8	63,8	60	-3,8
93	2nd floor	63,8	63,7	60	-3,7
93	3rd floor	63,7	63,6	60	-3,6
93	4th floor	63,6	63,5	59,9	-3,6
93	5th floor	63,4	63,4	59,7	-3,7
93	6th floor	63,3	63,2	59,6	-3,6

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
93	7th floor	63,1	63	59,4	-3,6
94	Ground floor	63,3	64,1	59,6	-4,5
94	1st floor	63,8	64,6	61	-3,6
94	2nd floor	63,8	64,6	61	-3,6
94	3rd floor	63,7	64,5	61	-3,5
94	4th floor	63,5	64,3	60,9	-3,4
94	5th floor	63,3	64,1	60,7	-3,4
94	6th floor	63,1	63,9	60,5	-3,4
94	7th floor	62,9	63,6	60,3	-3,3
94	8th floor	62,7	63,4	60,1	-3,3
95	Ground floor	59,8	59,8	56,2	-3,6
95	1st floor	60,4	60,6	57,4	-3,2
95	2nd floor	61	61,3	58,5	-2,8
95	3rd floor	61,2	61,4	58,8	-2,6
95	4th floor	61,3	61,5	58,9	-2,6
95	5th floor	61,3	61,5	58,9	-2,6
95	6th floor	61,3	61,5	58,9	-2,6
95	7th floor	61,3	61,5	58,9	-2,6
95	8th floor	61,3	61,4	58,9	-2,5
96	Ground floor	57,5	56,1	59,3	3,2
96	1st floor	58,2	56,8	60,2	3,4
96	2nd floor	58,2	56,7	60,1	3,4
96	3rd floor	58,1	56,7	60	3,3
96	4th floor	57,9	56,6	59,8	3,2
96	5th floor	57,7	56,4	59,6	3,2
96	6th floor	57,5	56,3	59,3	3
96	7th floor	57,4	56,2	59,1	2,9
97	Ground floor	55,5	54,8	54,6	-0,2
97	1st floor	56,3	55,5	56,1	0,6
97	2nd floor	57	56,1	57,1	1
97	3rd floor	57,4	56,4	57,5	1,1
97	4th floor	57,6	56,6	57,6	1
97	5th floor	57,6	56,7	57,6	0,9
97	6th floor	57,7	56,7	57,6	0,9
97	7th floor	57,7	56,8	57,6	0,8
97	8th floor	57,7	56,8	57,6	0,8

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
98	Ground floor	52,8	51,7	54,2	2,5
98	1st floor	54,5	53	55,7	2,7
98	2nd floor	54,8	53,3	56	2,7
98	3rd floor	54,7	53,2	56	2,8
98	4th floor	54,6	53,2	55,9	2,7
98	5th floor	54,6	53,1	55,9	2,8
98	6th floor	54,5	53,1	55,8	2,7
99	Ground floor	53,4	52,8	53,6	0,8
99	1st floor	54,3	53,5	54,6	1,1
99	2nd floor	54,9	54	55,3	1,3
99	3rd floor	55	54,1	55,4	1,3
99	4th floor	55,1	54,2	55,5	1,3
99	5th floor	55,2	54,3	55,5	1,2
99	6th floor	55,3	54,5	55,5	1
99	7th floor	55,4	54,6	55,6	1
99	8th floor	55,5	54,7	55,6	0,9
100	Ground floor	55,7	55,1	58,9	3,8
101	Ground floor	56,3	56,6	56,9	0,3
101	1st floor	56,7	56,9	57,4	0,5
101	2nd floor	57,1	57,2	57,9	0,7
101	3rd floor	57,3	57,5	58,1	0,6
101	4th floor	57,5	57,7	58,3	0,6
101	5th floor	57,8	58	58,5	0,5
101	6th floor	58	58,2	58,7	0,5
101	7th floor	58,2	58,5	58,9	0,4
101	8th floor	58,4	58,7	59,1	0,4
102	Ground floor	55,1	55,3	58,8	3,5
102	1st floor	55,2	55,4	59,1	3,7
102	2nd floor	55,3	55,6	59,1	3,5
102	3rd floor	55,5	55,7	59	3,3
102	4th floor	55,6	55,9	59	3,1
102	5th floor	55,8	56,1	58,9	2,8
102	6th floor	56,2	56,5	59	2,5

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
103	Ground floor	60,7	61,4	61,5	0,1
103	1st floor	61	61,7	61,9	0,2
103	2nd floor	61,4	62	62,4	0,4
103	3rd floor	61,8	62,4	62,7	0,3
103	4th floor	62,1	62,8	63	0,2
103	5th floor	62,5	63,2	63,4	0,2
103	6th floor	62,7	63,4	63,6	0,2
104	Ground floor	65,2	64	64,6	0,6
104	1st floor	65,8	64,5	65,3	0,8
104	2nd floor	65,8	64,5	65,4	0,9
104	3rd floor	65,7	64,6	65,4	0,8
105	Ground floor	63,2	62,3	62,9	0,6
105	1st floor	64,1	62,9	63,6	0,7
105	2nd floor	64,3	63,2	63,9	0,7
106	Ground floor	53,3	54,8	56,6	1,8
106	1st floor	53,5	55,4	57,7	2,3
106	2nd floor	53,9	55,6	57,8	2,2
106	3rd floor	54,3	55,8	57,9	2,1
107	Ground floor	49	54,2	55,6	1,4
107	1st floor	49,2	56,4	57,9	1,5
107	2nd floor	49,5	56,8	58,3	1,5
107	3rd floor	49,8	56,9	58,3	1,4
107	4th floor	50,1	56,9	58,3	1,4
107	5th floor	50,4	56,9	58,2	1,3
108	Ground floor	59,4	57,9	59,2	1,3
108	1st floor	60,4	58,7	60,7	2
108	2nd floor	60,8	59,1	61,3	2,2
108	3rd floor	61	59,2	61,4	2,2
108	4th floor	60,9	59,2	61,4	2,2
108	5th floor	60,8	59,1	61,3	2,2
108	6th floor	60,7	59,1	61,1	2
108	7th floor	60,5	59	61	2
108	8th floor	60,4	58,9	60,9	2

ID	FLOOR	Laeq 24h Baseyear	Laeq 24h 0-incident	Laeq 24h Borgarlina	0-incident/Borgarlina
109	Ground floor	59,8	55,1	60,6	5,5
109	1st floor	59,8	55,3	60,6	5,3
109	2nd floor	59,6	55,5	60,5	5
109	3rd floor	59,3	55,6	60,2	4,6
109	4th floor	59	55,5	59,9	4,4
109	5th floor	58,6	55,4	59,5	4,1
109	6th floor	58,2	55,2	59,1	3,9
109	7th floor	57,9	55,1	58,8	3,7
109	8th floor	57,7	55	58,5	3,5
109	9th floor	57,4	54,9	58,3	3,4

8 Conclusion

The aim of the acoustic study is to determine the noise contribution tied to the development of the BRT, i.e the Borgarlínan (Lota 1) project.

In the study, base year noise levels range from 43.4 dB(A) to 67.8 dB(A), with 89% of receptors exceeding 55 dB(A) and 12% exceeding 65 dB(A). In the 0-incident scenario, levels vary from 43.5 dB(A) to 68.2 dB(A), with 89% exceeding 55 dB(A) and 20% exceeding 65 dB(A). In the Borgarlínan scenario, levels range from 50.6 dB(A) to 66.8 dB(A), with 95% exceeding 55 dB(A) and 3% exceeding 65 dB(A). Overall, 58% of receptors experience noise level reductions in the project scenario, while some buildings see an increase in noise due to traffic diversions or BRT system. Notably, Laugavegur, Suðurlandsbraut, and Hverfisgata witness reduced noise levels for most of their buildings.