Wicklow County Council

N11/M11 Junction 4 to Junction 14 Improvement Scheme

Option Selection Report
Appendix C7 – Noise and vibration

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1 Noise and vibration

1.1 Introduction

This report details the environmental assessment of the Stage 1 Preliminary Options Assessment for the N11/M11 Scheme with respect to the noise and vibration constraints identified in **Section 6** (Noise and vibration) of **Volume B**.

For the corridor assessment, the overall scheme has been split into two sections, i.e. the Northern Section and the Southern Section and the corridor options assessed are those discussed in **Section 6.1** of **Volume A**.

There are two zones associated with each corridor option referred to in this assessment:

- The potential road "footprint" which is the potential landtake required to construct or improve the road;
- The road "corridor" which is a 200m wide corridor centred around the alignment centre line for all off-line corridors. For the on-line Corridor Options 1 (North), 1 (South) and 5 (South), the width is variable, but is typically narrower than the width of the off-line corridors. The "footprint" sits inside the "corridor" boundary; and
- The "assessment study area" which includes a 300m assessment zone from the edge of the "footprint" line on both sides. There are four bands within this 300m assessment zone associated with each corridor option. These are referred to in the Potential Impact Rating (PIR) assessment criteria and are detailed in Section 1.3.1.

Section 1.2 outlines the methodology that was used to carry out the study, and **Section 1.3** outlines the assessment criteria which were used. The Stage 1 assessment and summary are presented in **Section 1.4** and references are listed in **Section 1.5**.

1.2 Methodology

The noise impact assessment has been conducted in accordance with the relevant guidance set down in **Section 5.0** of the Transport Infrastructure Ireland (TII), formerly National Roads Authority (NRA), 2004 Guidelines for the Treatment of Noise and Vibration in National Road Schemes (TII Noise Guidelines 2004)[1], within **Section 2** of the 2014 Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (TII Noise Guidelines 2014)[2] and in accordance with the requirements of the TII Project Management Guidelines 2019[3], and the TII Project Manager's Manual, 2019[4] and the TII Project Appraisal Guidelines for National Roads (PAG) Unit 7.0 – Multi Criteria Analysis[5] (hereafter referred to as the TII PAG).

In terms of operational noise, the TII 2004[1] and 2014[2] Noise Guidelines consider it appropriate to set the design goal for road traffic noise for new national roads in Ireland as follows:

- Day-evening-night 60dB L_{den} (free field)

Both TII noise documents referred to above[1,2] acknowledge that it may not always be sustainable to achieve this design goal. In such circumstances, nevertheless, a structured approach should be taken in order to ameliorate as far as practicable road traffic noise through the consideration of measures such as alignment changes, barrier type (e.g. earth mounds) or low noise road surfaces.

The assessment of potential noise impacts and ranking of corridor options is based primarily upon property counts, likely changes in traffic flow and a review of the likely requirement for mitigation measures. The potential magnitude of change in traffic noise levels has also been considered as part of this assessment to provide a further analysis of the potential impacts for each. The following has been conducted to assess the impact rating of each of the corridor options under consideration:

- Property counts have been conducted within four bands either side of the footprint line of each corridor option, i.e. 0 to 50m, 50 to 100m, 100 to 200m and 200 to 300m.

  The footprints represent the potential area required for a road including

[1]Transport Infrastructure Ireland, Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004. Available from: https://www.tii.ie/technical-services/environment/planning/Guidelines_for_the_Treatment_of_Noise_and_Vibration_in_National_Road_Schemes.pdf
[2] Transport Infrastructure Ireland, Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes, 2014. Available from: https://www.tii.ie/technical-services/environment/planning/Good_Practice_Guidance_for_the_Treatment_of_Noise_during_the_Planning_of_National_Road_Schemes.pdf
[3] Transport Infrastructure Ireland, Project Management Guidelines PE-PMG-02041, 2019. Available from: https://www.tiipublications.ie/library/PE-PMG-02041-02.pdf
[4] Transport Infrastructure Ireland, Project Management Manual PE-PMG-02042, 2019. Available from: https://www.tiipublications.ie/library/PE-PMG-02042-01.pdf
[5] Transport Infrastructure Ireland, Project Appraisal Guidelines for National Road Schemes Unit 7.0 – Multi Criteria Analysis, October 2016. Available from: https://www.tiipublications.ie/library/PE-PAG-02031-01.pdf

earthworks and ancillaries. In the case of the on-line corridor options, the footprint and the corridor are the same as space is heavily constrained by properties adjacent to the existing N11/M11. For the 0-50m band, all properties extending 50m from the footprint line are counted to ensure that an indicative road footprint is represented. This assumption for the purposes of this assessment, therefore, excludes all properties that may be acquired or demolished within the footprint, as these properties will no longer be receptors left in place. Using this information, the Potential Impact Rating (PIR) for each corridor option was established.

- Operational traffic noise levels at noise sensitive locations within 300m of each footprint were calculated taking into account the horizontal and vertical alignments for each corridor option, traffic flows for the Design Year and a traffic speed of 100km/hr.
- An assessment of the potential number of properties likely to be exposed to traffic noise levels at or above 60dB L_{den} and which meet the three TII criteria for noise mitigation was undertaken, and;
- An assessment of the likely change in traffic noise levels at properties along the existing N11/M11 and at newly affected properties in the case of off-line corridor segments has been conducted to assess the overall positive and negative impacts associated with the operation of each corridor option.

In terms of vibration, road traffic along normal well maintained surfaces, as is proposed for this road scheme, generates very low levels that are normally not perceptible to building occupants. For the purposes of this assessment, therefore, it is assumed that all routes will have a comparable low vibration impact during their operational stage and vibration is not assessed further.

The potential noise and vibration impacts associated with the construction phase of each route will be of short-term duration (less than 7 years). Whilst there will be varying impacts associated with each, the construction phase will be undertaken using standard road construction techniques and will be controlled through the use of construction noise and vibration limits. For the purpose of ranking options, the assessment has focused on longer term operational impacts only.

The ranking of corridor options during their operational stage is focused, therefore on the potential noise impact which will vary considerably between corridor options.

Based on the quantitative and qualitative analysis undertaken for each corridor option, all options have been assessed against the following scoring system based on the TII PAG[5] as follows:

7 – Major or highly positive;

6 – Moderately positive;

5 – Minor or slightly positive;

4 – Not significant or neutral;

3 – Minor or slightly negative;

2 – Moderately negative; and

1 – Major or highly negative.

1.3 Assessment criteria

The assessment of potential noise impacts and ranking of corridor options is based on the following assessment criteria:

- Potential Impact Rating (PIR)
- Likely Requirements for Noise Mitigation, and;
- Potential Changes in Noise Levels

1.3.1 Potential Impact Rating (PIR)

An assessment of potential noise impacts based upon the number of noise sensitive receptors within specified distance bands from each of the corridor options was undertaken.

The number of properties potentially sensitive to noise and/or vibration within 300m of each of the proposed corridor options has been identified. For the purpose of this study, property counts include existing residential properties, hospitals and medical buildings, educational buildings and religious buildings which were undertaken using OS mapping data[6]. The counts also take account of noise sensitive buildings which have been granted planning permission by Wicklow County Council (WCC) and Dún Laoghaire-Rathdown County Council (DLRCC) which were sourced from Geohive[7].

Property counts have been undertaken for four bands either side of the footprint line of each corridor option, i.e. 0 to 50m, 50 to 100m, 100 to 200m and 200 to 300m. For the 0-50m band, all properties extending out from the footprint line to 50m are counted to ensure that an indicative road footprint is represented. A weighting value for each distance band has been applied with a weighting factor of 4 for the closest distance band (0 to 50m) down to 1 for the furthest distance band (200 to 300m). For the PIR assessment, the calculated weighted value for each distance band is summed to obtain a total PIR value. The corridor option with the lowest PIR has the lowest nominal potential impact.

[6] Ordnance Survey Ireland. Licence Number 2020/35/CCMA/Wicklow County Council, OSI Digital Terrain Data (Prime 2) [Received from Wicklow County Council: 20 September 2019]
[7] Department of Housing, Planning and Local Government, National Planning Applications. Available from: https://data.gov.ie/dataset/national-planning-applications [Accessed: 02 April 2020]

Northern Section

Table 1.1 summarises the PIR values calculated for the northern corridor options using the weighting values for each distance band discussed above and taking account of existing properties and permitted developments/ properties within the 300m band.

Table 1.1: PIR assessment table Northern Section

Corridor Option	PIR 0-50m Band	PIR 50-100m Band	PIR 100-200m Band	PIR 200-300m Band	Total PIR
Corridor Option 1 (North)	2,264	1,656	2,470	1,100	7,490
Corridor Option 2 (North)	1,756	1,245	2,080	1,045	6,126
Corridor Option 3 (North)	1,260	1,107	1,898	974	5,239
Corridor Option 4 (North)	1,508	1,341	2,048	1,164	6,061

The highest PIR value is associated with Corridor Option 1 (North) (7,490) which follows the Red Corridor and is a fully on-line option. An on-line option will typically result in the highest PIR value due to the high number of existing properties located in proximity to the road edge.

Corridor Options 2 (North) and 4 (North) have similar PIR values to each other (6,126 and 6,061 respectively) with Corridor Option 3 (North) counting the lowest overall PIR. On the basis of the PIR analysis in isolation, Corridor Option 1 (North) has the highest potential noise impact due to the number and distribution of noise sensitive properties. On the basis of the above, Corridor Option 3 (North) would result in the lowest potential noise impacts.

Southern Section

Table 1.2 summarises the PIR values calculated for the southern corridor options using the weighting values for each distant band discussed above and taking account of existing properties and permitted developments/ properties within a 300m distance corridor.

Table 1.2: PIR assessment table Southern Section

Corridor Option	PIR 0-50m Band	PIR 50-100m Band	PIR 100-200m Band	PIR 200-300m Band	Total PIR
Corridor Option 1 (South)	672	405	484	210	1,771
Corridor Option 2 (South)	288	231	258	165	942
Corridor Option 3 (South)	488	369	444	247	1,548
Corridor Option 4 (South)	516	390	488	298	1,692
Corridor Option 5 (South)	672	405	484	211	1,772

The highest PIR value is associated with Corridor Options 1 (South) and 5 (South) (1,771 and 1,772 respectively) which follow the Red Corridor and Red Corridor (A) respectively. These corridors both follow the existing N11 and are therefore on-line options. An on-line option will typically result in the highest PIR value due to the high number of existing properties located in proximity to the road edge.

Corridor Option 4 (South) has the next highest PIR (1,692) followed by Corridor Option 3 (South) (1,548). Corridor Option 2 (South) has the lowest overall PIR (942) compared to the other corridor options.

On the basis of the PIR analysis in isolation, Corridor Options 1 (South) and 5 (South) have the highest potential noise impact due to the number and distribution of noise sensitive properties. On the basis of the above, Corridor Option 2 (South) would result in the lowest potential noise impacts.

Whilst the PIR assessment above provides information on the number of noise sensitive properties in the vicinity of each corridor option, the TII 2004[1] and 2014[2] Noise Guidelines acknowledge that the PIR process only provides an initial high level screening for option ranking. This is particularly true for studies where on-line upgrades form part of a corridor option. Consideration must also be given to the potential change in traffic noise levels at properties along the existing and new alignments to further determine potential overall noise impacts.

In addition to property counts, other factors which also dictate the potential noise impact from a corridor option, relate to its vertical alignment (cuttings, embankments, at grade, tunnels etc.), road traffic flows and potential for noise mitigation.

1.3.2 Likely requirement for noise mitigation

Consideration should be given to the off-line corridor option segments that are introducing traffic flows where none presently exist or along on-line corridor options where the alignment is modified or traffic flows are altered, to determine the requirement for noise mitigation. The following three conditions must be satisfied under the TII 2004[1] and 2014[2] Guidelines in order for noise mitigation to be provided:

- The combined expected maximum traffic noise level, i.e. the relevant noise level, from the proposed road development together with other traffic in the vicinity is greater than the design goal of 60dB L_{den};
- The relevant noise level is at least 1dB more than the expected traffic noise level without the proposed road development in place; and
- The contribution to the increase in the relevant noise level from the proposed road development is at least 1dB.

Calculation of noise footprint

The operational stage noise footprint for a given corridor option is dependent on a range of factors including traffic volumes, traffic speed, road surface type and the vertical alignment. For this assessment, traffic flows in terms of the Annual Average Daily Traffic (AADT) flows, percentage HGV's, horizontal and vertical alignments have been provided by the design team.

In order to analyse the potential noise impacts associated with the corridor options, the number of properties likely to require noise mitigation was determined using the following methodology:

- A 3D alignment for each corridor option was used to develop a 3D noise model of the corridor option provided by the design team;
- An indicative 3D contour mapping was obtained from LIDAR[8] grids up to 30m spacing. This was merged with a detailed topographical survey at Kilmacanoge[9] as the information was available as the time of assessment;

[8]Transport Infrastructure Ireland, 2m Grid Spacing LIDAR Mapping based on survey in 2010-2011. Available from: https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=b7c4b0e763964070ad69bf8c1572c9f5 [Accessed: January 2019] & 30m Grid Spacing LIDAR InfraWorks 360 Model Builder Software [Accessed: August 2019]

[9] Kilmacanoge Topographical Survey, 2017. Received from Kildare National Roads Design Office [Accessed: 05 February 2019]

- AADT traffic flows and percentage HGV's for individual sections of each corridor option and the existing N11/M11 were provided by the project traffic consultants for the Design Year of 2042 for the Do-Something and Reference Case scenarios;
- A standard hot rolled asphalt road surface was assumed for all corridor options;
- Using guidance from the TII's 2014 Guidelines[2], calculated traffic noise levels at properties within 300m of the road alignment were established using predictive noise modelling; and
- Noise levels were calculated at the same assessment locations for the Reference Case scenario for the year 2042 to determine the change in noise levels, and the requirement, if any, for noise mitigation.

Proprietary noise calculation software was used for the purposes of this study. The selected software, Brüel & Kjær Type 7810 *Predictor*, calculates traffic noise levels in accordance with the Calculation of Road Traffic Noise (CRTN)[10] and TII 2004 noise guidance[1]. The CRTN method of predicting noise from a road scheme consists of the following five elements:

- Divide the road scheme into segments so that the variation of noise within this segment is small;
- Calculate the basic noise level at a reference distance of 10 metres from the nearside carriageway edge for each segment;
- Assess for each segment the noise level at a specified receiver location point (i.e. noise sensitive building) taking into account distance attenuation and screening of the source line;
- Correct the noise level at the receiver location point to take account of site layout features, and the size of source segment; and
- Combine the contributions from all segments to give the predicted noise level at the receiver locations for the whole road scheme.

The calculations are based on Method A prescribed in the TII Guidelines[1] using hourly traffic data, determined from the diurnal traffic profiles provided in Appendix 1 of the TII 2004 noise Guidelines[1]. The CRTN methodology is used to produce $L_{A10(hour)}$ values which are then converted to $L_{Aeq(1\ hour)}$ values using the formula from Method A[1]. The output of the noise model using this method is calculated road traffic noise in terms of the L_{den} parameter. This is the noise parameter used in Ireland to describe and assess traffic noise.

[10] Department of Transport - UK. (1988) Calculation of Road Traffic Noise (CRTN). Available from: http://bailey.persona-pi.com/Public-Inquiries/M4-Newport/C%20-%20Core%20Documents/14.%20Noise%20and%20Vibration/14.2.1%20-%20Department%20of%20Transport%20and%20Welsh%20Office%20Calculation%20of%20Road%20Traffic%20Noise.%201988.pdf

Table 1.3 and **Table 1.4** summarise the number of properties calculated above 60dB L_{den} and the number of properties likely to require noise mitigation as per the three conditions for noise mitigation outlined above for the northern and southern sections respectively.

Table 1.3: Noise mitigation requirements Northern Section

Corridor Option North	**Indicative No of Properties above 60dB L_{den}**	**No of Properties Potentially Requiring Noise Mitigation**
Corridor Option 1 (North)	1,783	7
Corridor Option 2 (North)	1,661	28
Corridor Option 3 (North)	1,477	37
Corridor Option 4 (North)	1,347	26

For the Northern Section of the study area, the results of the modelling assessment have determined that the indicative number of properties exposed to road traffic noise levels above 60dB L_{den} are highest along Corridor Option 1 (North) which follows the on-line alignment. Corridor Option 2 (North) has the second highest number of properties exposed to traffic noise levels above 60dB L_{den} followed by Corridor Option 3 (North) and Corridor Option 4 (North).

The highest number of properties potentially requiring noise mitigation is along Corridor Option 3 (North). Corridor Options 2 (North) and 4 (North) have a similar number of properties likely to require noise mitigation. Corridor Option 1 (North) has the lowest number of properties likely requiring noise mitigation due to the minor change in noise levels above the existing noise environment as a result of the on-line upgrade option.

Table 1.4: Noise mitigation requirements Southern Section

Corridor Option South	**Indicative No of Properties above 60dB L_{den}**	**No of Properties Potentially Requiring Noise Mitigation**
Corridor Option 1 (South)	453	35
Corridor Option 2 (South)	371	58

Corridor Option South	Indicative No of Properties above 60dB L_{den}	No of Properties Potentially Requiring Noise Mitigation
Corridor Option 3 (South)	484	61
Corridor Option 4 (South)	487	73
Corridor Option 5 (South)	453	35

For the Southern Section of the study area, the results of the modelling assessment have determined that the indicative number of properties exposed to road traffic noise levels above 60dB L_{den} are similar along all corridor options, except Corridor Option 2 (South). The number of properties calculated above 60dB L_{den} along Corridor Option 4 (South) is marginally higher compared to the other corridor options with Corridor Option 2 (South) having the lowest number of properties in this assessment criterion.

The highest number of properties potentially requiring noise mitigation is along Corridor Option 4 (South), followed by Corridor Option 3 (South) and Corridor Option 2 (South). Corridor Options 1 (South) and 5 (South) have the lowest number of properties likely requiring noise mitigation due to the minor change in noise levels above the existing noise environment as a result of the on-line upgrade option.

1.3.3 Mitigation options

For all corridor options, opportunities for mitigation will likely incorporate a combination of a low noise road surface (LNRS) and noise barriers.

The TII 2014 Noise Guidelines[2] recommend a correction of -2.5dB for a LNRS compared to Hot Rolled Asphalt (HRA). An example surface is Stone Mastic Asphalt (SMA) which is commonly used along Irish roads which provides this level of reduction.

Where noise barriers are required, these can take the form of solid walls (concrete/brick), acoustic timber barriers, metal, plastic and bio barriers. The use of earth bunds can also be used as noise barriers where sufficient space is available. The location, height and length of noise barriers will be defined for the emerging preferred route following detailed noise modelling.

For sections of the on-line corridor alignment, the use of a LNRS would assist in reducing traffic noise levels at a large number of properties along the corridor. The on-line upgrade option may also provide an opportunity to incorporate new or enhance existing acoustic barriers along noise sensitive boundaries to reduce traffic noise levels at noise sensitive areas, where required.

For off-line corridor options, the use of a LNRS and noise barriers is likely to be used in combination to achieve the required traffic noise reductions.

1.3.4 Potential change in traffic noise levels

The potential change in traffic noise levels at noise sensitive locations associated with the operational stage of the individual corridor options has been calculated.

Traffic noise levels have been calculated for the Reference Case scenario, i.e. along the existing N11/M11 corridor at the surrounding noise sensitive locations in the assessment study area. The calculated traffic noise levels associated with each of the corridor options have been compared against the Reference Case traffic noise levels to determine the relative change at each noise sensitive location. For the Northern Section, a total of 3,499 noise sensitive buildings have been modelled for each corridor option, which capture all properties within 300m of all corridors in the study area. For the Southern Section, a total of 996 noise sensitive buildings have been modelled for each corridor option, which capture all properties within 300m of all corridors in the study area.

Assessment of Change in Traffic Noise Levels

In the absence of any Irish guidelines or standards relating to assessing the effects associated with changes in road traffic noise levels, reference is made to the UK's Design Manual for Roads and Bridges (DMRB) LA 111 Noise and vibration Revision 01 (2020)[11]. This document provides suggested magnitude rating tables relating to changes in noise levels associated with road traffic noise.

The magnitude of impacts is assessed by comparing the Reference Case noise level against the Do-Something scenario. The calculated road traffic noise levels used in this study relate to the Design Year of 2042, hence in line with the DMRB guidance, the following magnitude of change is applied for the long-term period (Design Year) as reproduced in **Table 1.5**.

Table 1.5: Classification of magnitude of traffic noise impacts in long term (DMRB 2020)[11]

Long-term Magnitude	Long term noise change, dB
Major	Greater than or equal to 10.0
Moderate	5.0 to 9.9
Minor	3 to 4.9
Negligible	Less than 3.0

[11] Design Manual for Roads and Bridges LA 111Noise and vibration, 2020. Available from: UK's Design Manual for Roads and Bridges (DMRB) LA 111 Noise and Vibration Rev 01 (2020). [Accessed: 02 April 2020]

For the purposes of ranking options, those options which introduce a new traffic source to properties and by association result in negative changes in noise levels have been scored lower than those with negligible impacts. The number of properties likely to experience positive changes in noise levels have been determined also, where traffic is diverted off the existing N11. The primary differentiator, therefore, is the potential for increases in traffic noise levels at new receptor points. The principle being that introducing negative impacts at new receptors is less preferable to reducing impacts at current receptors. Furthermore, opportunities exist along the on-line corridor options to incorporate noise mitigation measures as part of the upgrade works to reduce traffic noise levels overall along the corridor options which have the potential to result in positive impacts to existing properties.

Northern Section

Table 1.6 presents the number of properties calculated to experience a moderate negative change (+5 to +9.9dB) and major negative change (+10dB) change in noise level above the Reference Case scenario within the Northern Section representing a potential significant negative impact. The number of properties calculated to experience a moderate (-5 to -9.9dB) and major (-10dB) reduction in noise level compared to the Reference Case scenario has also been calculated to determine a potentially significant positive impact when compared to the Reference Case scenario.

Table 1.6: Number of properties with moderate and major changes in noise levels - Northern Section

Corridor Option North	**No of Properties Likely to Experience Change in Noise Level**			
	Moderate Negative	**Major Negative**	**Moderate Positive**	**Major Positive**
Corridor Option 1 (North)	0	0	0	0
Corridor Option 2 (North)	8	16	352	0
Corridor Option 3 (North)	36	24	566	50
Corridor Option 4 (North)	33	22	407	86

The assessment has determined that along Corridor Option 1 (North), there are no properties calculated to experience a magnitude of change greater or less than 5dB.

As traffic volumes between the Reference Case and Do-Something scenarios are the same along Corridor Option 1 (North), the change in noise environment along this corridor option is within +/-3dB compared to the Reference Case scenario and hence is negligible when compared against the DMRB long term significance criteria.

Corridor Option 2 (North) will result in a lower number of properties likely experiencing a moderate or major negative change in noise levels across the study area compared to Corridor Options 3 (North) and 4 (North). The likely number of properties experiencing a positive change in noise levels along this corridor are significantly greater than Corridor Option 1 (North), but less than those associated with Corridor Options 3 (North) and 4 (North).

Corridor Options 3 (North) and 4 (North) are likely to result in the highest number of properties experiencing a moderate or major negative change in noise levels compared to the other corridor options. Both corridor options, however, have the highest number of properties likely to experience a moderate or major positive change in noise levels compared to the other options with Corridor Option 4 (North) resulting in the highest positive impacts overall.

Southern Section

Table 1.7 presents the number of properties calculated to experience a moderate negative change (+5 to +9.9dB) and major negative change (+10dB) change in noise level above the Reference Case scenario within the Southern Section representing a potential significant negative impact. The number of properties calculated to experience a moderate (-5 to -9.9dB) and major (-10dB) reduction in noise level compared to the Reference Case scenario has also been calculated to determine a potentially significant positive impact when compared to the Reference Case scenario.

Table 1.7: Number of properties with major change in noise levels -Southern Section

Corridor Option South	**No of Properties Likely to Experience Change in Noise Level**			
	Moderate Negative	**Major Negative**	**Moderate Positive**	**Major Positive**
Corridor Option 1 (South)	0	0	0	0
Corridor Option 2 (South)	28	18	166	0
Corridor Option 3 (South)	14	168	53	0
Corridor Option 4 (South)	24	151	68	0

Corridor Option South	No of Properties Likely to Experience Change in Noise Level			
	Moderate Negative	Major Negative	Moderate Positive	Major Positive
Corridor Option 5 (South)	0	0	0	0

The assessment has determined that along Corridor Options 1 (South) and 5 (South), there are no properties calculated to experience a magnitude of change greater or less than 5dB. As traffic volumes between the Reference Case and Do-Something scenarios are the same along this Corridor Option 1 (South), the change in noise environment along this corridor option is within +/-3dB compared to the Reference Case scenario and hence is negligible when compared against the DMRB long term significance criteria.

Corridor Option 2 (South) will result in a lower number of properties likely experiencing a moderate to major negative change in noise levels across the study area compared to Corridor Options 3 (South) and 4 (South). This corridor option is determined to result in the highest number of properties likely experiencing a positive change in noise levels compared to the other corridor options.

Corridor Options 3 (South) and 4 (South) are likely to result in the highest number of properties experiencing a moderate to major negative change in noise levels compared to the other corridor options. Corridor Option 4 (South) results in a marginally higher number of properties likely to experience a positive change in traffic noise levels compared to Corridor Option 3 (South), both corridor options result in lower positive changes to noise levels compared to Corridor Option 2 (South).

1.4 Stage 1 corridor options assessment

All corridor options have the potential to generate a negative noise impact at noise sensitive properties impacted by the new and existing alignments. A positive impact will be experienced at a number of existing properties along the N11/M11 where the proposed option diverts from the existing N11/M11 road.

Taking account of the assessments set out above, the impact rating score and associated qualitative assessment for each corridor option within the Northern Section of the study area are summarised in **Table 1.8**.

Table 1.8: Summary assessment table Northern Section

Assessment Criteria	Corridor Option 1 (North)	Corridor Option 2 (North)	Corridor Option 3 (North)	Corridor Option 4 (North)
Potential Impact Rating (PIR)	7,490	6,126	5,239	6,061

Assessment Criteria	Corridor Option 1 (North)	Corridor Option 2 (North)	Corridor Option 3 (North)	Corridor Option 4 (North)
No. of Properties likely above 60dB L_{den}	1,783	1,661	1,477	1,347
No of Properties likely to experience a Major Negative Impact	0	16	24	22
No of Properties likely to experience a Moderate Negative Impact	0	8	36	33
No of Properties likely to experience a Major Positive Impact	0	0	50	86
No of Properties likely to experience a Moderate Positive Impact	0	352	566	407
No of properties likely to require noise mitigation	7	28	37	26
Qualitative Assessment	Minor or slightly negative	Minor or slightly negative	Minor or slightly negative	Minor or slightly negative
Score / Impact Level	3	3	3	3
Preference	Preferred	Intermediate	Intermediate	Intermediate

Taking account of all assessment criteria, Corridor Option 1 (North) is determined to result in a *minor or slightly negative* impact level in terms of noise. This is determined on the basis of the lowest number of properties likely to require noise mitigation and the negligible magnitude of negative change that will be experienced at properties overall within the study area. Opportunities exist along this corridor to incorporate noise mitigation measures as part of the upgrade works to reduce traffic noise levels overall along the corridor which have the potential to result in positive impacts to existing properties. On balance, this corridor option is ranked marginally above the other options as the preferred option due to the less significant change in traffic noise levels compared to the other options.

Taking account of all assessment criteria, Corridor Option 2 (North) is determined to result in a *minor or slightly negative* impact level in terms of noise.

For this corridor option, the number of properties exposed to noise levels above 60dB L_{den} is second highest compared to the other options. This corridor option has a comparable number of properties likely requiring noise mitigation to Corridor Option 4 (North) and a lower number compared to Corridor Option 3 (North). This corridor option results in a lower number of properties likely to experience negative impacts compared to Corridor Options 3 (North) and 4 (North). This corridor option results in a lower number of properties likely experiencing a positive noise impact compared to Corridor Options 3 (North) and 4 (North). On balance this option is ranked intermediate.

Corridor Option 3 (North) is determined to result in a *minor or slightly negative* impact in terms of noise. This corridor option has the highest likely requirement for noise mitigation and has the highest potential negative impacts compared to the other corridor options. For this corridor option, the number of properties exposed to noise levels above 60dB L_{den} is second lowest compared to the other options. Additionally, this corridor option results in the highest number of properties likely to experience a positive impact compared to the other corridor options. On balance this option is ranked intermediate.

Corridor Option 4 (North) is determined to result in a *minor or slightly negative* impact in terms of noise. This corridor option has a comparable number of properties likely requiring noise mitigation to Corridor Option 2 (North) and a lower number compared to Corridor Option 3 (North). For this corridor option, the number of properties exposed to noise levels above 60dB L_{den} is lowest compared to the other options. Additionally, this corridor option results in the second highest number of properties likely to experience a combination of major and moderate positive impacts compared to the other corridor options. On balance this option is ranked intermediate.

Taking account of the assessments set out above, the impact rating score and associated qualitative assessment for each corridor option within the Southern Section of the study area are summarised in **Table 1.9**.

Table 1.9: Summary assessment table Southern Section

Assessment Criteria	**Corridor Option 1 & 5 (South)**	**Corridor Option 2 (South)**	**Corridor Option 3 (South)**	**Corridor Option 4 (South)**
Potential Impact Rating (PIR)	1,771	942	1,548	1,692
No. of Properties likely above 60dB L_{den}	453	371	484	487
No of Properties likely to experience a Major Negative Impact	0	18	168	151

Assessment Criteria	Corridor Option 1 & 5 (South)	Corridor Option 2 (South)	Corridor Option 3 (South)	Corridor Option 4 (South)
No of Properties likely to experience a Moderate Negative Impact	0	28	14	24
No of Properties likely to experience a Major Positive Impact	0	0	0	0
No of Properties likely to experience a Moderate Positive Impact	0	166	53	68
No of properties likely to require noise mitigation	35	58	61	73
Qualitative Assessment	Minor or slightly negative	Minor or slightly negative	Moderately negative	Moderately negative
Score / Impact Level	3	3	2	2
Preference	Preferred	Intermediate	Least Preferred	Least Preferred

Taking account of all assessment criteria, Corridor Options 1 (South) and 5 (South) are determined to result in a *minor or slightly negative* impact level in terms of noise. This is determined on the basis of the lowest number of properties likely to require noise mitigation and the negligible magnitude of negative change that will be experienced at properties overall within the study area. Whilst these options do not provide a moderate or major positive impact to properties along the existing N11/M11, this option will result in the least negative impact overall. Opportunities exist along this corridor to incorporate noise mitigation measures as part of the upgrade works to reduce traffic noise levels overall along the corridor which have the potential to result in positive impacts to existing properties. On balance, these corridor options are ranked marginally above Corridor Option 2 (South) as the preferred options due to the less significant change in traffic noise levels compared to the other options.

Taking account of all assessment criteria, Corridor Option 2 (South) is determined to result in a *minor or slightly negative* impact level in terms of noise. For this corridor option, the number of properties exposed to noise levels above 60dB L_{den} is lowest compared to the other options.

This corridor option has the second lowest number of properties likely requiring noise mitigation compared to the other corridor options and results in lower total negative magnitude of changes compared to Corridor Options 3 (South) and 4 (South). This corridor option results in the highest number of properties likely experiencing a positive noise impact compared to the other corridor options. On balance this option is ranked intermediate.

Corridor Options 3 (South) and 4 (South) are determined to result in a *moderately negative* impact level in terms of noise. Corridor Option 4 (South) results in the highest number of properties likely to require noise mitigation compared to the other options and Corridor Option 3 (South) has the second highest. Both options result in a high number of properties experiencing a *major negative* impact overall to newly affected properties. The number of properties likely to experience a *moderate positive* impact is lower along both Corridor Options 3 (South) and 4 (South), compared to Corridor Option 2 (South). On balance both these corridor options are ranked as least preferred.

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