M2
Strandlodsvej Portal Study
Phase 2: Design Development

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Revision summary

Version	Date	Scope of revision	Change description
1.0	15 June 2026	First Draft	N.A
1.1	14 July 2026	First issue	Layout fixes

1. Introduction

In 2025, MS were tasked by Borgerrepræsentationen with preparing a proposal for a planning allocation for covering the open metro trough between the Strandlodsvej portal located south of Lergravsparken Station, and Øresund Station on the M2 Metro line, as well as exploring alternative uses for a cover.

The result of this initial phase of work was that instead of a cover placed over the trough, a noise attenuation barrier solution was adopted. This report considers a number of barrier options, each bringing a distinct aspect to the table in terms of shape, coverage or extent.

Borgerrepræsentationen has made a budget reservation of DKK 2 million to cover MS's costs to prepare concepts.

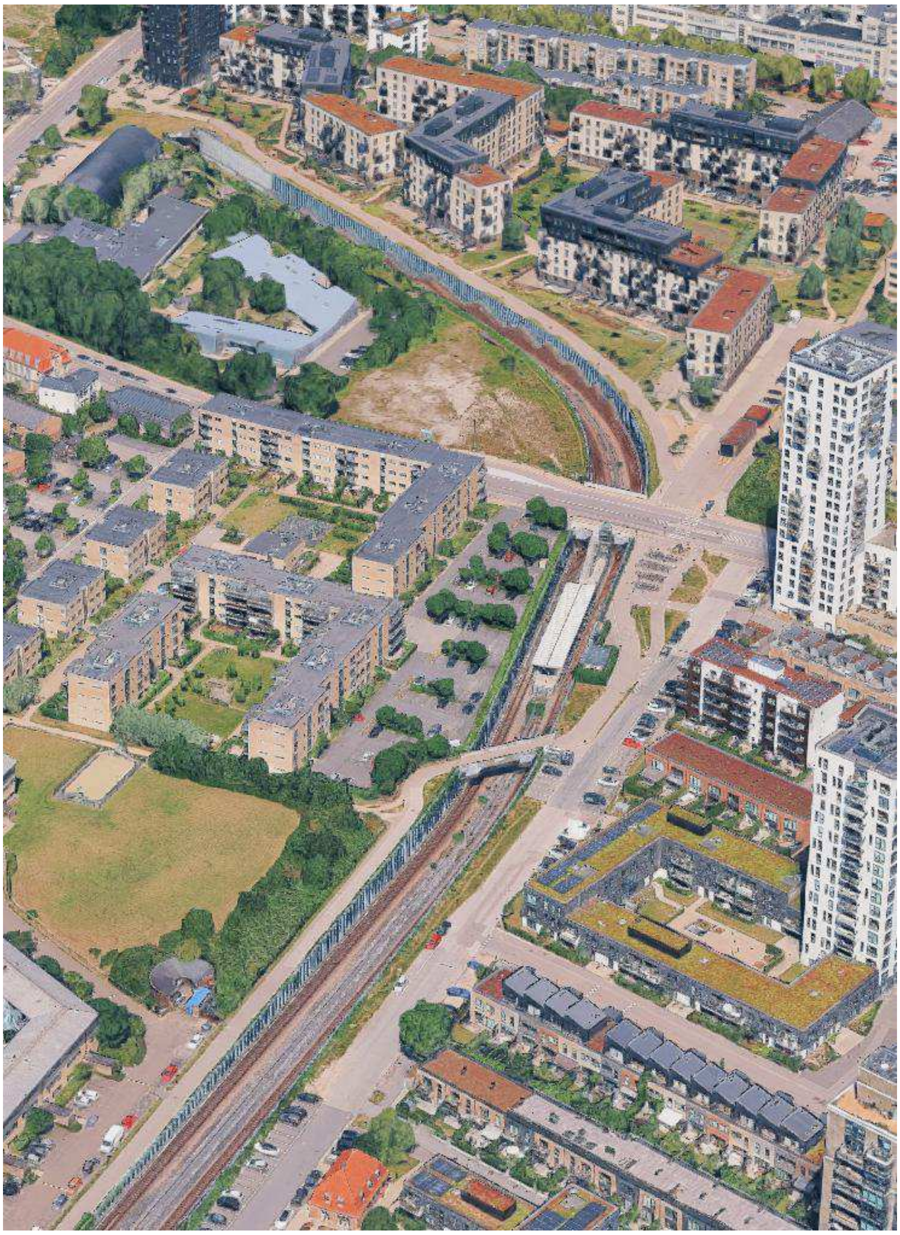


Figure 1: Strandlodsvej Portal and Øresund Station; Aerial View

1.1 Purpose

This report expands upon the Phase 1 Study and looks at the development of the barrier solution.

This report also considers the extension of the barrier system south of Øresund Station, parallel to Krimsvej as far south as the existing noise barrier structure is placed, where Krimsvej meets Tovelillevej.

1.2 Scope

The scope of this study is limited to proposed solutions between the Strandlodsvej tunnel portal and to the location approximately 500 m south of Øresund Metro Station, where the railway reaches ground level.

This report will:

- give an overview of the existing structure;
- offer a basis for design of noise mitigation measures based on a noise study
- consider several variations of noise barrier size, shape and arrangement for comparison.
- consider several material options for the barrier, which offer a range of benefits;
- present a cost and programme summary;
- present an evaluation of the proposed solutions, considering each of the items above;
- conclude on the most advantageous feasible solution; and
- offer a suggested way forward to deliver the chosen solution.

The solutions presented remain conceptual to assist in option selection. Concerns and caveats are covered in later sections of this report, which identify next steps to be taken on a preferred option.

1.3 Applicability

This report is location-specific, and any proposed solutions herein may not be applicable to any other location.

1.4 References

Code	Reference description
1	ØK58 Undersøgelse af overdækning af Amager Metroen

2. Existing Arrangement

2.1 Metroselskabet Assets

The existing trough structure is constructed from walls made of secant piles and steel sheet piles. Secant piles are used at the western end of the trough at the tunnel portal and are used for 39 m of the alignment. The remaining 225 m length portion of the trough are constructed from steel sheet piles. Both the sheet piles and the secant piles rely on ground anchors.

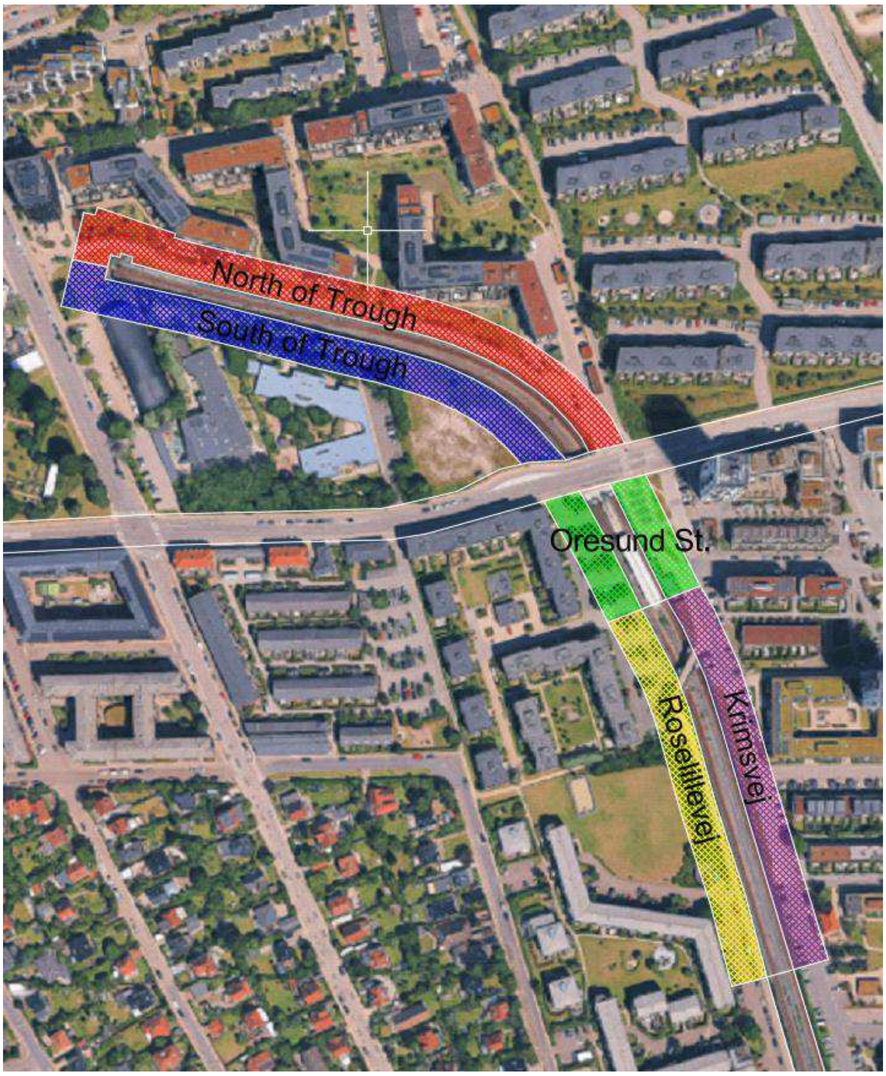


Figure 2: Strandlodsvej Portal Areas

Staircases are located on either side of the portal. The stairs on the north side of the track offer access to the walkway (Northbound), while the southern stairs are located separately from the trough and offer access to the adjacent technical room. Access to these facilities shall not be hindered by any new works.

Figure 3: Portal Staircases

The trough features twin rail tracks and includes a pair of crossovers in sequence. This track arrangement rules out any possibility of having columns placed in the trough. The track runs on ballasted sleepers throughout.

Figure 4: Crossover Location

The base slab of the trough is 600 mm thick, and its upper face sits 600 mm below the Top of Rail level. The trough system relies on both vertical ground anchors to tie down the base slab and raked ground anchors tying back the retaining wall and capping beam into the limestone bedrock.

The depth of the trough varies from approximately 9.5 m at the deepest point, rising to approximately 6 m at the Øresundsvej Bridge.

The inner rail radius is approximately 100 meters and is thus the sharpest curve above-ground outside of the CMCs, which makes the alignment unique.

Figure 5: Gradient section south of Øresund Station

Øresund Station is situated approximately 5 m below local surface level. The track through the station zone is level. The section of track immediately south of Øresund Station is at gradient, with the track near Tovelillevej situated at approximately local ground level.

Typically, between 500 and 550 trains pass through this section every day.

2.2 Adjacent buildings

North of the trough are three blocks of residential buildings built in 2017 varying from 5 to 7 floors, and a residential tower with 13 floors. The ground floor of the residential tower is activated with restaurants, while the three residential blocks have gardens and patios facing the trough on ground level. The gardens and patios are bordered by a 5 m wide green space followed by a bike- and pedestrian path. Nestled between the pedestrian path and the trough is a 3 m wide grassed margin.

The south side of the trough is characterised by a triangular plot, which is bordered by Strandlodsvej and Øresundsvej. Towards Strandlodsvej to the west is a covered badminton court with an associated parking space. Adjacent to the covered badminton court towards east are two institutions housing both kindergarten and nursery with associated parking. South of the institutions towards Øresundsvej is a greenbelt. Some of the institutions' recreational outdoor spaces are located to the north and are directly bordering the trough and its sheet piled walls, while there are also playground spaces between the buildings and to the South, nestled in the greenbelt. The separation between the institution boundary on the outside of the sheet piled wall is of the order of 2 m.

The easternmost part of the triangular plot is currently undeveloped and is bordered by Øresundsvej and the curved part of the Metro's alignment. The undeveloped area is included in detailed area plan no. 503 'Lergravsvej' which was passed in May 2014 and allowed the construction of a parking garage with an activated ground level with retail shops. However, as of February 2026 the owner has applied for a revised zoning plan, allowing them to develop the area for housing in 5–7 storeys, with a floor area ratio of up to 185, including a grocery store and smaller outward-facing functions on the ground floor. In the orientation note from KK, it is stated that in the continued work, it is important to pay attention to road traffic noise and railway noise, so that the homes comply with the Danish Environmental Protection Agency's indicative noise limits.

The area adjacent to Øresund Station and going south along the trough on Krimsvej and Roselillevej, where an extension of the noise barrier is being discussed, is populated by residential buildings on both sides. However, the properties are generally low rise, and at a distance from the trough. For large parts of the distance, parking spaces and a road are located in between the trough and residences. On the westside, a recreative area bordered by a mound that effectively constitutes a noise barrier is already placed adjacent to the railway from the point where Krimsvej meets Tovelillevej, coinciding with the location where the railway line is at surface level. See Figure 5, above.

3. Design Objectives

A number of high-level design requirements have been established to assist in the development of potential solutions.

This report will expand on the Phase 1 Study, and consider the selection of the best barrier type, in terms of

- Acoustic performance
- Appearance & local integration
- Durability & lifetime
- Cost and installation programme
- Maintenance

An updated cost and programme estimate has been prepared that includes

- construction cost
- any closure costs and programme, including lost revenue
- long term maintenance costs over 100 years
- Costs associated with expropriation

This report also extends the scope to cover secondary benefits of the barrier, to ensure urban fit within the local neighbourhood, including:

- Biodiversity
- Visual identity
- Perceived safety and lighting

The study will also consider how the proposal may offer some added value to the local community.

4. Noise Assessment

A desktop assessment of the noise levels that may be received by sensitive receptors, has been undertaken. The assessment is excerpted here in Appendix A and is also enclosed in the delivery to Økonomiforvaltningen as Annex 1.

The results predict noise levels in the area surrounding the trough using a standardised calculation method used at operational railways.

It should be noted that the software (Nord2000) used for the calculations assumes a well-maintained track and also does not assign noise penalties to curves or switches.

However, the calculation method is the approved method for determining the noise impact – and is also employed in the EU-regulated Noise Impact Assessment (Støjhandlingsplan) undertaken at 5-year intervals to assess noise levels from metro in operation.

The results are shown below in three manageable illustrations, shown as 3D noise-contour models, as follows.

1) Noise level audible at the nearest buildings on the vertical face
2) Noise level audible at 1.5m above ground levels.
3) Noise levels across a slice running perpendicular to the rail alignment – taken at a critical location.

Figure 6 below, shows (1) the noise that can theoretically be expected on the vertical faces of the three buildings most susceptible to noise.

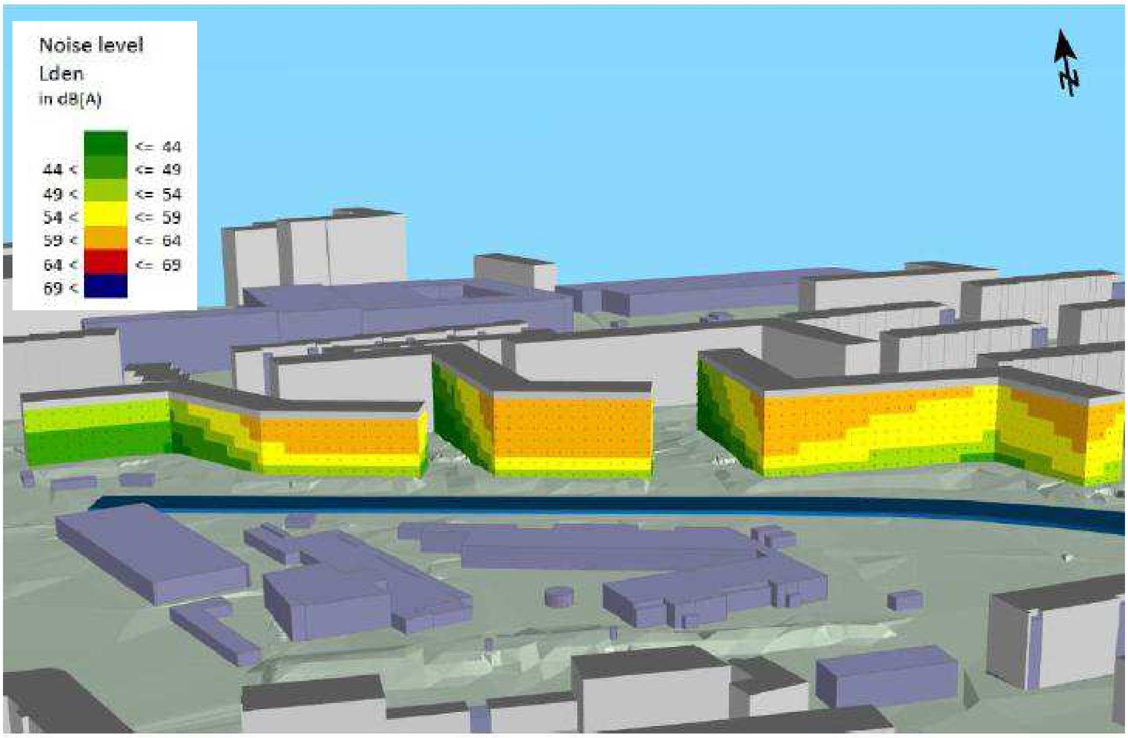


Figure 6: Noise level contours on south face elevation, north of the trough

These following observations can be drawn from Figure 6 :

- Based on theoretical calculations, none of the buildings to the north of the metro trough are expected to be subject to noise levels above 64 dB(A).

- Approximately 35% of the properties are expected to be subject to noise levels between 59 and 64 dB(A).

Figure 7 below, shows (2) the noise that can theoretically be expected at a height of 1.5 m from ground level.

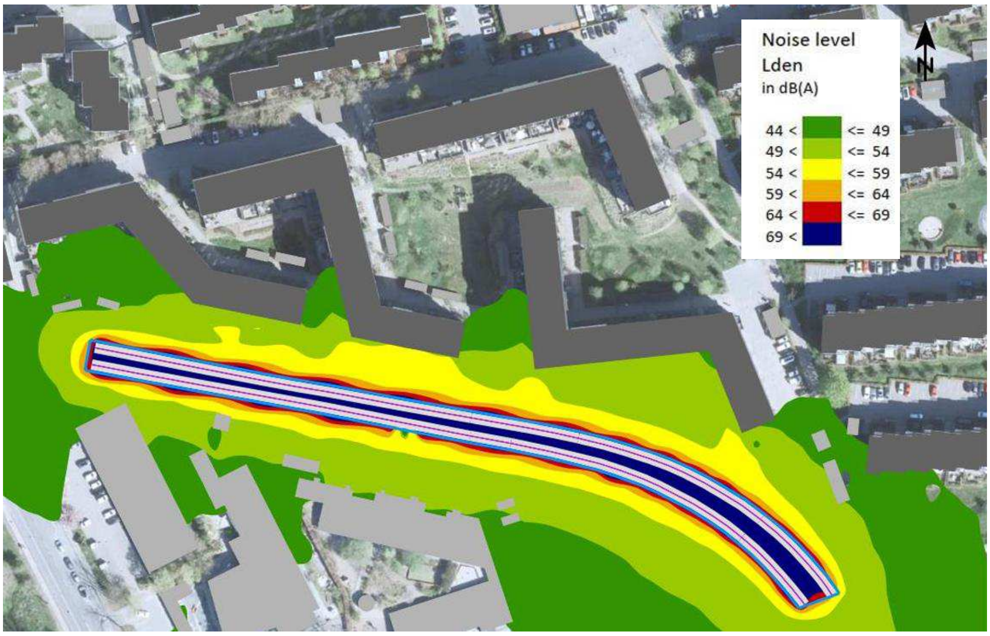


Figure 7: Noise level contours at 1.5 metres above ground level

The following observation can be drawn from Figure 7:

- Based on theoretical calculations, the volume of noise audible to pedestrians walking near the trough is typically below 59 dB, unless you lean up against the sheet piled wall.

Figure 8, below, shows (3) the noise that can theoretically be expected across a slice near where the nearest building to the trough is located.

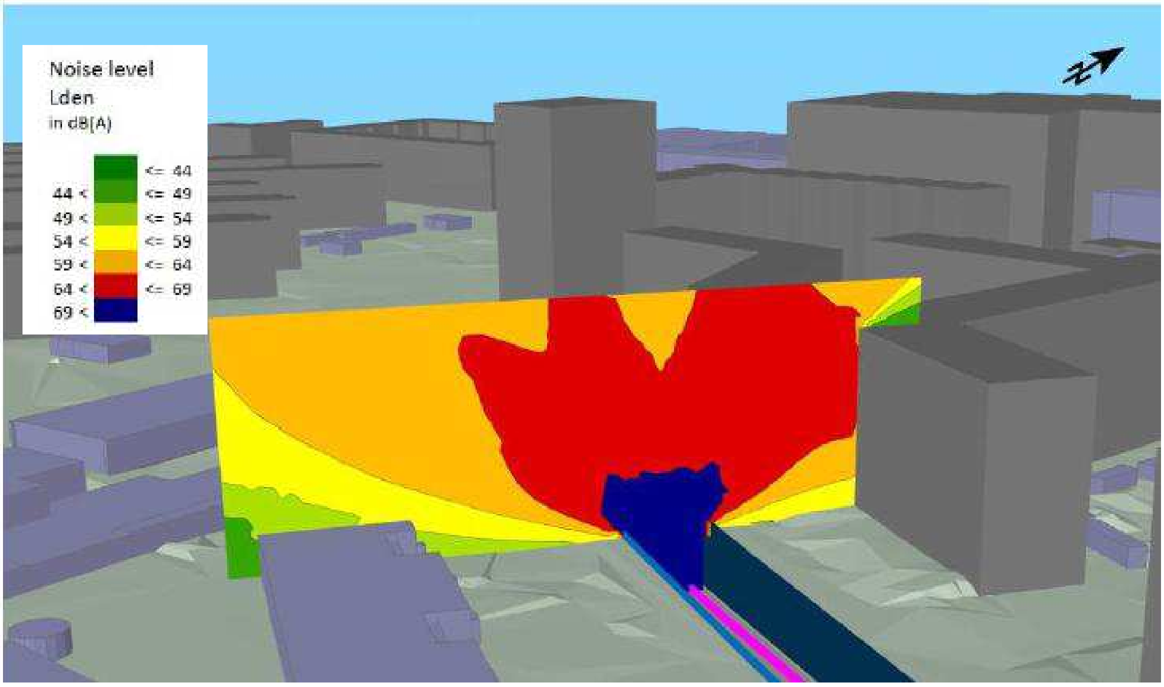


Figure 8: Noise level contours at slice near building corner

These following observations can be drawn from Figure 8:

- Based on theoretical calculations, the corner of the building is very close to being subjected to noise exceeding 64 dB(A).

- Building to the south of the trough are low rise, and generally not subject to noise above 54 dB(A).

In the future, Metroselskabet expects to be able to validate and potentially improve on the accuracy of the baseline noise values, however, the effect of modifying the trough area with a barrier system of one type or another can still be understood to reduce the baseline noise by a set amount, as it is expected that any revision to the baseline noise levels in the surrounding areas would be impacted linearly.

In light of this, Metroselskabet is planning to undertake some simple noise measurements to assist in validating the calculations, to understand better the effect of the proposed solutions.

It should be noted that noise levels will not be constant but will to some degree vary both between seasons and over time due to the maintenance schedule for tracks and vehicles over the year. This means that it cannot be excluded, that noise levels above the mentioned levels can periodically occur.

A target reduction value of 6 dB is proposed, as this value is considered to make a noticeable difference to sensitive receptors. This value is also considered to be achievable using current technology on the market.

5. Noise Reduction Options and Scenarios

The proposals have been established in four different themes:

- The General arrangement: The general geometry and placement of the barriers directly affect the level of noise reduction offered to receptors.

- The material choice: The specific noise-absorbing barrier panel material will offer a range of attributes, that will allow reasoned comparison evaluation. Typically, the solutions offer similar noise absorption, so can be assessed separately to the General Arrangement.

- Additional Measures: Several suggestions that are optional extras that may be of interest to the local community.

- The extent to which barriers are placed adjacent to the railway.

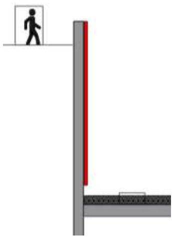
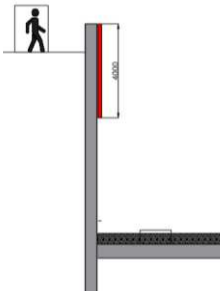
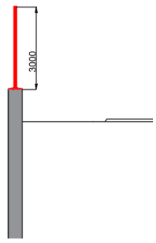
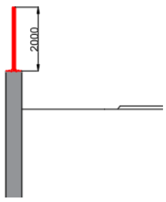
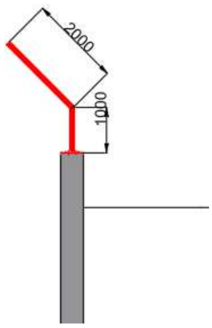
The options will be discussed further in this chapter.

5.1 Geometric Placement Option

We have developed five options as to how noise can be reduced in the zones under consideration, using variant solutions as to how the barrier and noise absorbing system may be arranged, to achieve a range of noise reduction in the local area. These options are illustrated and described in Table 1, below. These options have been developed into realistic scenarios that can offer logical and practical construction solutions that can be applied on site.

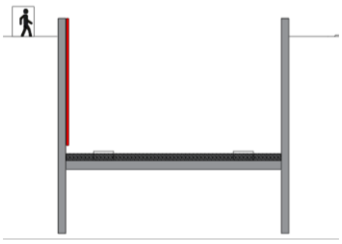
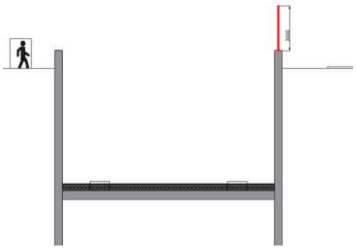
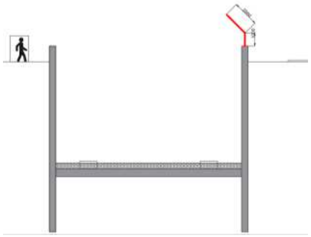
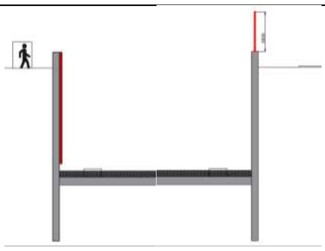
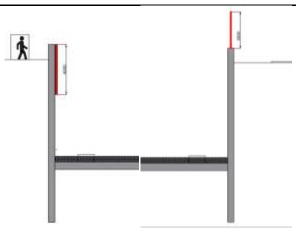
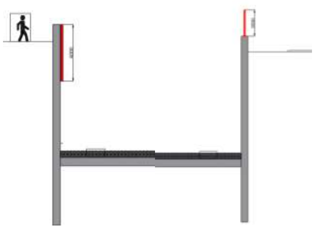
Each scenario offers its own unique functional benefits and disbenefits, which are highlighted in Table 2 below.

Table 1: Noise Reduction Option Components

Options	Cross-section
Option (A): Full height absorption panels on the inside of trough wall.	
Benefits: Sound reflected from the south wall is typically reflected to the north of the trough and absorbed which results in a significantly lower volume heard by local sensitive receptors.	
Issues: Installation requires access inside the trough, requiring single-track closure.	
Option (B): Half-height (4m) Absorption panel on inside of trough wall.	
Benefits: Sound reflected from the south wall is typically reflected to the north of the trough and absorbed which results in a significantly lower volume heard by local sensitive receptors. This option offers lower performance than Option (A).	
Issues: Installation requires access inside the trough, requiring single-track closure. This option offers lower impact on operations than Option (A).	
Option (C): 3m high barrier on the top of sheet piled wall, using H-beams bolted to outside of the sheet piles.	
Benefits: Sound is blocked from being received by the local receptors adjacent to the trough. Minimal work is required inside the trough.	
Issues: The high barrier design has a high visual impact to pedestrians using the footpath.	
Option (D): 2m high barrier on the top of sheet piled wall, using H-beams, bolted to outside of sheet piles	
Benefits: Sound is blocked from being received by the local receptors adjacent to the trough. Minimal work is required inside the trough. This option has reduced visual impact compared to Option (C).	
Issues: This option has lower acoustic performance compared to Option (C).	
Option (E): 1m+2m high ‘Hamburg‘ type barrier on the top of sheet piled wall, using H-beams, bolted to outside of sheet piles. The angle proposed is 45 degrees.	
Benefits: Acoustically, it has similar and perhaps better performance compared to Option (C). Visually this arrangement has the lowest impact from the perspective of pedestrians using the footpath.	
Issues: The overhang will increase the loading upon the sheet piles, however, this has been checked, and the impact is negligible.	

5.2 Geometric Placement Combinations

Table 2: Proposed Noise Reduction Scenarios

Scenario	Cross-section	Performance
Scenario 1: Option (A) applied only		Noise reduction in the order of **7–8 dB** can be achieved at floors 1–4 of the nearby properties. The upper floors generally experience a smaller noise reduction than the mid-level floors. At Strandlodsvej 67, the reduction at the upper floors is approximately **2–3 dB**.
Scenario 2 Option (C) applied only		Noise reduction in the order of **6–10 dB** can be achieved at floors 1–3 of the property at Strandlodsvej 67 (the central property). At the upper floors, the reduction is limited to approximately **3–4 dB**, and at ground-floor level to approximately **5 dB**.
Scenario 3 Option (E) applied only		Noise reduction in the order of **7– 10 dB** can be achieved at floors from ground level to the 4th floor of the property at Strandlodsvej 67 (the central property). At the uppermost floors, the reduction is limited to approximately **4–6 dB**
Scenario 4.1 Option (A) and Option (C) applied together		A noise reduction in the order of **7–10 dB** can be achieved at all floors of the residential buildings north of the railway cutting. North of the trough, in the area between the trough and the residential buildings, noise reductions of approximately **6–10 dB** are achieved. The difference between Option 4.1 and 4.2 is neglible.
Scenario 4.2 Option (B) and Option (C) applied together		
Scenario 5 Option (B) and Option (D) applied together.		Noise reduction in the order of **5–10 dB** can be achieved at all storeys of the residential building. North of the trough, in the area between the trough and the residential buildings noise reductions of approximately **6–10 dB** is achieved.

A detailed assessment is provided in Appendix A

6. Material Selection

Noise barriers are typically available in the form of framed panels with an infill material that is effective in absorbing the sound. We have researched a number of different materials available on the market and investigated likely candidate materials for this project. The sustainability attributes that are considered regarding the material as a resource are source location, reused or recycled, end-of-life handling, and durability. Carbon footprint is assessed in section 8.2.2.

6.1 Søuld – Eelgrass panels

Søuld's eelgrass panels are cradle-to-cradle gold certified and made from eelgrass collected in Denmark, sometimes even in Amager, and aligns with Metroselskabet's focus on offsite biodiversity and circular economy. The panels can be almost entirely directly reused at end of life. However, these acoustic panels are made for indoor environments and have only been tested in a single outdoor setting where acoustic performance was not the primary requirement. Its long-term resilience in outdoor conditions is less established than traditional materials, but maintenance solutions may be possible, where the long-term performance is retained, by replenishing the eelgrass insulation where shrinkage has occurred. The eelgrass material is shown in Figure 9, below.

Figure 9: Søuld's eelgrass material

6.2 Miljøskærm – Recycled wind turbine panels

Acoustic panels made from recycled fiberglass from wine turbine blades aligns with Metroselskabet's focus on circular economy and addresses a growing issue of end-of-life turbines, which can be harvested in Denmark. At end-of-life, the panels can be returned to be recycled. These acoustic barriers, as shown in *Figure 10* are designed for noise reduction in exterior environments. As the source material was originally engineered to withstand extreme weather, the panels are durable.

Figure 10: Miljøskærm's panels installed in residential area.

6.3 Noistop – Rockwool panels

Noistop, produced by Rockwool Group, is an acoustic panel made for exterior environments and commonly used along railways and motorways. The material is derived from volcanic rock, so it is a natural, abundant resource that is fully recyclable, naturally water resistant, and ideal for outdoor environments. The source of the raw material is unknown, and the processing occurs in Poland. The panels can be returned for recycling at end-of-life.

Figure 11: Rockwool's Noistop Panels

6.4 Transparent Panels

Transparent panels are made from acrylic and have the benefit of letting sunlight through the barrier. It is a virgin material of plastic origins and may be possible to recycle at end-of-life. The panels are tried and tested in motorway use and durable for exterior environments. Climbing plants would not be added to the transparent panels, as it would restrict daylight. This material is also the most attractive to graffiti artists, as the material is flat.

Figure 12: Acrylic-type noise reflecting panels

6.5 Add-on Items

Various additional add-on items that can be applied to the surface of noise barrier have been considered. These can be applied to any of the options relatively easily. These items have not been included in the cost estimation at this stage – as any costs are highly subjective to the specification of their inclusion.

6.5.1 Plants for urban nature

The additional space between the barrier and the footpath allows for plants and climbers to be planted. Compared to the current scenario, this would improve the amount of urban nature along the path. Climbing plants would have no negative effect on the panels but would slightly increase maintenance costs in the first 2 to 3 years and would require occasional clipping (every 10+ years).

6.5.2 Artificial Lighting

Lighting could be added to the panels in the form of fixtures, wayfinding, or art. This would increase light on the walking path when it is dark.

6.5.3 Art Installations

Using the barrier as art would make them multi-functional and give something back to the neighbours. The art could be curated and could potentially change over time. The panels could also be used as a linear museum, perhaps telling the history of Amagerbanen or the industrial history of the local area.

6.5.4 Decorative cladding

Many noise barrier manufacturers offer decorative timber cladding as part of the system. If a timber cladding was to be applied to the section between the portal and Øresundsvej, the additional cost of cladding is expected to be DKK 2 million, but will not impact the overall programme.

6.5.5 Collaboration with local schools or institutions

Should the panels be installed on the south side of the trough, in the backyard of the daycare, it may be beneficial to collaborate with the institution on a solution that is interesting and potentially, interactive for children.

7. Extent Selection

The choice of the extent of the system, should be based on which areas around the metro area are to be protected against possible noise.

Based on the desktop noise analysis undertaken, the current buildings south of the trough (daycare facilities) are not subject to particularly high noise levels.

The consideration to extend to the south of the trough is thus not considered relevant. However, cost and construction programme implications of selecting this option are presented in Chapter 9.3.

Figure 13:Possible Extent of Southwest Extension

The buildings south of Øresundsvej, to the east and west, adjacent to Krimsvej are supposedly not subject to the same noise levels as heard north of Øresundsvej. This is in part, due to the distance of the buildings from the railway, but also in part to the alignment being relatively straight through this section, which tends to develop a lower impact noise profile.

Where Krimsvej meets Tovelilevej, there are existing noise barriers in place on both sides of the railway.

Metroselskabet has not recorded receiving noise complaints in this zone.

Given the greater distance between the railway and the adjacent buildings, taking into consideration that they are low-rise, as well as the fact that MS has not had complaints in the area, it is at this point hard to justify an extension of the barrier to the south of Øresund Station.

The cost implications of the choice of extent are presented in Chapter 9.3.

Figure 14: Possible extent of Krimsvej Extension

8. Option Appraisal

8.1 Initial Assessment

An initial assessment is undertaken to ensure to ensure removal of any options that do not meet the most basic functional criteria. Choice of materials does not form part of this assessment.

8.1.1 Geometric Assessment

Based on the simple geometric performance comparison, some simple pairwise comparisons can be made. A target of 6 dB is applied.

- Scenario 1 offers the worst solution in terms of performance of all solutions and is the most expensive. It is therefore disregarded.
- Scenario 2 is a tried and tested system, that has been widely used throughout Denmark, while Scenario 3 is somewhat novel. As Scenario 3 offers an improvement over Scenario 2, both shall be retained for consideration.
- Scenarios 4.1 and 4.2 offer similar performance. 4.1 can be disregarded in favour of 4.2.
- Scenario 5 offers a poorer visual solution compared to Scenario 3 and 4.2, and a poorer acoustic solution, and is therefore disregarded.

Scenarios 2, 3 and 4.2 are considered further.

8.1.2 Rail Safety Assessment

A Rail Safety Assessment has been carried out by Metroselskabet as required by Jernbaneloven to evaluate whether the works foreseen by this study would require approval by Trafikstyrelsen. Such analysis, defined as Significant Evaluation according to Bekendtgørelse nr. 711 of 20/05/2020 has been performed by Metroselskabet Safety and Engineering personnel and is presented in the table below.

Table 3: Rail Safety Assessment Summary

CSM-RA requirement for significance evaluation BEK711	Analysis of criteria
Additionality *assessment of the significance of the change taking into account all recent safety-related changes to the system under assessment and which were not judged to be significant.*	There are now other projects in parallel in the location. Complexity is **LOW.**
Failure Consequence *credible worst-case scenario in the event of failure of the system under assessment, taking into account the existence of safety barriers outside the system under assessment.*	Most credible worst case is noise barriers falling onto track and train impact causing **DERAILMENT.**
Novelty used in implementing the change *this concerns both what is innovative in the railway sector, and what is new for the organisation implementing the change*	The technique for installing is very common. Designer and construction company are expected to have experience with such common structures. Novelty is **LOW.**
Complexity of the change	As per novelty, there are no new techniques requiring specialized contractors. We also plan to have one contractor only. The design and contractor have an interface. Complexity is **LOW.**
Monitoring *the inability to monitor the implemented change throughout the system life-cycle and intervene appropriately*	As structures are standard, **after construction** monitoring is not necessary beside normal visual inspection interval for CW structures **During construction** we expect to implement track possession so structures or equipment falling on track nothing happen. Monitoring is **MEDIUM.**
Reversibility *the inability to revert to the system before the change;*	If installation is challenging, we can just stop and remove noise barrier. Reversibility is **HIGH.**
Conclusion: At this stage, we can conclude that change is **NOT significant.**	

It is concluded that the change is not significant, and thus no railway approval by Trafikstyrelsen is required. Design and execution of works can therefore be managed in coordination with the metro operator.

Further steps would require detailed coordination and analysis of the execution of works, to be undertaken with contractor and operator, to identify detailed construction risk and planning of track possessions.

Scenario 2 or 3, neither of which require operative access inside of the trough, are deemed to be the best options in terms of rail safety during construction, and future inspection and maintenance

Scenario 4.2 is considered acceptable and although access is required for construction and long-term maintenance, the changes required to be made are considered feasible and manageable in terms of rail safety.

8.1.3 Structural Impact

A structural assessment has been undertaken, in order to evaluate the impact of the proposed noise mitigation systems on the existing anchored sheet pile retaining wall, located south of the Strandlodsvej Portal.

The analysis considered the five Option components as shown in Table 1. Following a preliminary qualitative review, the detailed analysis focused on the governing configurations represented by Option (A), Option (C), and Option (E).

The study considered the effects of additional permanent loading, saturated loading conditions, and wind actions in accordance with the relevant Eurocode requirements. The structural response of the retaining structure was evaluated through a combination of FEM analysis and simplified hand calculations.

The results indicate that the proposed barrier systems generate only limited increases in structural demand, when compared with the available capacity of the existing retaining structure.

The governing condition corresponds to Option (C), which was found to remain within acceptable utilisation limits for both the sheet pile wall and anchor system.

A local verification of the proposed H-beam support member and bolted connection for Option (C) was also undertaken. The assessment confirmed that the proposed HEB160 section and M20 grade 8.8 bolted connection provide adequate resistance against the governing bending, shear, and combined loading actions.

Based on the performed assessment, the proposed barrier arrangements are considered structurally acceptable from both a global retaining wall perspective and a local structural support perspective without requiring strengthening of the existing sheet pile wall or anchor system.

These conclusions are subject to a number of assumptions adopted within the assessment, and to the completion of detailed fabrication and installation design during subsequent project stages.

8.1.4 Results of Initial Assessment

Based on the discussion above alone, **Scenarios 2 and 3 are the most preferable Scenarios**, while **Scenario 4.2** may also be considered.

8.2 Detailed Evaluation

The detailed evaluation focuses on the choice of material, and how they affect the various evaluation criteria. The detailed evaluation will focus on several key parameters that allow us to conveniently compare the scenarios at either a qualitative level, or where relevant, at quantitative levels. For each parameter, a comparison is described, and a simple evaluation is provided.

8.2.1 Contribution to the City

The location of this project in close proximity to residential buildings and directly along a footpath requires consideration on how the barrier contributes to the local landscape. This criterion covers topics such as perceived safety (tryghed), wayfinding, urban nature, lighting, and interactivity. Table 4, below, compares the scenarios to the baseline for the different criterion within 'Contribution to the City', and includes opportunities for the add-ons (section 6.5) to be implemented.

Perceived safety (*tryghed*) is an important consideration, as the project site is used as a path to/from Øresund Station and has a direct impact on metro passengers and other citizens using this area. The primary concern is that a high vertical barrier restricts sightlines and creates feelings of enclosure. Scenario 3 addresses this through its 45° angled geometry: when a surface slopes away from the pedestrian, it expands the perceived space and preserves sky visibility. A vertical wall also casts a hard, long shadow across the footpath in the morning, whereas the angled profile allows sunlight to reach beneath the edge. Graffiti is another concern, as this can create a feeling that an area is 'unkept.'

Wayfinding is included in the assessment because the barrier reduces the visibility to Øresund Station compared to the baseline scenario. The barrier however gives new opportunity for signage directing passengers to the station, and the distinctive geometry of Scenario 3 functions as a spatial landmark that aids orientation in its own right

Urban Nature is a priority for Copenhagen Municipality and Metroselskabet with the belief that it positively contributes to urban environments and particularly increases satisfaction of one's overall transport journey. Being that this barrier is in the 'backyard' of neighbours, it should feel like an integrated piece of the landscape, which is characterized by trees, shrubs, and grasses. All material options have the possibility for climbing plants, and the angled surface of Scenario 3 offers a larger planting face than a vertical wall, with dense vegetation also serving as a natural deterrent to graffiti.

Natural Lighting is closely linked with perceived safety, when lighting is insufficient (too dark, or too bright) in the area. Daylight is an important factor, and the angled geometry of Scenario 3 is the only configuration that actively reduces shadow impact on the footpath. The angled face also provides an ideal surface for integrated warm lighting, guiding pedestrians toward the station and signaling that the space is active and maintained after dark.

Interactivity considers how the barrier can be engaged with by locals. This could be via a linear display showcasing stories or art referencing the Metro or the local coastal environment, integrated planting and seating, or the natural evolution of the barrier surface through vegetation over time. A surface without planting, lighting, or identity reads as neglected infrastructure — which directly undermines the sense of safety and ownership in the space.

Table 4: Contribution to the City Comparison Table

	Scenarios							
	Base	1	2, 4	3	5	2, 4	3	5
Material	N.A	Rockwool, Eelgrass, Turbine Blade				Transparent		
Criteria								
Perceived Safety	B	B	E	B	D	D	B	C
Wayfinding	A	A	C	B	C	C	B	C
Opportiunity for Urban Nature	D	D	B	A	B	C	C	C
Natural Lighting	A	A	E	C	D	C	B	C
Opportunity for Interactivity	E	E	C	C	C	D	D	D
Overall Assessment	C	C	D	B	C	C	C	C

Based on the assessment above, and considering all criteria having equal weighting, then it would appear that **Scenario 3** is the most optimum arrangement in terms of contribution to the city. However, both the weighting and the score of these aspects are very subjective and may reasonably be challenged. These aspects could be considered topics to focus and elaborate upon through community engagement sessions.

8.2.2 Carbon

The assessment of carbon considers the entire lifecycle of the product by comparing carbon from the production and construction phases (A1-A4) and end-of-life and recycling (C/D). Information on a product's climate impact will mostly derive from EPD's or data collected to form an EPD so their carbon numbers are comparable by using the same standard. Carbon is calculated over a 100-year lifetime meaning that calculations include replacement of panels after 25 years, and replacement of the structure after 50 years, which is also reflected in the price estimate. Similar to the cost assessment, the acoustic panel alone is only a portion of the barrier, while the structure is the primary driver of cost and carbon. The overall carbon footprint of each option is presented in Figure 15: Carbon Impact Comparison ChartFigure 15, below.

Table 5: Carbon Impact Comparison Table

	A1-A3: Material production and processing (tons CO2e)				C End-of-life options
Scenario	1	2 and 3	4.2	5	
Søuld	-16	-6.0	-14	-12	Reuse/recycle, take-back scheme
Miljøskærm	3.6	1.3	3.1	3	Recycle
Noistop	18	6.8	16	14	Recycle, take-back scheme
Acrylic	N.A	10	19	16	Likely recycle
Panel Casing	182	68	159	136	Recycle
Structure	0	127	140	85	Recycle

*taking into account 3 panel replacements and 1 structural replacement over 100-year design life

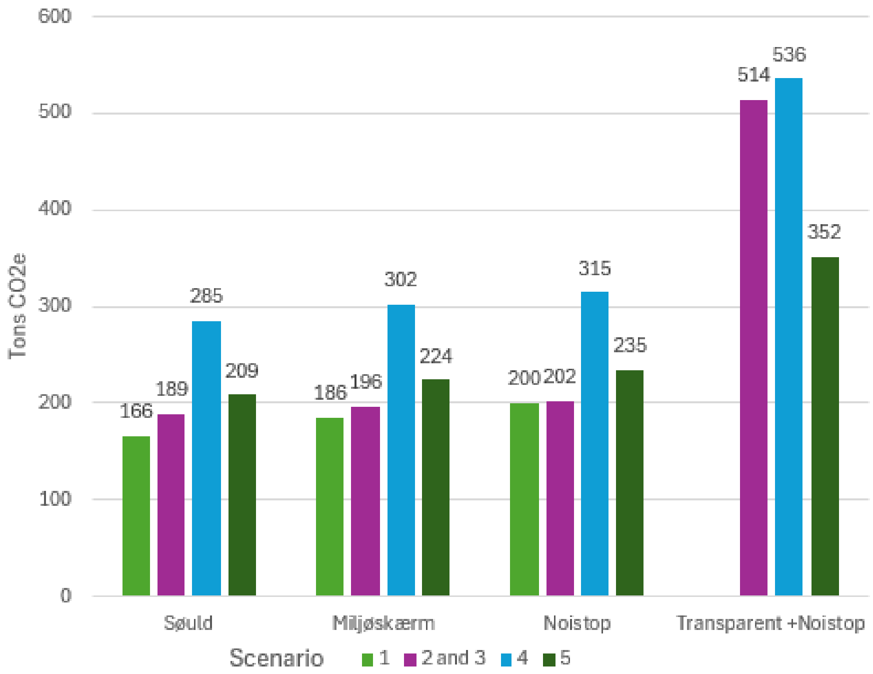


Figure 15: Carbon Impact Comparison Chart

8.2.3 Cost

A cost assessment allows us to capture a number of different parameters and see them as a financial cost. These include:

- Capital construction costs;
- Maintenance costs;
- Cost to Metro operations;
- Cost of land purchase; and
- Additional costs, which are made up of a risk allowance for project uncertainties at this stage, and an allowance for project management costs.

Each of these is described in more detail in this chapter.

8.2.3.1 Capital Construction Costs

Capital construction cost, including materials and labour. MS has established a construction cost estimate with an external consultant, to ensure having the best possible market estimate for the materials and installation cost. The estimate has been undertaken in accordance with prices from 2026 Q2.

The effect of the choice of insulation material makes a very small difference to the overall cost. The initial construction cost accounts for approximately 15 to 20%, of which the insulation material accounts for approximately 20 to 25% of the cost. Scenario 4 uses the most noise insulation material, and a capital cost comparison is offered as an illustration in Figure *16*, below.

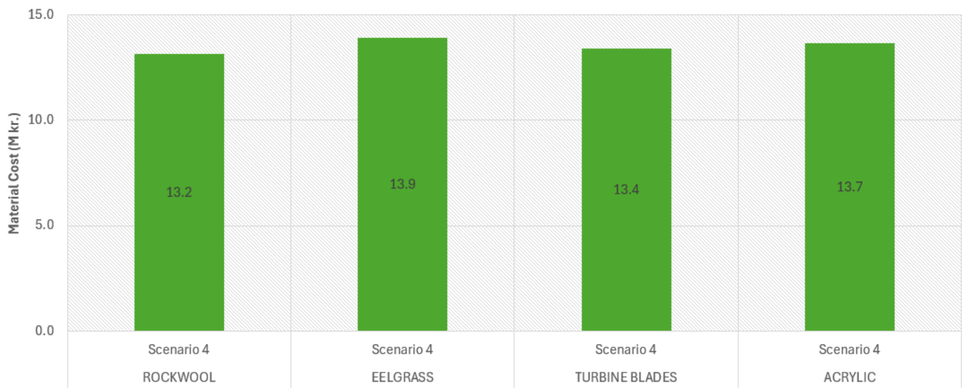


Figure 16: Initial Capital Cost Comparison of Insulation Materials

8.2.3.2 Maintenance Costs

Maintenance costs, considering the long-term costs over the entire design life of 100 years. This has been undertaken in accordance with EN 15459-1:2017 (Annex D) that explicitly lists the annual maintenance costs as a percentage of the various components, to be used in life cycle cost calculations. The standards state costs for static and passive elements, applicable to noise barriers and similar structures, and also including allowance for end-of-life costs. Maintenance costs have been identified for:

- Annual maintenance.
- Inspections undertaken every 3 years.
- Detailed Inspections and minor works, undertaken every 10 years.
- Demolition, disposal and replacement costs undertaken in accordance with the product design life, taken as 25 years for all products in this study.

The maintenance cost has been developed to provide a cost estimate over 100 years design life, using Net Present Value (NPV) method, in accordance with other Metro projects. This uses a suitable inflation value and discount rate.

The cost of the maintenance and inspection over 100 years makes up approximately **75 to 80%** of the total cost estimate for each scenario, and is presented in *Figure 17*.

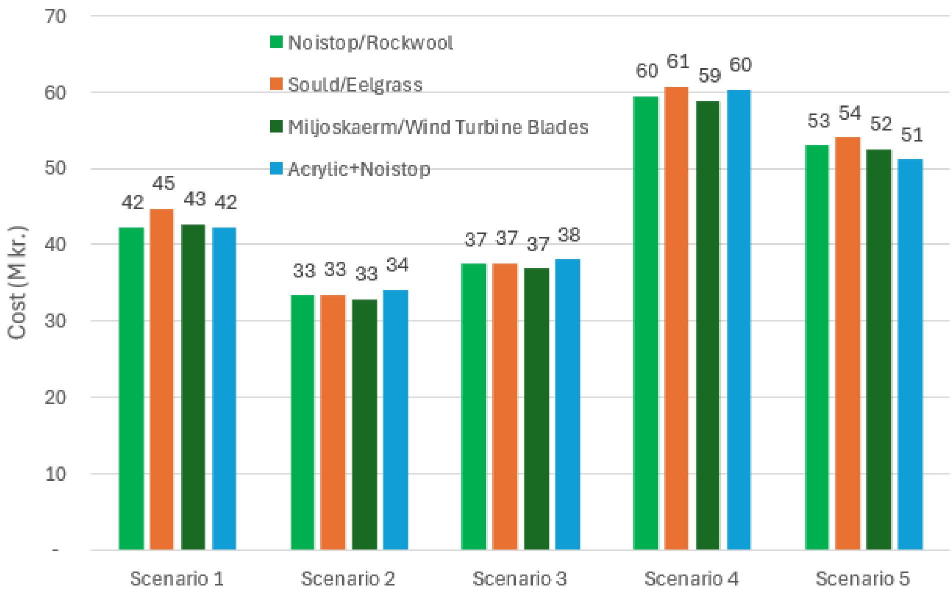


Figure 17: Maintenance Costs Comparison

8.2.3.3 Costs to Metro Operations

The cost of the impact of each proposed scenario upon Metro Operations has been estimated and included in the overall cost estimate. These costs include those directly relating to closures, as well as any lost revenue due to disruption of services. The costs have been based on the reasonable assumption that work undertaken adjacent to the track will require localised single-track closures, which incur cost for track lookouts, and costs associated with reduced service, and its impact on ticket sales. A further allowance for occasional late re-opening of the line after closures is included.

Full track closures are not envisaged for any of the proposed scenarios.

Single-track closures have a significant impact on metro operations. During peak operational hours, we operate trains at 3-minute headways between trains cars in each direction between Lergravsparken and Øresund Station. Running with a single-track closure effectively means we reduce headway to 20-minute intervals, similar to night operations. Therefore, for all scenarios proposed, we will undertake all track closures during the night.

The impact of this is that practical working hours near the track are limited to 3.5 hours each night, and yet the costs for full shifts are taken into account. On M2, night shift works are typically permitted for 5 nights per week, from Sunday night to Thursday night, but not at weekends. This will be the basis of our cost and programme calculations.

An allowance for late reopening has been included for 5% of all closures.

The cost of closures for each option is typically about 3% of the total cost.

8.2.3.4 Cost of Land Purchase

Cost of land required to undertake the works for temporary land rental has been calculated. For the main options considered, no land purchase is required.

The triangular site to the south of the trough is currently undeveloped, and would serve as an ideal worksite for the period. However, the owner has initiated the process for a change of the local plan, meaning we cannot assume its availability for this project. An allowance for land rental of this area is however included in the cost estimate. A comparison is presented in Figure 18.

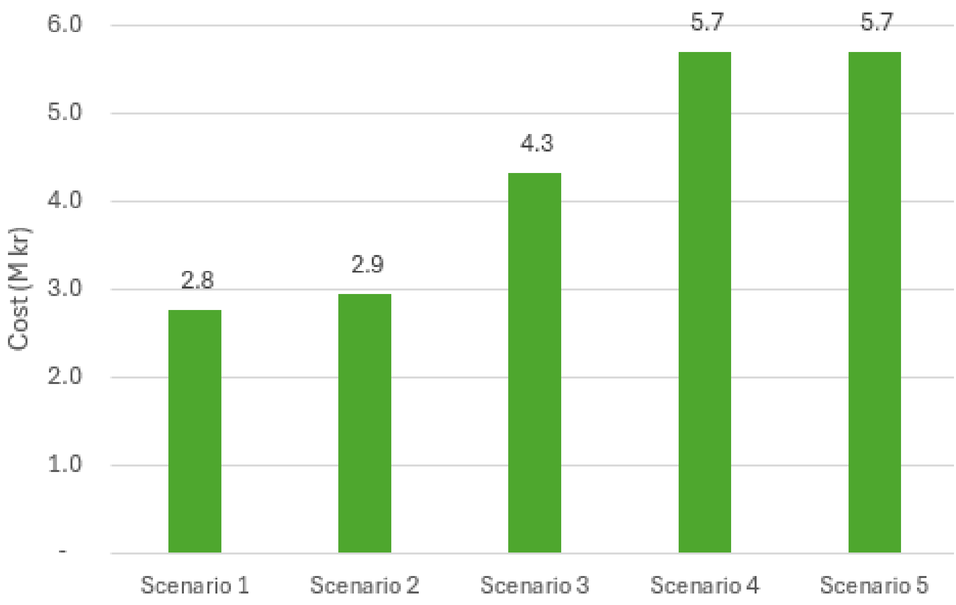


Figure 18: Expropriation Costs Comparison

8.2.3.5 Additional Costs

The costs also include:

- An allowance for project procurement costs, such as client project management, contractor overheads, design costs, and profit. An uplift of 36% has been applied, as per other MS projects. It has only been applied to construction costs.

- An amount of contingency has been added, to cover uncertainties related to the level of detail and impact to the local neighbourhood. 50% has been used, in accordance with NAB, with respect to the level of detail of the study.

8.2.3.6 Overall Cost Comparison

The table below shows the cost estimates for Scenarios 2 and 3 (which only includes a surface barrier, and Scenario 4, which also includes noise attenuation panels inside the trough. Risk allowance has been included within each item.

Given that the Eelgrass solution is very slightly more expensive, the cost has been presented below using this material.

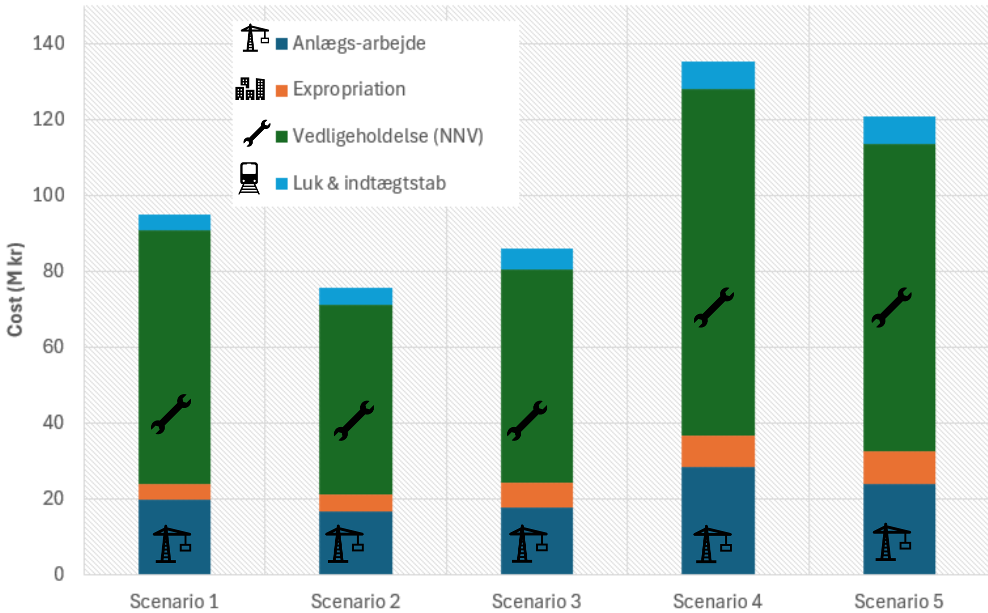


Figure 19:Total Cost Comparison Chart, all Scenarios with Eelgrass/Søuld

It is clear from the comparison chart in Figure 19, that while there is a difference in the capital construction costs of each of the material options, any differences are dwarfed by the long-term maintenance costs – the main contributor being the replacement of the panels every 25 years, and replacement of the frames every 50 years.

8.2.4 Construction Programme

While the construction programme is directly linked to the cost, the impact it has on disruption to the local area in the short-term, and potential for reputational damage to Metroselskabet and its owners are of critical importance. The construction programme should be considered, and ideally minimised as far as is reasonably practicable. As stated in Section 8.2.3.3, the programme has been based on reduced available hours of nighttime working. As shown in *Figure 20*, a range of between 17 and 24 weeks may be expected, depending on the option chosen.

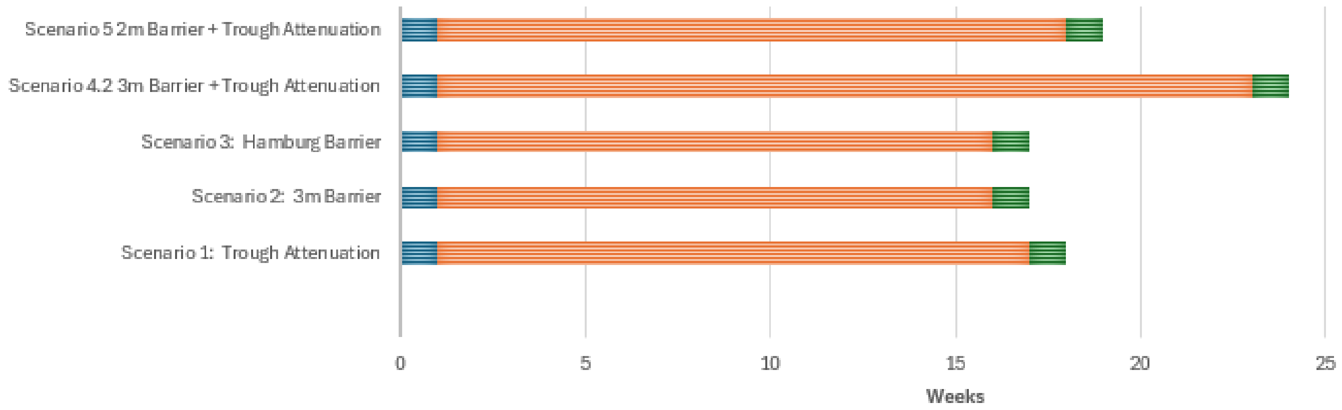


Figure 20: Construction Programme Chart

9. Conclusions

The choice of final best solution has been made more simple by opting for a staged approach.

- We consider the preferred geometry, not accounting for the material choice. This ensures the overall performance and value.
- Then we consider the material choice independently.

9.1 Geometry Selection

The geometric selection of Scenario 2 or 3 would limit the initial investment and offer a quality product that is expected to reduce the noise significantly. It also has operational benefits in the construction and operational phase while not requiring any construction or maintenance work inside of the trough, which keeps the construction programme to a more acceptable duration. Regardless of the material choice, the cost estimate of Scenario 4 adds approximately 120% to the cost estimate.

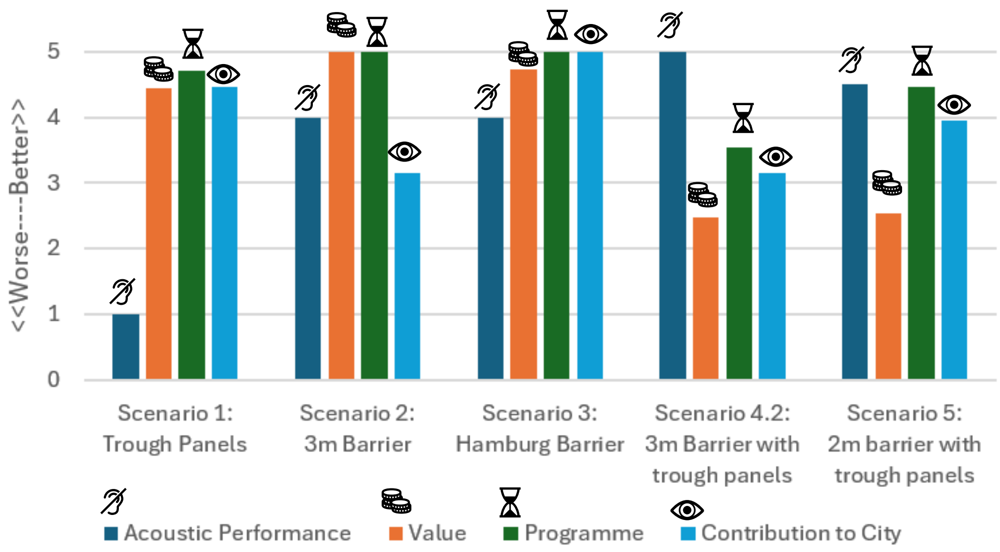


Figure 21: Geometric Evaluation Criteria Comparison

At this stage, there are concerns that Scenario 3 may be seen as a novel approach. However, the structural assessment undertaken and reported in Chapter 8.1.3, suggest that Scenario 3 is feasible. Given that it performs slightly better than Scenario 2, and offers a lower impact to neighbours and pedestrians, it is proposed as the preferred solution.

Based on the information presented in Figure *21*, a balanced option could be to opt for a phased approach, and select Scenario 3, and later, after accessing the true performance, consider applying the noise attenuation panels in the trough, to effectively augment Scenario 3 to Scenario 4.

The addition of panels in the trough at a later stage is expected to cost an additional DKK 46 to 49 million – if deemed to be necessary. Undertaking this stage later may allow it to be coordinated with other closures, such as the 3xR project.

9.2 Material Selection

The variation in total cost between the options are within 1% of each other. Taking into account the tried and tested recycled wind turbine blade product with a proven track record of noise absorption, and excellent circularity attributes, with only a 0.3% cost increase, it perhaps offers the best all-round proposal.

The acrylic material is the only material that does not absorb sound but simply reflects it. As such, it is not considered to be acoustically optimal. It is also the least sustainable by quite some margin.

The Eelgrass product has not been used extensively in an outdoor environment, and while it has inherent acoustic properties, it is not supported by test data – and as such, there is a risk that it may not perform as required – risking early replacement of the panels for an alternate product.

Given the recycled wind-turbine blades offers a more sustainable solution that has a tried and tested acoustic performance with minimal cost impact, it is considered the most preferable solution, as presented in Figure 22.

It may be an attractive proposition to include some eelgrass insulation material for a portion of the works, as a pilot, to understand how it performs.

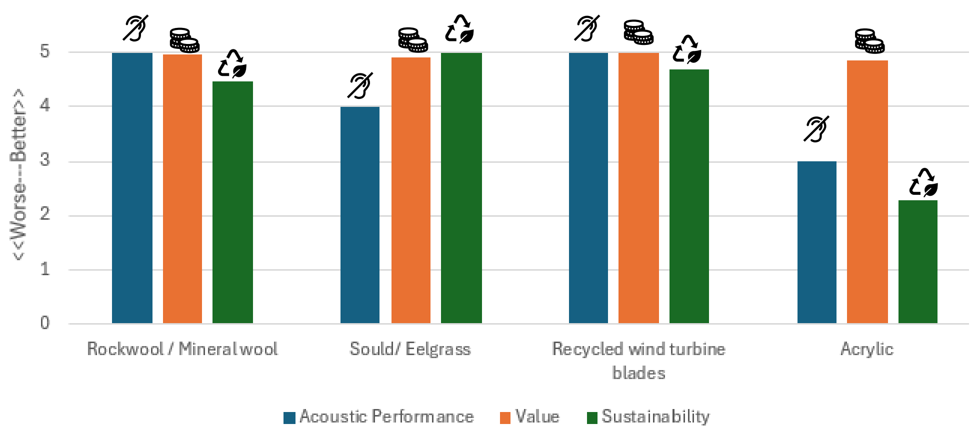


Figure 22: Acoustic Material Evaluation Criteria Comparison

The cost of Scenario 3 using any of the materials as a noise absorbing material, applied only to the section north of Øresund Station, adjacent to the properties, over a 100-year period is estimated to be approximately DKK 85 to 87 million.

9.3 Variations

We have considered two further variations:

- **Extension of the system south along Krimsvej:**
  This increases the cost estimate and construction programme by an **additional 186%**. At this stage, there is little evidence to suggest that it is required, and therefore offers little value.

- **Provision for noise protection to the south and west of the metro:**
  This increases the cost estimate and construction programme by an **additional 100%**. The logistics of working in the 2 m path between the daycare facility and the railway trough adds complexity but is thought to be manageable – potentially requiring specialist equipment to bring in the materials. At this stage, this variation is not considered to offer a significant benefit.

10. Next Steps

There are a number of crucial next steps to be undertaken to ensure successful delivery of the project. These include taking some critical decisions, and development of the engineering to a detailed design level for construction.

Assuming the proposed solution of Scenario 3 is selected, a number of tasks remain to undertake:

- The extent of the barrier must be determined – as to whether we shall extend the system south of Øresund Station, along Krimsvej, or on the south-west side of the railway (see Chapter 9.3)

- The add-on options (Chapter 6.5) should be developed to understand the cost implications, before we consider proposing them in detail to the local neighbours.

- In collaboration with the City of Copenhagen, we propose to initiate meetings with local stakeholders and residents to present the solution, to allay any concerns they may have, and to enter into a dialogue, with a focus on the visual impact. Appendix B offers some visualisations of the various options. The scale and content of these meetings will be coordinated further with Copenhagen Municipality.

- With a clear definitive solution, a more detailed risk assessment will help ensure that safety approval is not a hinderance, and also may allow us to optimise the programme through a mature risk management process, in collaboration with Metro Service.

Following this, once all approvals are in place, the next step would be to commission the detailed design and construction of the works.

Appendix A

Noise Study Results

Scenario 1 – Noise absorbing railway trough

The inner side of the railway trough's sheet-pile walls (and concrete wall) is clad with sound-absorbing panels. In the calculation scenario, an absorption classification of DL_α = 8 dB has been assumed. The noise reduction achieved by installing absorptive panels in the trough from bottom to top is illustrated in Figure 9, Figure 10 and Figure 11.

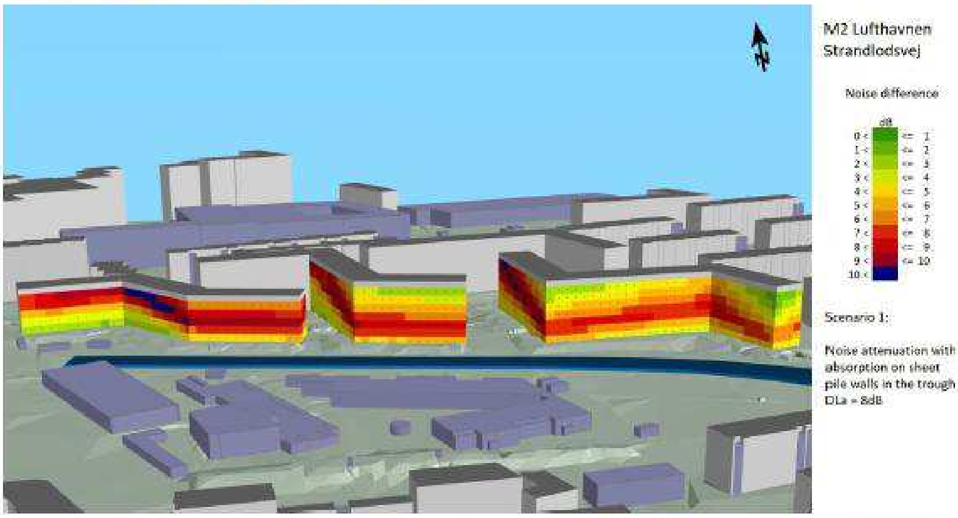


Figure 9 – Scenario 1. Noise reduction at residential façades due to installation of absorption on the railway cutting's sheet-pile walls.

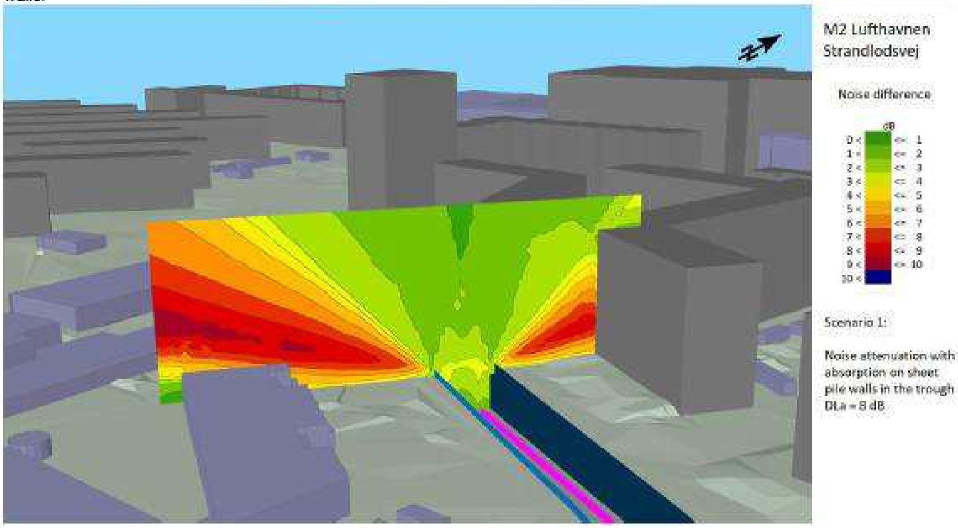


Figure 10 – Scenario 1. Noise reduction illustrated by a cross-section calculation at Strandlodsvej 67A.

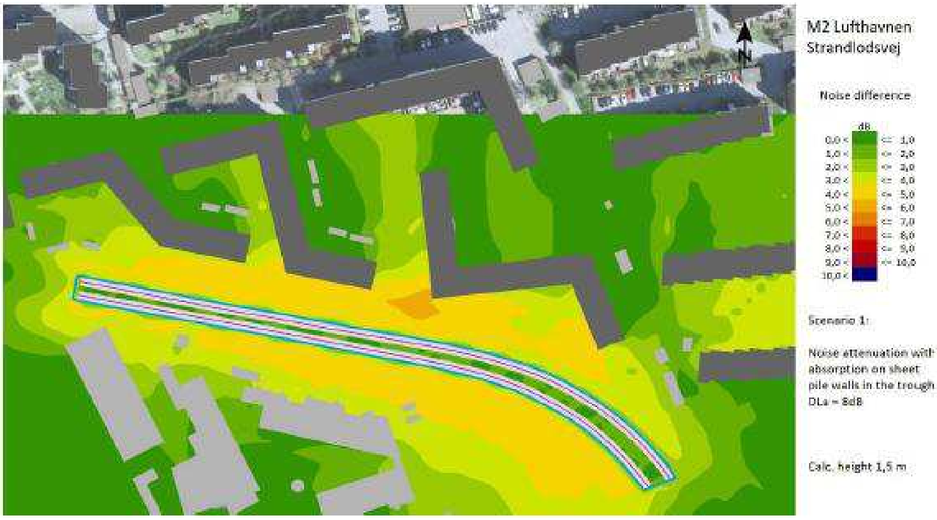


Figure 11 – Scenario 1. Reduction of noise propagation at 1.5 m above ground level

By installing sound-absorbing panels on both walls of the railway trough over the entire wall height, a noise reduction in the order of 7–8 dB can be achieved at floors 1–4 of the property at Strandlodsvej 67, which is the central of the three properties closest to the trough. Similar reductions are observed for the two neighboring properties at Øresundsvej 145–155 and Strandlodsvej 63.

The upper floors generally experience a smaller noise reduction than the mid-level floors. At Strandlodsvej 67, the reduction at the upper floors is approximately 2–3 dB, corresponding to a minor change in noise levels.

At ground-floor level, the reduction is generally smaller than at floors 1–4, as the ground floor is already better shielded from both direct and reflected noise.

For outdoor areas along both sides of the railway trough, including the kindergarten's outdoor playground south of the trough, the noise level is reduced by 4–5 dB (see Figure 11).

If panels with an absorption classification of DL_α = 10 dB are selected instead of DL_α = 8 dB, the facade noise reduction at floors 1–4 can be further improved by 1–2 dB. However, the upper floors (5th and 6th floors) at Strandlodsvej 67 and Øresundsvej 145–155 will overall continue to experience reductions below the design criterion of 6 dB.

Scenario 2 – 3 m high vertical sound-absorbing noise barrier

A 3 m high vertical sound-absorbing barrier is installed on the northern sheet pile wall of the railway trough between Øresundsvej and the tunnel portal. The barrier is assumed to have an absorption classification of DL_{α} = 8 dB. No absorption is applied to the sheet pile walls in the trough.

The noise reduction provided by the barrier is illustrated in Figure 12, Figure 13 and Figure 14.

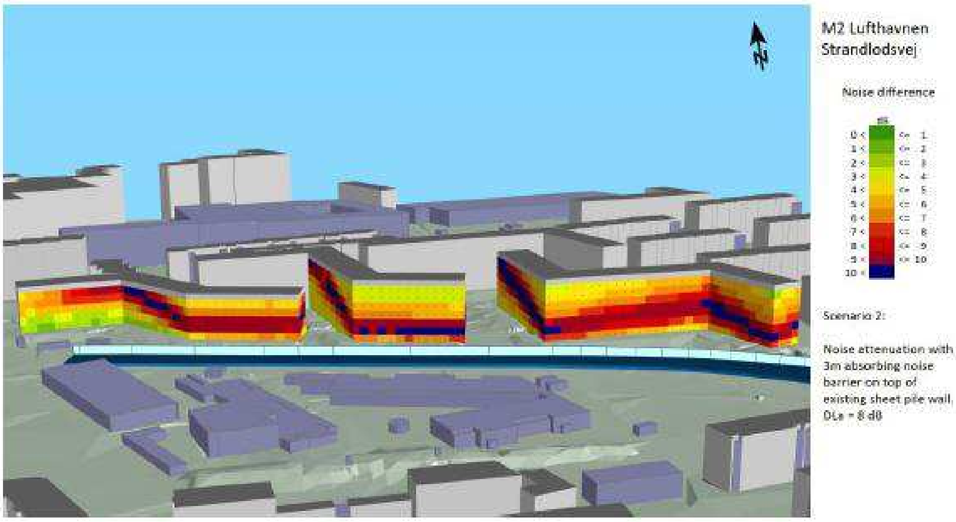


Figure 12 – Scenario 2. Noise reduction at residential facades due to installation of a 3 m high absorptive barrier on top of the northern sheet pile wall.

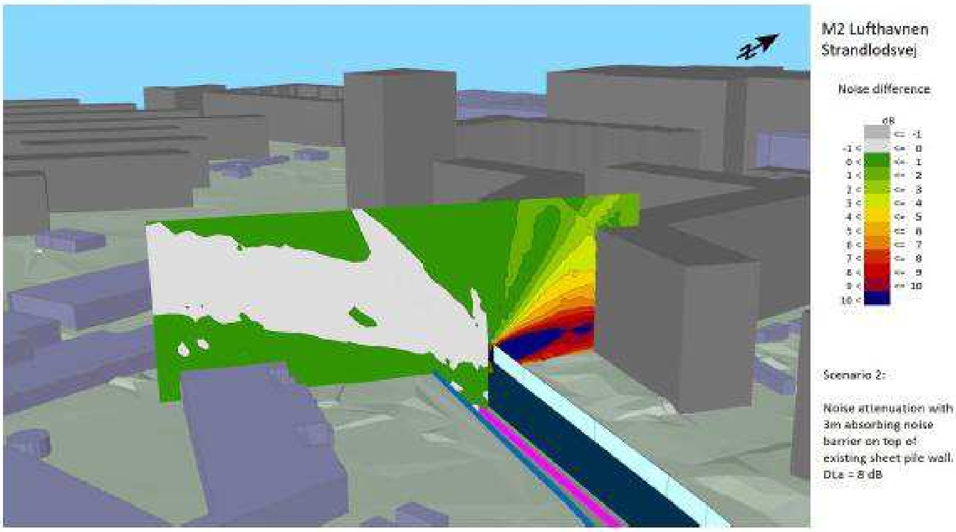


Figure 13 – Scenario 2. Noise reduction illustrated by a cross-section calculation at Strandlodsvej 67A.

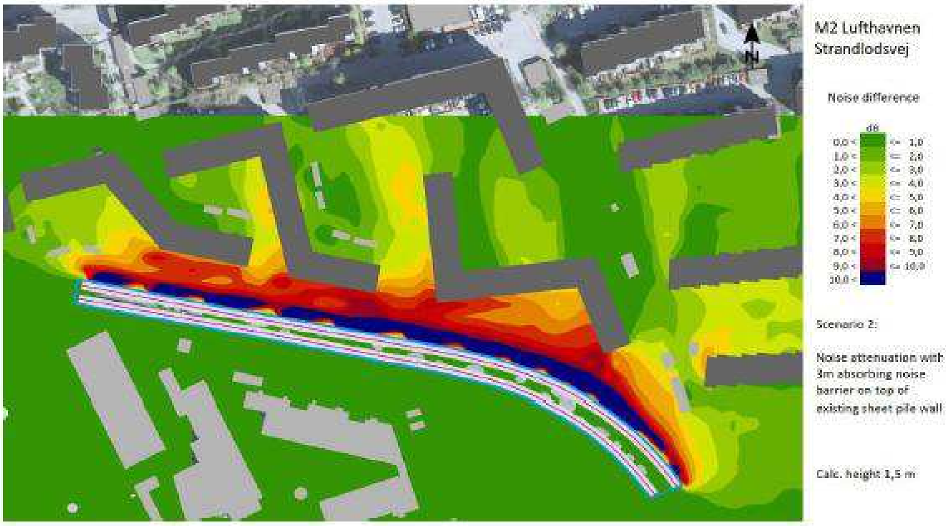


Figure 14 – Scenario 2. Reduction of noise propagation at 1.5 m above ground level

With a 3 m high vertical sound-absorbing noise barrier on top of the existing screening edge along the entire section from Øresundsvej to the tunnel portal, a noise reduction in the order of 6–10 dB can be achieved at floors 1–3 of the property at Strandlodsvej 67 (the central property). At the upper floors, the reduction is limited to approximately 3–4 dB, and at ground-floor level to approximately 5 dB.

Figure 13 shows a minor increase in noise levels south of the trough in the range of 0–1 dB. A detailed analysis indicates that the increase is approximately 0.2 dB, which is not perceptible. The increase is caused by the assumed absorption classification of DL_α = 8 dB for the noise barrier, resulting in a small reflection of sound towards the south. The use of a barrier with an absorption classification of DL_α = 10 dB may be considered; however, it is not assessed to be necessary.

For outdoor areas south of the railway trough, a marginal noise reduction in the range of 0–1 dB is observed, confirming that reflections from the barrier will not adversely affect noise conditions at the calculation height of 1.5 m above ground level, which is the standard height for noise mapping of outdoor areas.

North of the railway trough, in the area between the railway and the residential buildings, noise reductions of approximately 7–10 dB are observed, though slightly lower at the eastern property, Øresundsvej 145–155.

A sketch with dimensions of the barrier is provided in Appendix 2.

Scenario 3 – 1 m high vertical sound-absorbing barrier with overhang

A 1 m high vertical sound-absorbing barrier with a 2 m long overhang is installed on the northern sheet pile wall of trough between Øresundsvej and the tunnel portal. The angle of the overhang relative to vertical is 45 degrees. The total vertical extension above the existing edge is approximately 2.4 m. The vertical part of the barrier is assumed to have an absorption classification of $DL_α$ = 8 dB, while the absorption classification of the overhang is assumed to be "infinite", due to a model limitation. No absorptive panels is applied to the inner walls of the railway trough.

The noise reduction provided by the barrier is illustrated in Figure 15, Figure 16 and Figure 17.

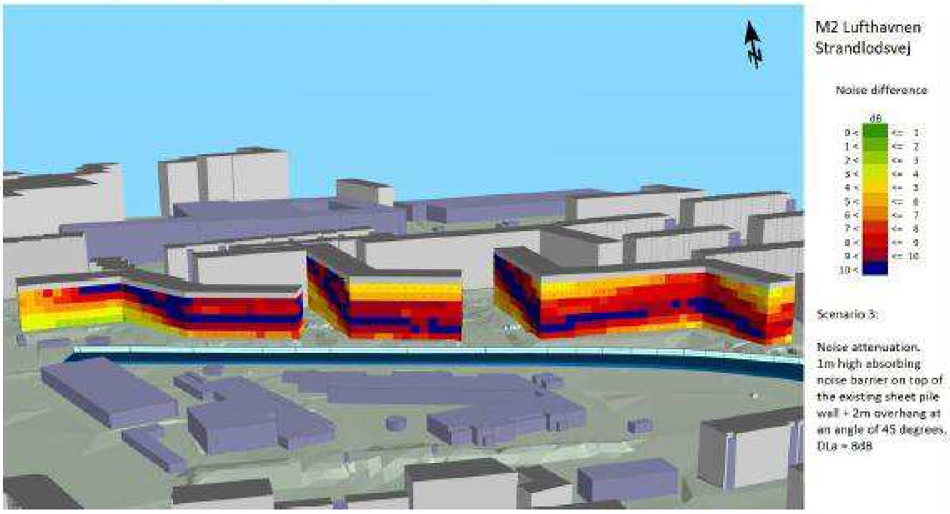


Figure 15 – Scenario 3. Noise reduction at facades. Absorptive barrier with overhang on top of the northern wall.

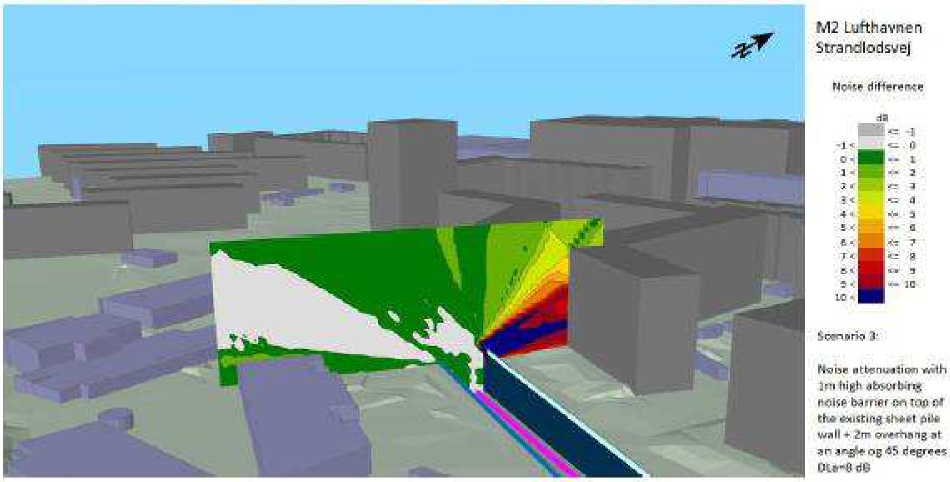


Figure 16 – Scenario 3. Noise reduction shown by a cross-sectional calculation at Strandlodsvej 67A.

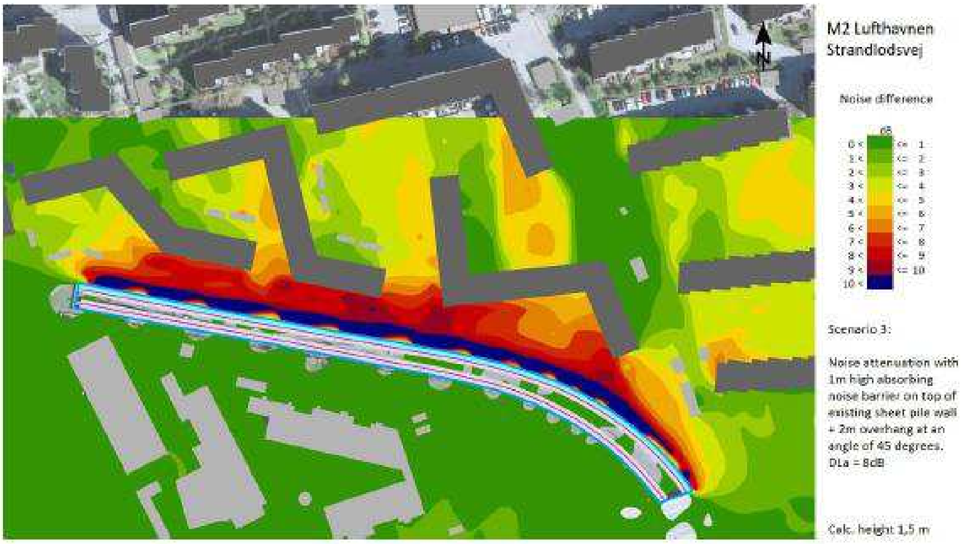


Figure 17 – Scenario 3. Noise reduction of sound propagation at 1.5 m above ground level.

With a 1 m high vertical sound-absorbing noise barrier equipped with a 2 m overhang inclined at 45 degrees relative to vertical, on top of the existing screening edge, a noise reduction in the order of 7–10 dB can be achieved at floors from ground level to the 4th floor of the property at Strandlodsvej 67 (the central property). At the uppermost floors, the reduction is limited to approximately 4–6 dB.

Figure 16 shows a minor increase in noise levels south of the trough in the range of 0–1 dB. A detailed analysis indicates that the increase is approximately 0.5 dB at heights above 5 m. This increase is not perceptible. The noise increase is caused by the assumed absorption classification of DL_α = 8 dB for the vertical noise barrier section, which results in a small reflection of sound.

For outdoor areas south of the trough, a marginal noise reduction in the range of 0–1 dB is observed, confirming that reflections from the barrier will not adversely affect noise conditions at the calculation height of 1.5 m above ground level. North of the trough, in the area between the trough and the residential buildings, noise reductions of approximately 7–10 dB are observed.

A sketch with dimensions of the barrier with overhang is provided in Appendix 3.

Scenario 4 – 3 m high vertical noise barrier and absorbing panels on the southern wall of the railway trough

A 3 m high vertical sound-absorbing barrier is installed on top of the existing northern sheet-pile wall. In addition, sound-absorbing panels are installed along the southern wall of the railway cutting over its full height. The absorption classification of both the barrier and the panels is assumed to be DL_{α} = 8 dB. The noise reduction provided by the barrier is illustrated in Figure 18, Figure 19 and Figure 20.

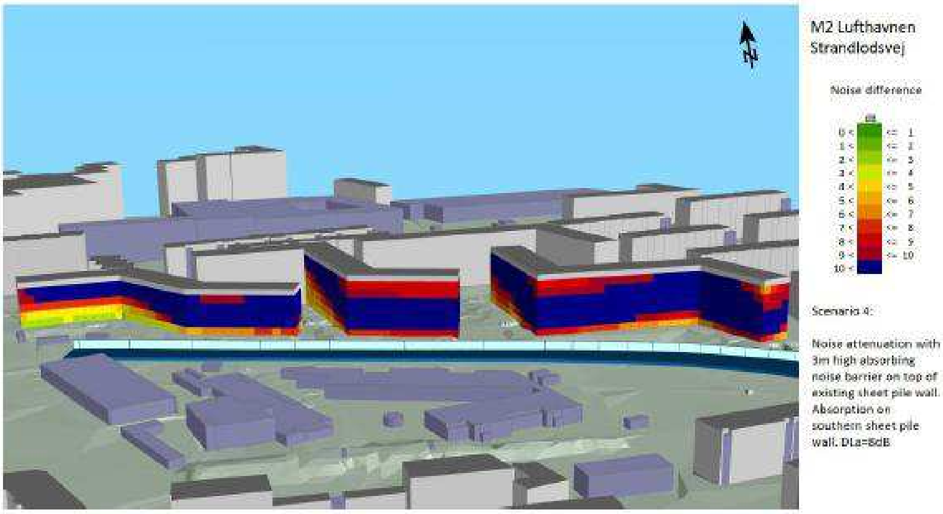


Figure 18 – Scenario 4. Noise reduction at residential facades with a 3 m high vertical absorptive noise barrier on the northern sheet-pile wall and absorptive panels installed on the southern sheet-pile wall.

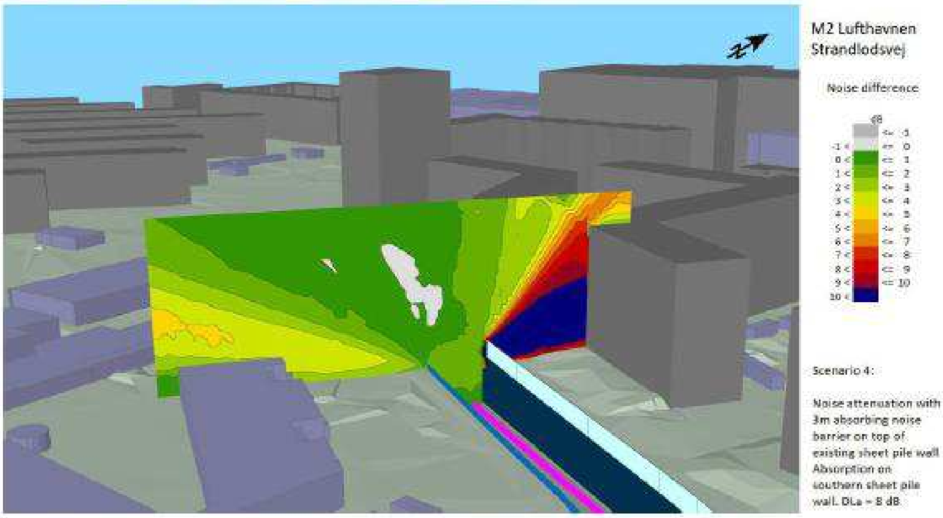


Figure 19 – Scenario 4. Noise reduction shown by a cross-sectional calculation at Strandlodsvej 67A.

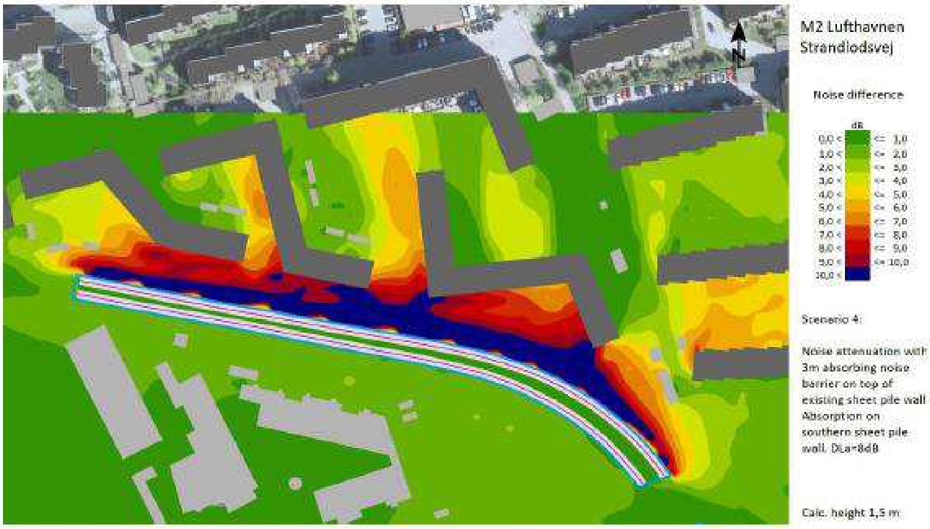


Figure 20 – Scenario 4. Noise reduction of sound propagation at 1.5 m above ground level.

With a 3 m high vertical sound-absorbing barrier on top of the northern sheet-pile wall, combined with a fully absorptive southern wall of the railway trough, a noise reduction in the order of 7–10 dB can be achieved at all floors of the residential buildings north of the railway cutting. The solution meets the objective of achieving at least 6 dB noise reduction at all floors.

At the outdoor areas south of the railway trough, a noise reduction of 1–2 dB is observed. The limited reduction is due to the fact that no absorptive panels have been included on the northern sheet pile wall. North of the trough, in the area between the trough and the residential buildings, noise reductions of approximately 6–10 dB are achieved.

Supplementary calculations, in which absorptive panels are installed only on the upper 4 m of the southern sheet-pile wall of the trough, show that approximately the same noise reduction can be achieved as with full-height panels of the entire wall. The results of the supplementary calculation are shown in Figure 21, which, when compared with Figure 18, are seen to be almost identical. The minor differences are insignificant.

A sketch with dimensions of the barrier is provided in Appendix 4.

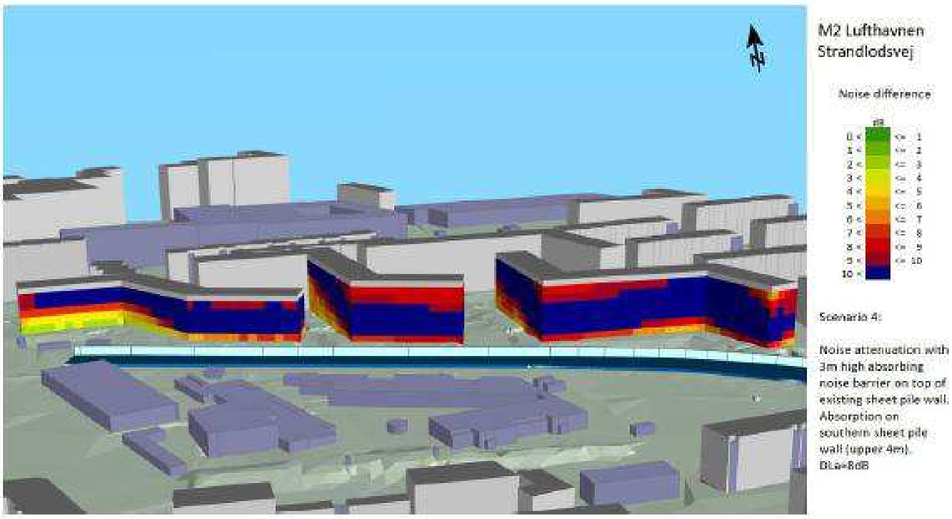


Figure 21 – Scenario 4. Noise reduction at residential façades with a 3 m high vertical absorptive barrier on the northern sheet-pile wall and absorptive elements installed on the upper 4 m of the southern sheet-pile wall.

Scenario 5 – 2 m vertical barrier and absorption on the southern wall of the railway trough

A 2 m high vertical sound-absorbing barrier is installed on top of the existing sheet-pile wall. In addition, absorptive panels are installed on the upper 4 m of the southern sheet-pile wall.
The absorption class of both the barrier and the panels is assumed to be DL_{α} = 8 dB.
The noise reduction provided by the barrier is illustrated in Figures 22, 23 and 24.

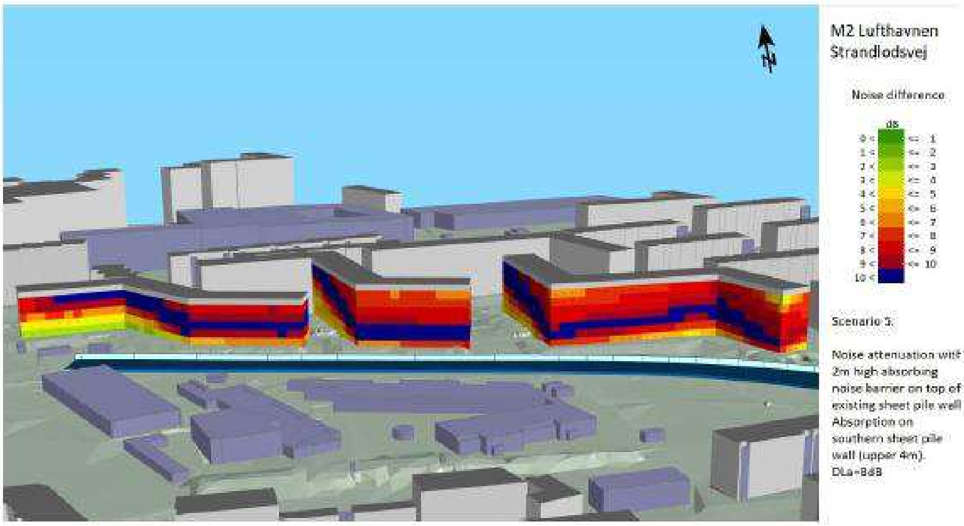


Figure 22 – Scenario 5. Noise reduction at residential facades with a 2 m high vertical absorptive barrier on the northern sheet-pile wall and absorptive panels installed on the upper 4 m of the southern sheet-pile wall..

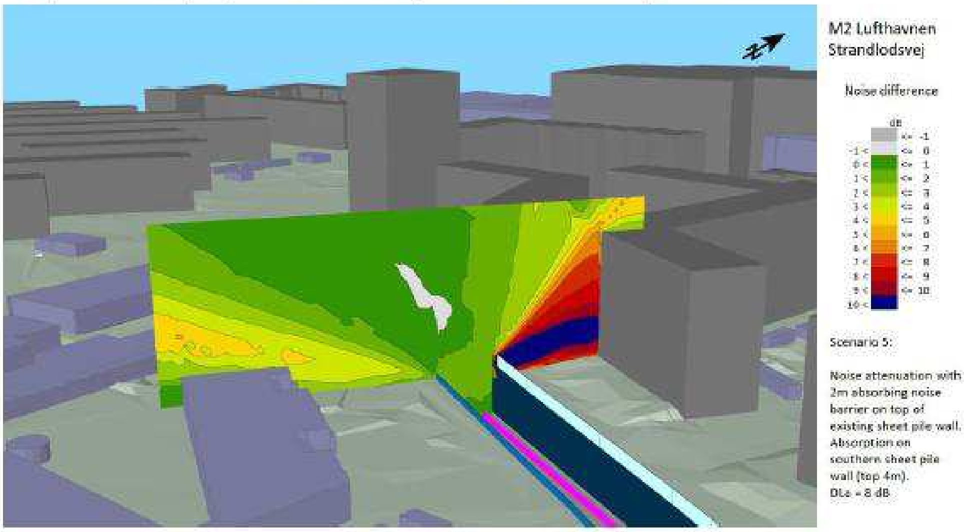


Figure 23 – Scenario 5. Noise reduction shown by a cross-section calculation at Strandlodsvej 67A.

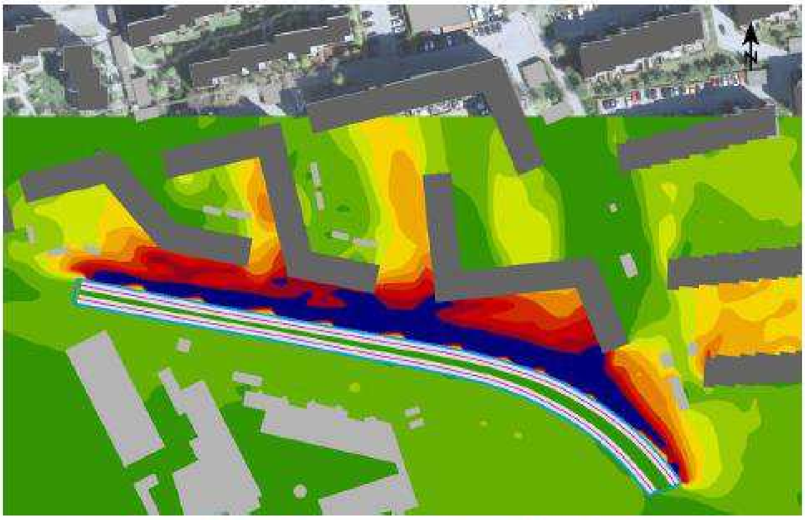


Figure 24 – Scenario 5. Noise reduction of sound propagation at 1.5 m above ground level.

With a 2 m high vertical sound-absorbing noise barrier installed on top of the northern sheet-pile wall, combined with absorptive panels on the upper 4 m of the southern sheet pile wall, a noise reduction in the order of 5–10 dB can be achieved at all storeys of the residential buildings north of the trough. With a few exceptions on the lowest storey, the target of at least 6 dB noise reduction is met.

At outdoor areas south of the trough, a noise reduction of 1–2 dB is observed. The limited reduction is because no absorptive panels are included on the northern wall of the trough.

North of the trough, in the area between the trough and the residential buildings noise reductions of approximately 6–10 dB is achieved.

A sketch with dimensions of the barrier is provided in Appendix 5.

Appendix B

Visualisations

Location Plan

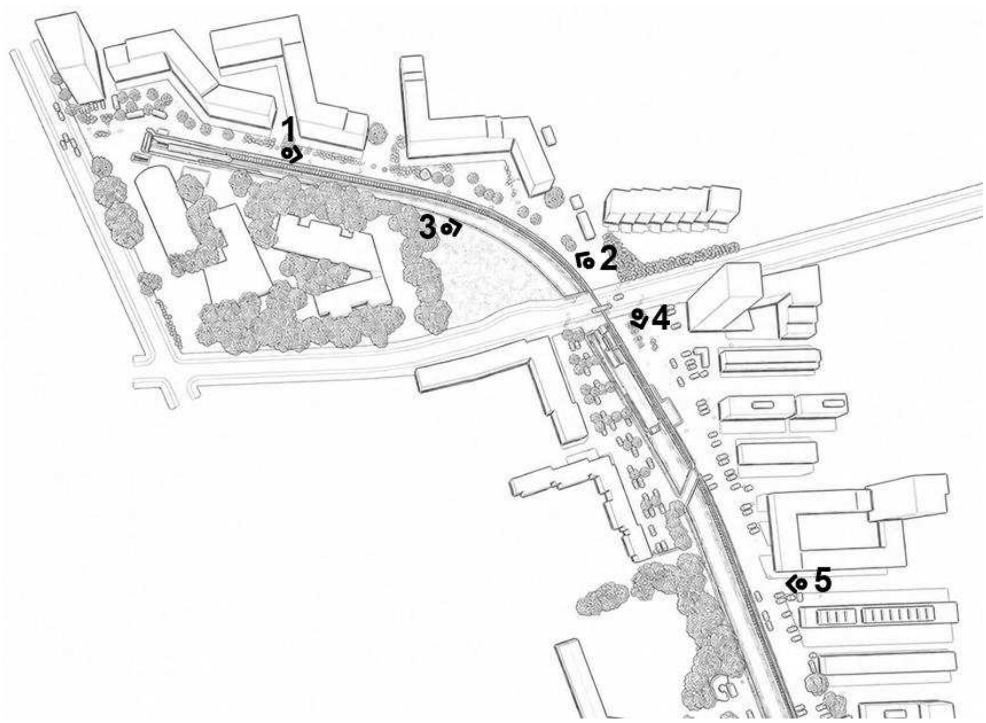
View 1: Looking east from north side of the trough

View 2: Looking north-west from the north-east side of Øresundsvej Bridge.

View 3: Looking east from the vacant lot on the south side of the trough.

View 4: Looking south from the south-east side of Øresundsvej Bridge.

View 5: Looking west from Krimsvej



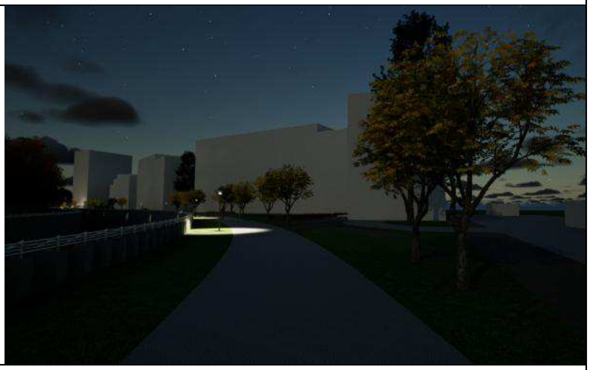
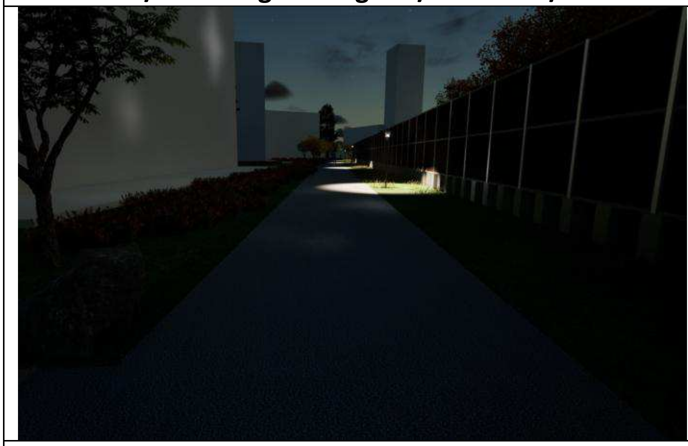
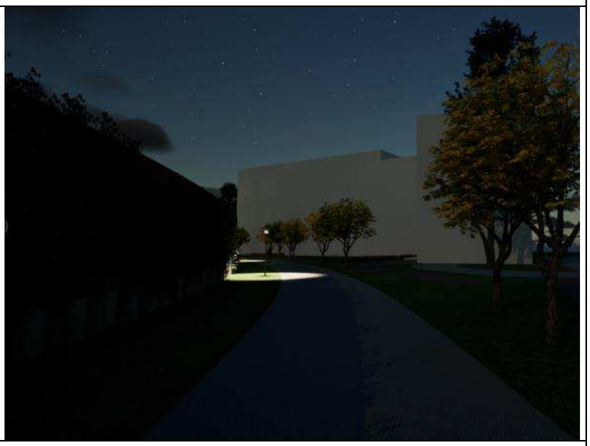
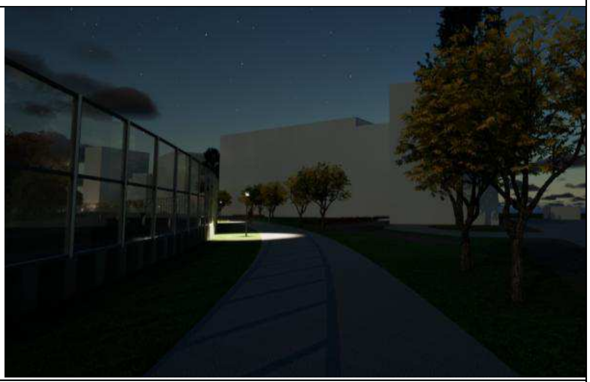
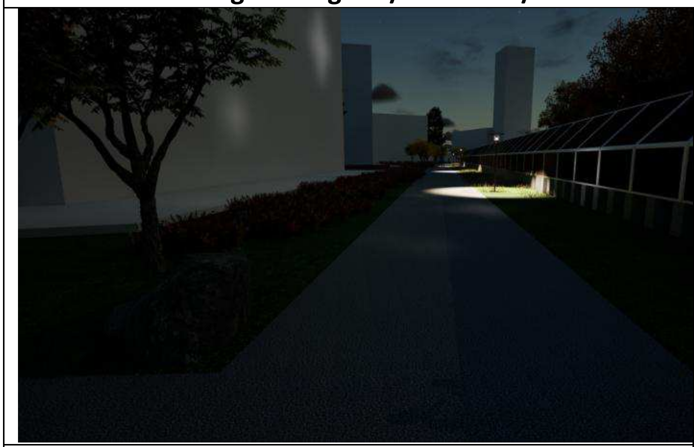
View 1	View 2
Current View / Scenario 1	
	
Scenario 2/Scenario 4 Wind turbine blades/Rockwool + Cladding	
	
Scenario 3 Wind turbine blades/Rockwool + Cladding	
	
Scenario 5 Wind turbine blades/Rockwool + Cladding	
	

Scenario 3 Acrylic/Transparent

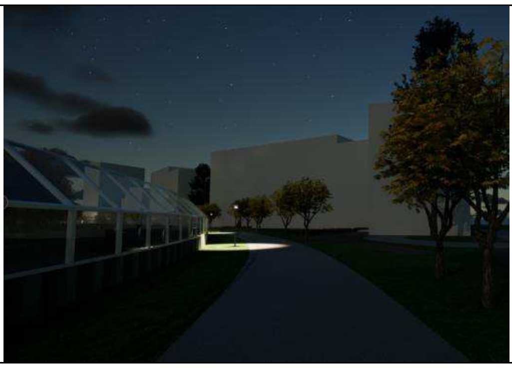
Scenario 3 Sould/Eelgrass

Scenario 3 Wind turbine blades/Rockwool + Cladding

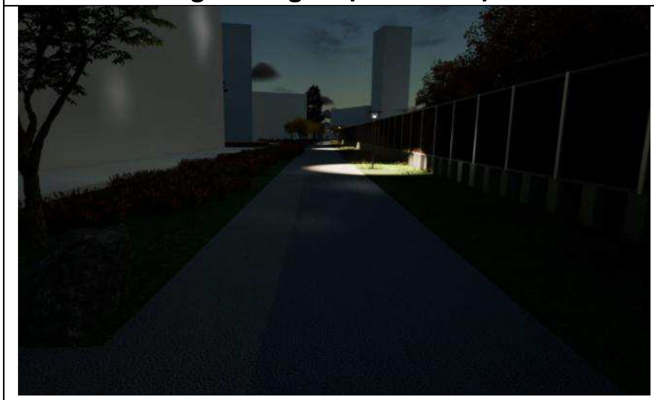
Scenario 3 Planting

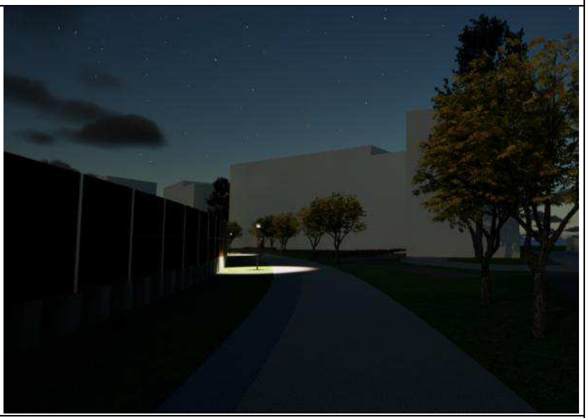
Current Scenario / Scenario 1 Night	
	
Scenario 2/4 Night+ Eelgrass/Rockwool/Wind Turbine Blades	
	
Scenario 2/4 Night+ Acrylic	
	
Scenario 3 Night+ Eelgrass/Rockwool/Wind Turbine Blades	
	

Scenario 3 Night+ Acrylic

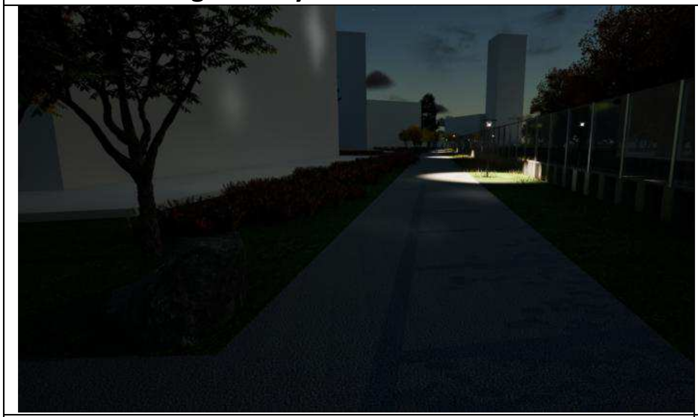


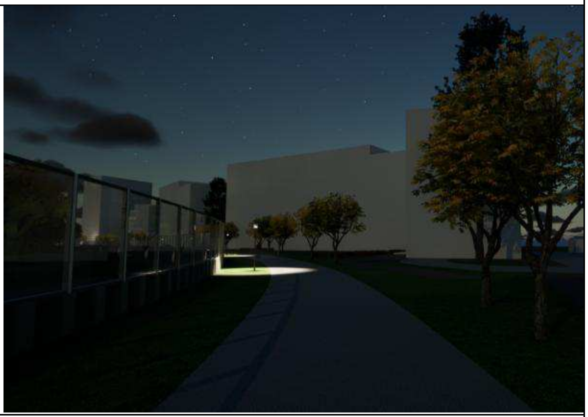
Scenario 5 Night+ Eelgrass/Rockwool/Wind Turbine Blades

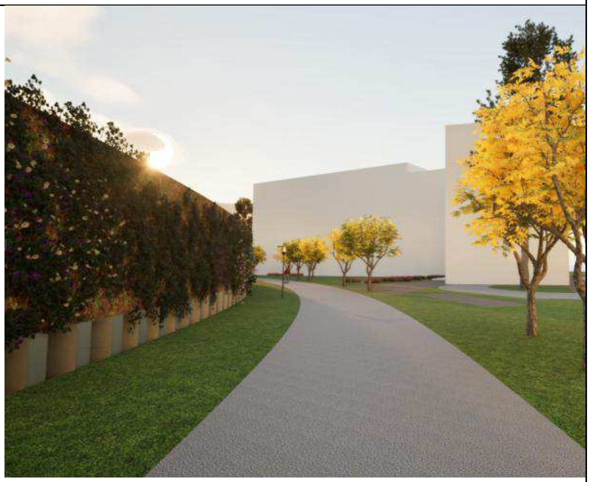




Scenario 5 Night+ Acrylic





Scenario 2/4 Planting Sunrise	
	
Scenario 3 Planting Sunrise	
	
Scenario 3 Planting Sunrise