

Hringrás, Álhella 1 – Noise study

MEMO

PROJECT NO.:	21334-001	DATE.:	2022-08-31
PROJECT PHASE:		NO.:	1
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DISTRIBUTION:	Hringrás Team		

Subject: Noise Control – Metal shredder / recycling system

1 Background

The objective is to illustrate the impact of the noise emission from a metal shredder and other related equipment. Also, to display ways to mitigate, if necessary, its negative effect on the property of the neighbouring business.

Nine sources have been defined, of which a metal shredder is the primal source and the others being: Shredder Motor, Cascade Fan, Cascade, Cascade Cyclone, Infeed, Cascade Baghouse, Ferrous Stock and Drum Magnet.¹ The aural signatures or sound pressure levels are measured at a given distance from the respective sources.²

An area of 4.500 m² is reserved for the shredder and its related equipment in the SW part of the property, covering less than 10% of its total area.

The noise source exact point of origin, on each device is not given, i.e., location and/or facade. The noise level stated, is given at a certain distance from the source (sound pressure level) as opposed to sound power level at the actual source which is better suited for calculations. The sound power level at the origin needs to be established by calculation to be able to model and simulate the impact of the noise from the shredder onto the surrounding environment.

2 Analysis and Mitigation

Computer programs are commonly used to model how sound waves are distributed from its source. SoundPLAN,³ a widely used program to forecast traffic and industrial noise, was used to make these calculations and graphical presentations. The program also includes a library with considerable amount of sound sources for various equipment. It also offers the user to add sound source measurements of machines or other equipment while under working conditions.

The sound or the noise is displayed with two kinds of parameters, sound power level and sound pressure level. The sound pressure level is dependent on the distance from the sound source, as opposed to the sound power level, which is independent of the distance, and is a measure of the sound power emitted by the source. Therefore, the sound power level is a parameter that must be known to be able to calculate the distribution of the sound pressure level. The relationship between sound power level and sound pressure level can be described with the following equation:

$$L_w = L_p + \left| 10 \cdot \log \frac{Q}{4 \cdot \pi \cdot r^2} \right|,$$

¹ Danieli drawings for similar shredder plants, DPC401-GB31-W1000-BD003 and DPC401-GB31-W1000-BD003.

² Information from Danieli, email and attached document "Noise Survey DCR 1827 – Reference.pdf", received 2022-06-03.

³ Further information about the applications – <https://www.soundplan.eu/en/>



where L_w is the sound power level, L_p is the sound pressure level, Q is the directivity factor and r [in m] is the distance⁴ from the source.

In the case of the metal shredder, $L_p = 95,5$ dB(A), Q is equal to 1 when a sound source radiates somewhat high above a surface (spherical sound propagation)⁵ and $r = 2$ m which results in $L_w = 95,5 + 17,0 = 112,5$ dB(A).

To utilise a frequency spectral data as a load for the noise calculations, the form of a similar metal shredder frequency spectrum was used.⁶ The spectrum was altered in such a way that it would sum up to the correct sound power level of 112,5 dB(A), see Table 2.

Table 1 Spectral Data, Metal Shredder, Sound Power Level (SWL).

No.		Sum	31Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
2	dB(A)	112,5	63,0	85,0	96,0	103,0	105,0	107,0	107,0	103,0

Due to lack of information regarding the frequency spectrums of the other equipment and given their lower sound pressure, their sound power levels are calculated as a sum value only.

The Directive factor Q is equal to 2 when noise source radiates from or is relatively close to a flat surface (hemispherical sound propagation).

Table 2 Noise sources, calculated Sound Power Level (SWL).

No.		SWL	SPL ⁷	Q	r	Notes
1	dB(A)	110,3	93,3	1	2 m	Shredder Motor (rel. height 5,8 m, thus Q=1)
2	dB(A)	112,5	95,5	1	2 m	Shredder (rel. height 5,8 m, thus Q=1)
3	dB(A)	109,2	95,2	2	2 m	Cascade Fan (rel. height 1,9 m, thus Q=2)
4	dB(A)	106,9	89,9	1	2 m	Cascade (rel. height 12,4 m, thus Q=1)
5	dB(A)	105,6	88,6	1	2 m	Cascade Cyclone (rel. height 12,3 m, thus Q=1)
6	dB(A)	100,4	86,4	2	2 m	Infeed (rel. height 1,0 m, thus Q=2)
7	dB(A)	102,0	85,0	1	2 m	Cascade Baghouse (rel. height 4,0 m, thus Q=1)
8	dB(A)	103,0	86,0	1	2 m	Ferrous Stock (rel. height 5,0 m, thus Q=1)
9	dB(A)	107,8	90,8	1	2 m	Drum Magnet (rel. height 3,0 m, thus Q=1)

A surface model was generated in SoundPLAN with the sites at Álhella 1 and 3 set at level planes, 15.5⁸ m (above sea level). Surface absorption factor was set at $\alpha = 0$ for asphalt or similar surfaces (full reflection effect).

The location of the numbered noise sources can be seen on attached maps 1 and 2 and relative elevation on maps 5 and 6.

⁴ Normal measurement distance selected between sound source and receiver is 1 m, due to safety reasons the receiver was stationed 2 m from the source. The difference is corrected in the equation by setting $r = 2$.

⁵ "Compare Sound power, Sound pressure,." <http://www.sengpielaudio.com/calculator-soundpower.htm>

⁶ "Noise Control for a Metal Shredder and Recycling System". <http://www.sandv.com/downloads/1208saxe.pdf>

⁷ Sound Pressure Level = SPL

⁸ Value for Álhella 3 roughly deduced from ground floor elevation in regional building committee drawing 105, plot plan, dated 2011-10-12.



Calculation Scenarios:

1. No mitigation measures (no wall). (Maps 1, 3 and 5)
2. With a wall as a mitigation measure. (Maps 2, 4 and 6). Wall height spanning from 1,80 m to 6,55 m, covering the whole southwest boundary of the property.

The proposed wall shall be made of a material not weighing less than 20 kg/m² and must be fully airtight. The surface area of each side of the wall is ~ 870 m² with a varying height along its length (going from north to south):

- Part 1: Length = 89,1 m and height = 1,80 m
- Part 2: Length = 25,4 m and height = 5,50 m
- Part 3: Length = 49,8 m and height = 6,55 m
- Part 4: Length = 31,3 m and height = 5,50 m
- Part 5: Length = 38,1 m and height = 1,80 m

Total length of the wall summing up to 233,7 m.

The attached noise level display maps of plan/cross-section/birds-view results from both calculation scenarios.

3 Criteria

The Icelandic criteria regarding sound levels from noisy workplaces are defined in the Icelandic Noise Regulation No. 724/2008, see Table 3. The maximum values for A-weighted sound levels, $L_{p,Aeq,T}$, are identical for day, evening and night.

Table 3 Maximum values for A-weighted sound levels $L_{p,Aeq,T}$ from industrial activities.

Type of dwelling	Limits for noise from workplaces						
	$L_{Aeq(07-19)}$		$L_{Aeq(19-23)}$		$L_{Aeq(23-07)}$		L_{AFmax} night
	At facade	Inside	At facade	Inside	At facade	Inside	Inside
Industrial sites and activity areas	70		70		70		

For industrial sites and activity areas, the limit is 70 dB(A) at the façade at all times, with no restriction regarding conditions indoors.

4 Conclusion

In the case of sound source 4 and 5, the emission was possible in either lower or higher elevation. To maximize the effect of total noise exposure the higher elevation was used.

Furthermore, in the local plan proposal it has been suggested, that the sound criteria should apply for the whole building plot of Álhella 3 instead of only the building façade as the noise regulation requires.

This precondition calls for a bigger mitigation solution, or a higher wall.

The wall described in section 2 above fully measures up to the requirements suggested in the local plan proposal and therefore also fulfils the Icelandic Noise Regulation No. 724/2008.

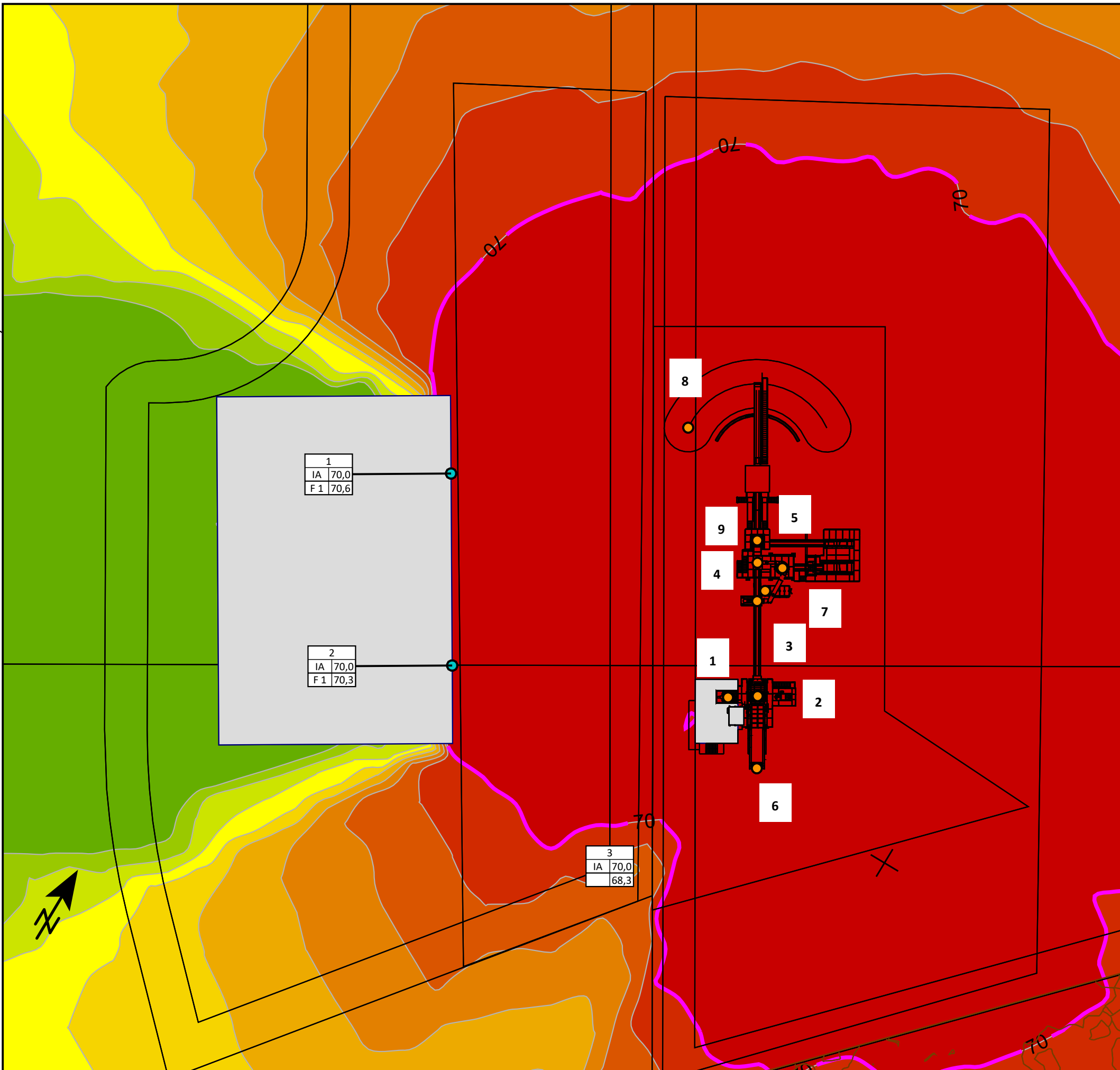
Customer: Hringrás
 Project: Álhella 1
 Project no. 21334-001

Map
1

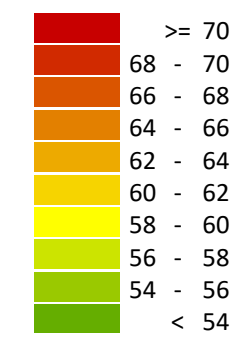
Noise Receiv. Pts - No wall, scenario #6
 Result number 131

Calculation in 2 m above ground

Project engineer: SvS/StGu/PG
 Created: 2022-06-24
 Processed with SoundPLAN 8.2, Update 2022-04-21



Levels Leq24
 in dB(A)



Signs and symbols

- Limit line [70 dB(A)]
- Point source
- Wall
- Point receiver

Length scale 1:750



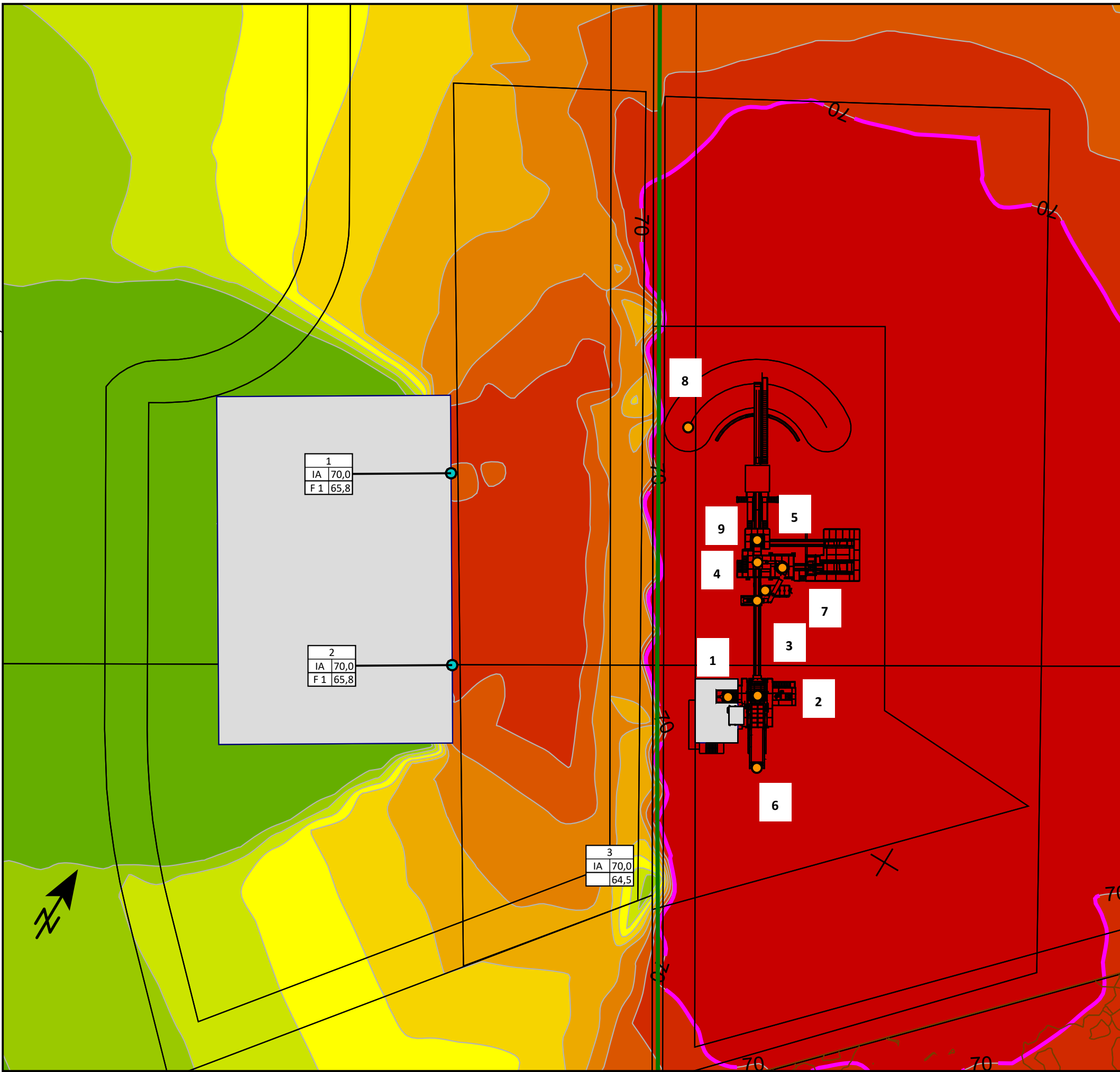
Customer: Hringrás
 Project: Álhella 1
 Project no. 21334-001

Map
2

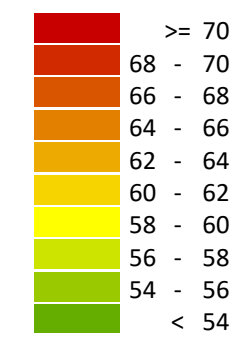
Noise Receiv. Pts - Wall h = 6,55 m, scenario #6
 Result number 132

Calculation in 2 m above ground

Project engineer: SvS/StGu/PG
 Created: 2022-06-24
 Processed with SoundPLAN 8.2, Update 2022-04-21



Levels Leq24
 in dB(A)



Signs and symbols

- Limit line [70 dB(A)]
- Point source
- Wall
- Point receiver

Length scale 1:750



Customer: Hringrás
Project: Álhella 1
Project no. 21334-001

Map

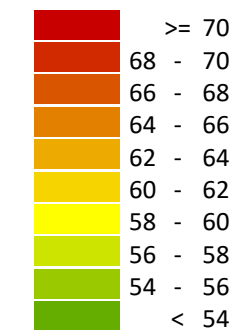
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Noise Cr.-Sec. Calc. - No wall, scenario #6
Result number 331

Project engineer: SvS/StGu/PG
Created: 2022-06-23
Processed with SoundPLAN 8.2, Update 2022-04-21



Levels Leq24
in dB(A)



Signs and symbols

- Limit line [70 dB(A)]
- Point source
- Wall
- Point receiver

Length scale 1:750



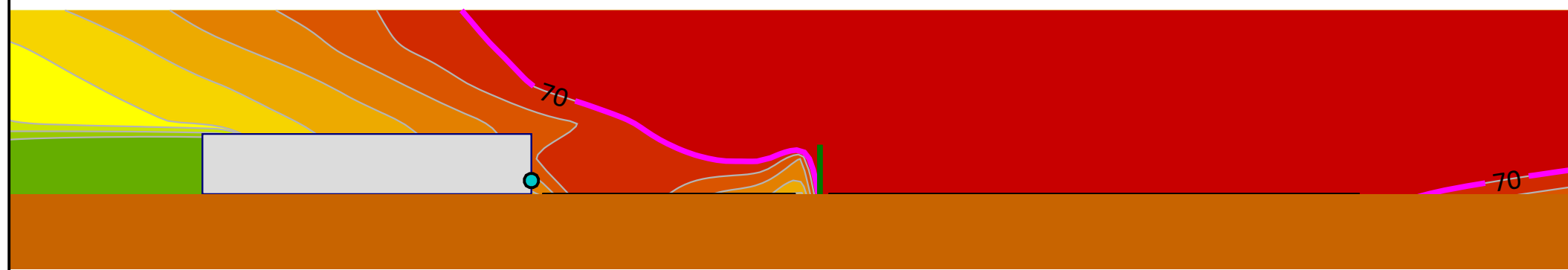
Customer: Hringrás
Project: Álhella 1
Project no. 21334-001

Map

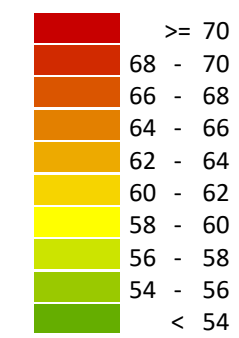
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Noise Cr.-Sec. Calc. - Wall h = 6,55 m, scenario #6
Result number 332

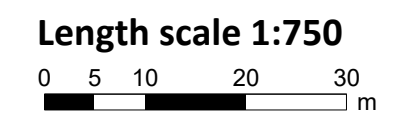
Project engineer: SvS/StGu/PG
Created: 2022-06-24
Processed with SoundPLAN 8.2, Update 2022-04-21



Levels Leq24
in dB(A)



- Signs and symbols
- Limit line [70 dB(A)]
 - Point source
 - Wall
 - Point receiver



Customer:Hringrás
Project: Álhella 1
Project no. 21334-001

Map

5

Noise Grid Calc. - No wall, scenario #6

Result number 231

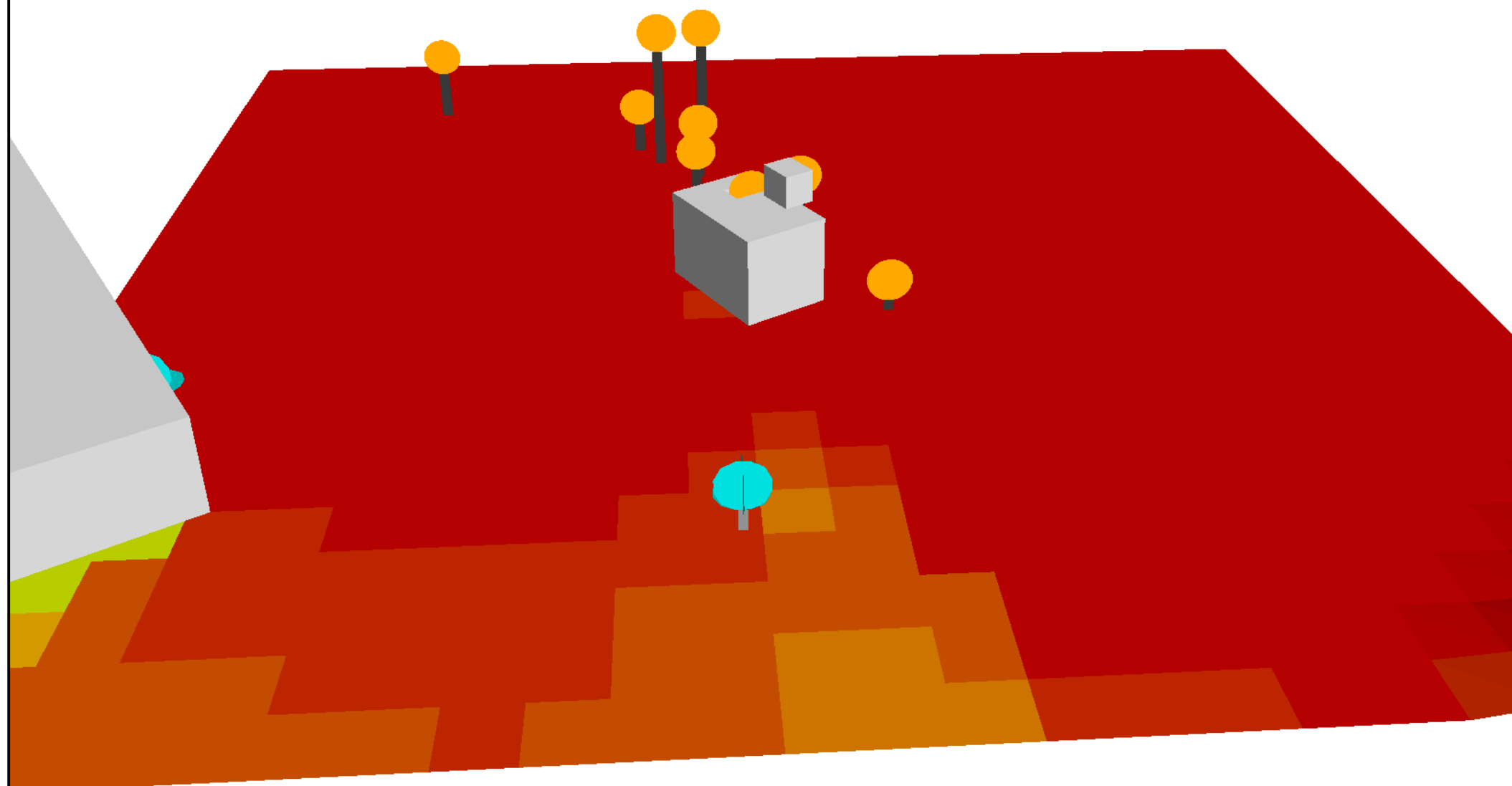
Birdsview

Calculation in 2 m above ground

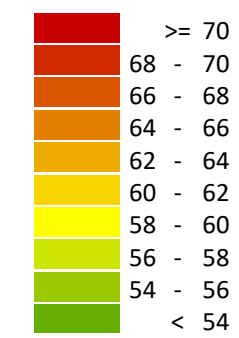
Project engineer: SvS/StGu/PG

Created: 2022-06-23

Processed with SoundPLAN 8.2, Update 2022-04-21



Levels Leq24
in dB(A)



Signs and symbols

- Limit line [70 dB(A)]
- Point source
- Wall
- Point receiver

Length scale 1:750



Customer: Hringrás
Project: Álhella 1
Project no. 21334-001

Map

6

Noise Receiv. Pts - Wall h = 6,55 m, scenario #6
Result number 132

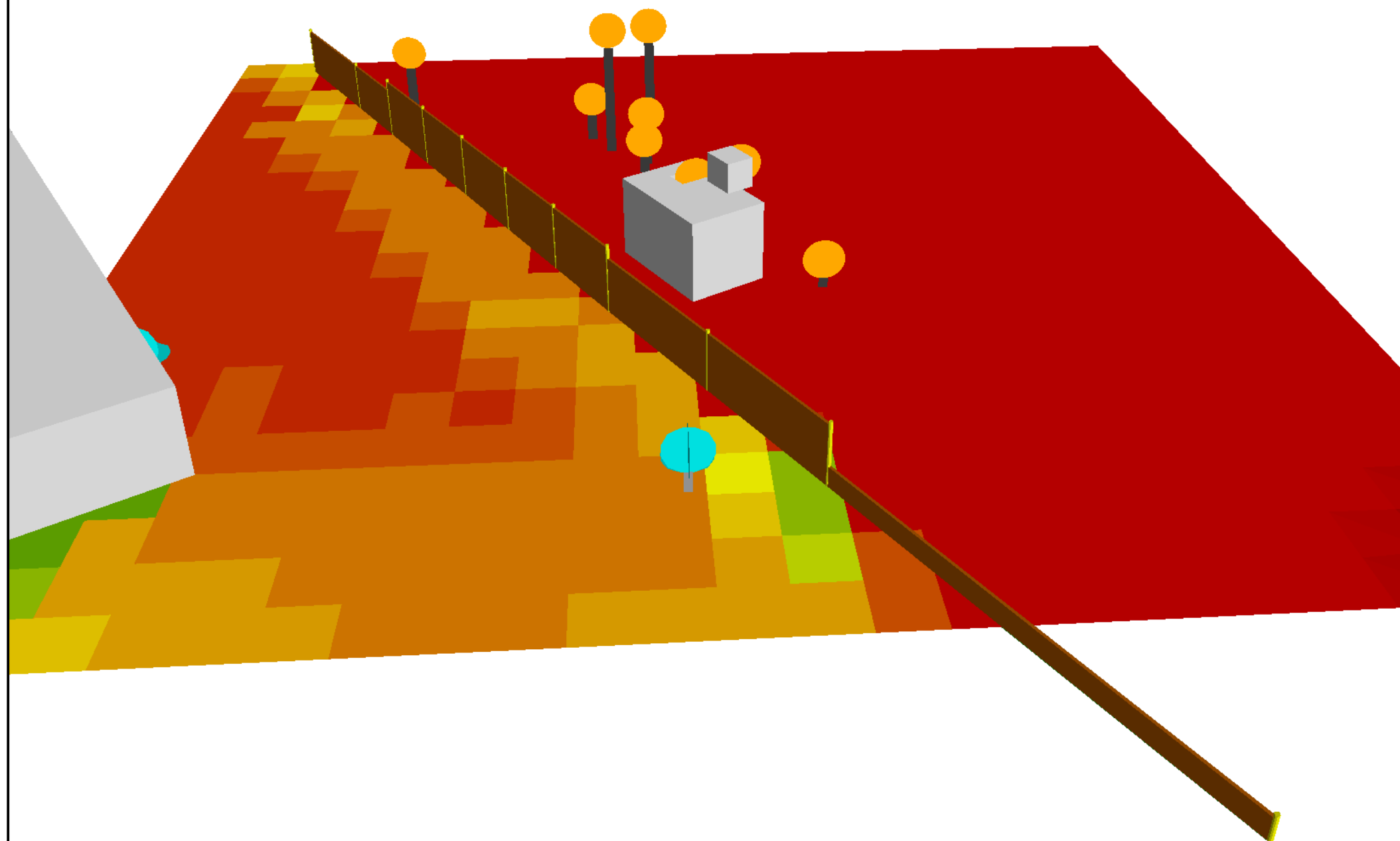
Birdsview

Calculation in 2 m above ground

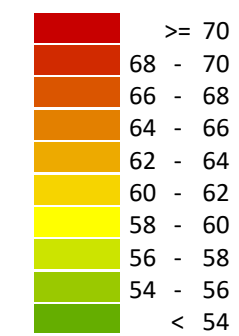
Project engineer: SvS/StGu/PG

Created: 2022-06-24

Processed with SoundPLAN 8.2, Update 2022-04-21



Levels Leq24
in dB(A)

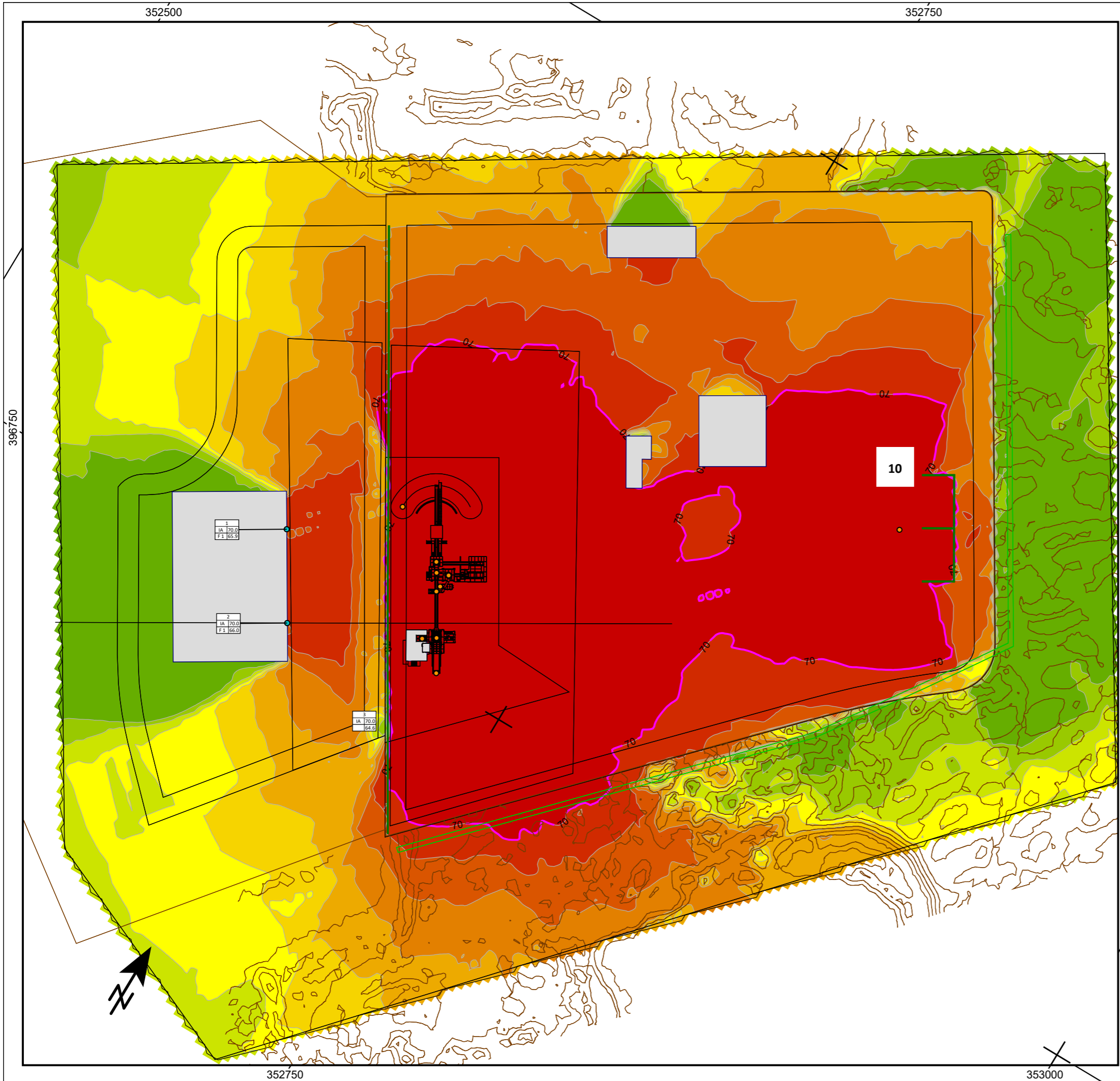


Signs and symbols

- Limit line [70 dB(A)]
- Point source
- Wall
- Point receiver

Length scale 1:750





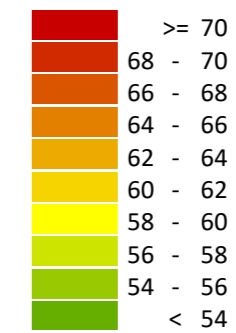
Customer: Hringrás
 Project: Álhella 1
 Project no. 21334-001

Map
7

Noise Grid Calc. sc.#6, w/ woodchipper(10)
Result number 241
 Calculation in 1.8 m above ground
 with 2.5 m berm (southeast and northeast of property)

Project engineer: SvS/StGu/PG
 Created: 2023-04-02
 Processed with SoundPLAN 8.2, Update 2023-03-31

Levels Leq24
 in dB(A)



Signs and symbols

- Limit line [70 dB(A)]
- Point source
- Wall
- Point receiver
- Area
- Main building
- Bodeneffekte
- Noise calculation area
- Cross section
- Level table

Length scale 1:1500

