# Technical Note

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| **TO** | [redacted] (Scotland Transerv)<br>[redacted] (Scotland Transerv)<br>[redacted] (Transport Scotland)<br>[redacted] (Transport Scotland)<br>[redacted] (Transport Scotland) | **FROM** | [redacted] (WSP) |
| **DATE** | **20 December 2019** | **CONFIDENTIALITY** | **Internal** |
| **SUBJECT** | **70064876 – TNAP 2019-2023 Noise Mitigation Pilot – A82 Renton – Receptor Noise Level Changes** | | |

## BACKGROUND AND INTRODUCTION

For the A82 Renton noise barrier pilot location, initial preferred noise barrier alignments were previously provided by WSP on the 19 November 2019. The initial alignments provided on that date included preferred barrier routes for consideration on both the west and east sides of the A82.

The purpose of providing the initial barrier alignments was to facilitate the parallel consideration of other potential constraints to project delivery (by the respective dealing specialists) whilst the data necessary to facilitate noise level predications/modelling and optimisation of the acoustic requirements of the barriers (including height and length etc.) was awaited. The provided initial alignments were therefore selected with consideration to acoustic principles only and prior to undertaking any noise level predictions.

The approach to the determination of the initial barrier alignments is detailed within the WSP Memorandum dated 19 November 2019. In summary, the alignments were selected based upon a review of available 1m grid LiDAR Digital Terrain Model (DTM) (i.e. topographic) data and freely available aerial photography for the site and surrounding area. The barrier alignments were selected based on the routes within the existing topography that would provide the greatest acoustic path difference (best obstruction and therefore best noise reduction) between the A82 and the adjacent residential dwellings.

Subsequent to the provision of the initial alignments, it was agreed by Transport Scotland that a noise barrier / noise barriers on the west side of the A82 should not be progressed further as part of study for this pilot area. It is of note that the existing topography on the west side of the A82, with residential dwellings raised above and overlooking the A82 does not lend itself to the delivery of an affected noise barrier. However, to the east, ground height decreases with distance from road such that dwellings set down an existing slope. This topography lends itself to the delivery of an effective acoustic barrier and Transport Scotland have agreed that a barrier on this side of the A82 should therefore be progressed.

Subsequent to the provision of the initial barrier alignments, additional project information has recently been received, including the Ordinance Survey MasterMap Topography Layer (i.e. detailed OS referenced site mapping) and AddressBase Plus data, as well as receipt of approval for processing of the available traffic data into the formats required for noise modelling purposes.

At the meeting held between Scotland TranServ, Transport Scotland and WSP on 17 November 2019 and the subsequent project call on 19 December 2019, it was highlighted by WSP that there are a number of different approaches that can be adopted in the optimisation of acoustic barrier alignments, lengths and heights. These include, for example, a simple consideration of resulting receptor noise level changes applicable to different barrier heights/lengths, or assessment based on the WebTAG Noise workbook which allows consideration to monetised benefit ('net present value') and can assist in determining cost-benefit. It was also highlighted that the approach adopted in the noise modelling exercise, including the assumptions made, can have a bearing on assessment results. This includes how factors such as building heights, receptor heights, nature of ground cover and the façade locations selected for assessment are addressed.

## Modelled Scenarios

Prior to the project call on the 19 November WSP had already updated the noise model to reflect the received OS MasterMap data including an associated adjustment to the previously provided eastern indicative barrier alignment, such that this alignment is based on this mapping rather than the less accurate aerial photography. The noise model had also been updated to incorporate the OS MasterMap building layer data, with residential dwellings identified based on the AddressBase Plus data.

It was agreed that WSP would further update the model to incorporate the 2018 A82 traffic data (which had been processed into the formats required to inform noise level predictions). The model was then to be used to determine the residential receptor noise levels for the following scenarios:

- 2018 No Barrier;
- 2018 2m barrier;
- 2018 2.5m barrier;
- 2018 2.8m barrier; and
- 2018 3.0m barrier.

It was agreed that the noise barrier length to be adopted in the modelling exercise would be circa 240m, which was the length of the initial barrier alignment previously provided.

## Results

A total of 7 properties have been identified on the east side of the A82, all of which are located on Carman Road. In addition, a total of 7 properties have also been identified on the opposite (west) side of the A82, all on Upper Carman Road. The receptors on Upper Carman Road have also been included within the completed noise level predictions to enable consideration of possible noise level increases as a result of noise that could be reflected back in the opposite direction if an acoustically reflective barrier was constructed.

The noise model has been used to determine the $L_{A10,18hour}$ daytime noise level at each residential dwelling. The prediction point at each dwelling has been selected as 1m in front of the dwelling facade that is closest to, and facing in the direction of, the A82. A +2.5dB façade correction has been included in the modelled results. Predictions have been undertaken at both ground floor (1.5m above ground) and first floor (4m above ground) at each dwelling.

The resulting receptor noise levels for each assessed scenario are presented within Tables 1 to 4 below. Also presented are the receptor noise level changes arising as a result of each barrier option, and the 'average' increase / decrease across all dwellings on each side of the A82.

## Table 1 – East Side (Carman Road), Ground Floor, Façade noise Level, 2018 - $L_{A10,18hr}$ dB

| Receptor Name | Absolute Noise Level | | | | | Noise Level Change (over 2018 No Barrier) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | No Barrier | 2m Barrier | 2.5m Barrier | 2.8m Barrier | 3m Barrier | 2m Barrier | 2.5m Barrier | 2.8m Barrier | 3m Barrier |
| [redacted] | 58.8 | 56.3 | 55.5 | 55.1 | 54.9 | -2.5 | -3.3 | -3.7 | -3.9 |
| [redacted] | 66.0 | 60.9 | 59.9 | 59.3 | 58.9 | -5.1 | -6.1 | -6.7 | -7.1 |
| [redacted] | 64.5 | 59.1 | 58.2 | 57.8 | 57.5 | -5.4 | -6.3 | -6.7 | -7.0 |
| [redacted] | 65.5 | 60.0 | 59.0 | 58.5 | 58.1 | -5.5 | -6.5 | -7.0 | -7.4 |
| [redacted] | 65.8 | 60.3 | 59.3 | 58.7 | 58.4 | -5.5 | -6.5 | -7.1 | -7.4 |
| [redacted] | 57.9 | 54.6 | 53.9 | 53.5 | 53.2 | -3.3 | -4.0 | -4.4 | -4.7 |
| [redacted] | 63.1 | 59.7 | 59.0 | 58.7 | 58.5 | -3.4 | -4.1 | -4.4 | -4.6 |
| **Average for All Receptors** | - | - | - | - | - | **-4.4** | **-5.3** | **-5.7** | **-6.0** |

## Table 2 – East Side (Carman Road), First Floor, Façade noise Level, 2018 - $L_{A10,18hr}$ dB

| Receptor Name | Absolute Noise Level | | | | | Noise Level Change (over 2018 No Barrier) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | No Barrier | 2m Barrier | 2.5m Barrier | 2.8m Barrier | 3m Barrier | 2m Barrier | 2.5m Barrier | 2.8m Barrier | 3m Barrier |
| [redacted] | 61.4 | 57.5 | 56.7 | 56.3 | 56.0 | -3.9 | -4.7 | -5.1 | -5.4 |
| [redacted] | 70.1 | 63.2 | 62.1 | 61.4 | 61.1 | -6.9 | -8.0 | -8.7 | -9.0 |
| [redacted] | 68.1 | 61.7 | 60.9 | 60.4 | 60.1 | -6.4 | -7.2 | -7.7 | -8.0 |
| [redacted] | 68.8 | 62.4 | 61.4 | 60.8 | 60.5 | -6.4 | -7.4 | -8.0 | -8.3 |
| [redacted] | 69.2 | 62.6 | 61.6 | 61.0 | 60.7 | -6.6 | -7.6 | -8.2 | -8.5 |
| [redacted] | 59.5 | 55.9 | 55.3 | 54.9 | 54.7 | -3.6 | -4.2 | -4.6 | -4.8 |
| [redacted] | 66.0 | 61.6 | 60.9 | 60.6 | 60.4 | -4.4 | -5.1 | -5.4 | -5.6 |
| **Average for All Receptors** | - | - | - | - | - | **-5.5** | **-6.3** | **-6.8** | **-7.1** |

## Table 3 – West Side (Upper Carman Road), Ground Floor, Façade noise Level, 2018 - $L_{A10,18hr}$ dB

| Receptor Name | Absolute Noise Level | | | | | Noise Level Change (over 2018 No Barrier) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | No Barrier | 2m Barrier | 2.5m Barrier | 2.8m Barrier | 3m Barrier | 2m Barrier | 2.5m Barrier | 2.8m Barrier | 3m Barrier |
| [redacted] | 71.6 | 72.4 | 72.4 | 72.4 | 72.4 | +0.8 | +0.8 | +0.8 | +0.8 |
| [redacted] | 64.9 | 66.0 | 66.0 | 66.0 | 66.0 | +1.1 | +1.1 | +1.1 | +1.1 |
| [redacted] | 66.4 | 67.6 | 67.6 | 67.6 | 67.6 | +1.2 | +1.2 | +1.2 | +1.2 |
| [redacted] | 64.7 | 65.8 | 65.8 | 65.8 | 65.8 | +1.1 | +1.1 | +1.1 | +1.1 |
| [redacted] | 64.7 | 65.8 | 65.8 | 65.8 | 65.8 | +1.1 | +1.1 | +1.1 | +1.1 |
| [redacted] | 61.3 | 62.4 | 62.4 | 62.4 | 62.4 | +1.1 | +1.1 | +1.1 | +1.1 |
| [redacted] | 61.5 | 62.6 | 62.6 | 62.6 | 62.6 | +1.1 | +1.1 | +1.1 | +1.1 |
| **Average for All Receptors** | - | - | - | - | - | **+1.1** | **+1.1** | **+1.1** | **+1.1** |

## Table 4 – West Side (Upper Carman Road), First Floor, Façade noise Level, 2018 - $L_{A10,18hr}$ dB

| Receptor Name | Absolute Noise Level | | | | | Noise Level Change (over 2018 No Barrier) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | No Barrier | 2m Barrier | 2.5m Barrier | 2.8m Barrier | 3m Barrier | 2m Barrier | 2.5m Barrier | 2.8m Barrier | 3m Barrier |
| [redacted] | 73.6 | 74.4 | 74.4 | 74.4 | 74.4 | +0.8 | +0.8 | +0.8 | +0.8 |
| [redacted] | 66.5 | 67.6 | 67.6 | 67.6 | 67.6 | +1.1 | +1.1 | +1.1 | +1.1 |
| [redacted] | 68.6 | 69.8 | 69.8 | 69.8 | 69.8 | +1.2 | +1.2 | +1.2 | +1.2 |
| [redacted] | 64.6 | 65.7 | 65.7 | 65.7 | 65.7 | +1.1 | +1.1 | +1.1 | +1.1 |
| [redacted] | 66.5 | 67.6 | 67.6 | 67.6 | 67.6 | +1.1 | +1.1 | +1.1 | +1.1 |
| [redacted] | 64.1 | 65.1 | 65.1 | 65.1 | 65.1 | +1.0 | +1.0 | +1.0 | +1.0 |
| [redacted] | 64.3 | 65.3 | 65.3 | 65.3 | 65.3 | +1.0 | +1.0 | +1.0 | +1.0 |
| **Average for All Receptors** | - | - | - | - | - | **+1.0** | **+1.0** | **+1.0** | **+1.0** |

## Conclusion

It can be seen from Tables 1 and 2 above that the average noise reductions for properties at Carman Road range from 4.4dB to 7.1dB depending upon barrier height and receptor height considered. The single highest reduction is identified for the dwelling of Torabb, where a 9dB reduction is identified at first floor level for a 3m high barrier.

Comparison of Tables 1 and 2 identifies that greater noise level reductions are afforded at first floor height compared to ground floor height. This is because the existing topography (without barrier) provides less acoustic screening at first floor compared to ground floor.

From Tables 3 and 4, it can be seen that the installation of a reflective acoustic barrier (as modelled) would result in an increase in noise levels for dwellings on Upper Carman Road, of the order of 1dB. To minimise such increases, the proposed barrier should therefore be acoustically absorptive on the side facing the road. This is further considered below.

### ACOUSTIC PERFORMANCE

The *Manual for contract documents for highways works Series NG 2500 Special Structures* (MCHW) states the following at paragraph 14:

> *"The overall insulation performance of a barrier should be at least 10 dBA higher than the calculated screening attenuation. Care should be taken to prevent loss of performance through leakage at gaps and joints. It should be noted that the mass law may overpredict the insulation performance of barriers constructed from timber planks. Consideration should be given as to whether evidence of acoustic tests should be required to demonstrate achievement of specified requirements.*
>
> *BS EN 1793-2 recommends a classification of barrier products covering ranges of performance measured as $DL_R$ as follows:*
>
> > *B0 not tested*
> >
> > *B1 < 15*
> >
> > *B2 15 - 24*
> >
> > *B3 >24"*

In comparison the recently published LA119 *Roadside Environmental Mitigation and enhancement* document states the following at paragraph 5.3:

> "*The required sound insulation category specified by BS EN 1793-2: 1998 [Ref 12.N] shall be determined by the addition of 15 dB(A) to the maximum insertion loss specified for the barrier in the environmental statement or environmental assessment report."*

It can be seen from the tables above that the greatest degree of screening attenuation / insertion loss that is predicted to arise is 9dB (at Trabb, first floor). In accordance with the above, the minimum required $DL_R$ sound insulation performance required from the final selected barrier system should therefore be at least 24dB, a barrier system that has been tested and confirmed to be of B3 classification in accordance with BS EN 1793 would ensure compliance with this requirement.

With regards to absorptive barriers, the MCHW states the following at paragraph 15:

*“Absorptive materials reduce reflected noise and reverberation, which may sometimes reduce the effectiveness of a barrier. Acoustic test results may exceed the theoretical maximum of αi = 1 at some frequencies. This is acceptable provided the overall summation is less than the sum of the weightings. For an overall efficiency of 80%, the absorption index DLα is approximately 7; the limiting value allowed by the standard is DLα = 20. BS EN 1793-1 recommends a classification of barrier products covering ranges of performance measured as DLα as follows:*

*A0 not tested*

*A1 < 4*

*A2 4 – 7*

*A3 8 – 11*

*A4 > 11”*

The recently published LA119 *Roadside Environmental Mitigation and enhancement* document states the following at paragraph 5.4:

*“Where the environmental statement or environmental assessment report states that an absorptive barrier is required, the sound absorption shall be determined by BS EN 1793-1: 1998 [Ref 11.N], and:*

*1) where the barrier is determined as a single barrier, a minimum performance of class A1; or,*

*2) where the barrier is determined as a parallel barrier, a minimum performance of class A3”*

It can be seen from Tables 3 and 4 above that the installation of a reflective barrier will increase noise levels for properties on Upper Carman Road. The barrier to be installed should therefore be absorptive on its western side (i.e. the side facing properties on Upper Carman Road). It this case, the barrier is not a ‘Parallel Barrier’ (i.e. there is not a barrier on the opposite side of the road. Therefore, the side of the barrier facing the road and pper Carman Road should confirm to a minimum A1 absorption classification in accordance with BS EN 1793-1.

As noted above, the modelled results are dependent upon the approach adopted to the completed noise level predictions including the assumptions made. A more detailed Technical Memorandum will therefore be prepared for issue in the first full week of January. That memorandum will further document the approach that has been adopted in the completed noise modelling exercise. However, based on previous discussions, we trust that the above information is sufficient to inform the decision to be made over the preferred barrier height for this location.

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