SHEPPARTON BYPASS LINK STAGE ONE
SHEPPARTON NORTH

Consideration of Traffic Noise Level Changes at Existing Residential Dwellings Due to Changes in Road Configuration

Prepared for:
Greater Shepparton City Council
90 Welsford Street
Shepparton
Victoria 3630

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1. **INTRODUCTION**

It is proposed to construct a new road known as the Shepparton Bypass Link.

The proposed road will diverge from the Goulbourn Valley Highway at a location south of Kialla West and traverse lands to the west of Shepparton and Mooroopna, before re-joining the Goulbourn Valley Highway to the north of Congupna.

The proposed road is to be built in stages. Stage One will connect the Midland Highway west of Mooroopna to Wanganui Road north of Shepparton.

At the completion of the stage one road construction, it is expected that significant increases in traffic will occur along Wanganui Road, with more modest increases along Ford Road.

In response to concerns regarding the expected increase in traffic, Watson Moss Growcott has been engaged to conduct an assessment of likely changes in traffic noise level associated with the proposed Shepparton Bypass Link, Stage One. The assessment has included the following:

1. Two attended site visits during which the attending engineer carried out handheld traffic noise level measurements;

2. Analysis of four unattended noise logging devices deployed at representative locations along Wanganui and Ford Roads;

3. Review of traffic counts carried out (by others) concurrently with the noise logging and predicted traffic flows as result of the construction of Shepparton Bypass Link Stage One; and

4. Traffic noise modelling in accordance with ‘Calculation of Road Traffic Noise’ – Department of Transport Welsh Office (CoRTN) and the VicRoads Requirements of Developers.

This report sets out the results and findings of the assessment.
2. SITE AND ENVIRONS

The assessment has been carried out along Wanganui Road and Ford Road, Shepparton, from near Rudd Road where Stage 1 of the Shepparton Bypass Link is proposed to meet Wanganui Rd in the west to Grahamvale Road in the east.

A map showing the proposed bypass is included at Appendix 1.

Wanganui Road is located between Golf Drive in the west and the Goulburn Valley Highway in the east. It is currently surrounded primarily by farming land with some commercial uses particularly at the east end near the Goulburn Valley Highway. Three residential dwellings are located on the north side of the road.

Ford road connects the Goulburn Valley Highway in the west to Grahamvale Road in the east. The road is surrounded by a mixture of residential dwellings and farming areas. It is noted that additional residential dwellings are proposed and/or currently under construction in the area in the vicinity of Ford Road. Commercial use was identified near the Goulburn Valley Highway and Verney Road.

The subject site and surrounding area is located on flat land.

An aerial photo identifying the relevant components within the vicinity of Wanganui Road Reservation appears below:

An aerial photo identifying the relevant components within the vicinity of Ford Road Reservation appears below:
3. **NOISE ASSESSMENT METHODOLOGY**

3.1 **NOISE ASSESSMENT TERMINOLOGY**

The following terms are used in this report:

- **dB(A)**: Decibels recorded on a sound level meter, which has had its frequency response modified electronically to an international standard, to quantify the average human loudness response to sounds of different character.

- **L₉₀**: the level exceeded for 90% of the measurement period, which is representative of the typical lower levels in a varying noise environment. It is the noise measure defined by the EPA as the measure of the background noise level to use in determining noise limits.

- **Lₑq**: the equivalent continuous level that would have the same total acoustic energy over the measurement period as the actual varying noise level under consideration. It is the noise measure defined by the EPA as the measure of the noise to use in assessing compliance with noise limits.

- **L₁₀**: Commonly described as the average of the higher levels of a range of noise levels. It is the value of a range of values exceeded for 10% of the observation period, i.e. the level exceeded for 6 minutes for every 60 minutes of observation.

- **L₁₀,18hr**: The L₁₀,18hour noise level is the arithmetic average of the hourly L₁₀ noise levels measured between 6:00am and midnight.

3.2 **NOISE MEASUREMENT EQUIPMENT**

As part of the assessment, Watson Moss Growcott has carried out attended site measurements, as well as unattended noise logging within the boundaries of the subject site.

Noise measurements at the subject site were conducted using the following equipment:

**Table 1: Noise Measuring Equipment**

<table>
<thead>
<tr>
<th>Equipment Designation</th>
<th>Use of Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rion NA27 Precision Sound Level Meter</td>
<td>Handheld Noise Measurements</td>
</tr>
<tr>
<td>Ngara Real Time Sound Acquisition System</td>
<td>Unattended Noise Logging Measurements</td>
</tr>
</tbody>
</table>

The field calibration of the measurement equipment was checked before and after the site measurements, and was within the correct calibration range.

3.3 **TRAFFIC NOISE MODELLING IN RELATION TO FUTURE TRAFFIC NOISE LEVELS**

Calculation of future traffic noise levels has been conducted using the procedures set out in *Calculation of Road Traffic Noise* (CoRTN), Department of Transport (Welsh Office) 1988, as implemented in the software package Prediction of Environmental Noise (PEN) 3D.
4. TRAFFIC NOISE CONSIDERATIONS INCLUDING VICROADS TRAFFIC POLICY

The traffic noise assessment has given consideration to the VicRoads Traffic Noise Policy 2005.

The policy includes the following guidelines with regards to limiting noise next to new or improved roads:

*Where arterial roads and freeways are built on new alignments, or where existing arterial roads or freeways are widened by two or more lanes and buildings previously protected from traffic noise are exposed by removal of buildings required for widening, the traffic noise level will be limited to the objectives set out below or the level that would have prevailed if the road improvements had not occurred, whichever is the greater.*

- **Category A:** For residential dwellings, aged persons homes, hospitals, motels, caravan parks and other buildings of a residential nature, the noise level objective will be $63 \text{ dB(A)} L_{10} (18\text{hr})$ measured between 6 am and midnight,

- **Category B:** For schools, kindergartens libraries and other noise-sensitive community buildings the noise level objective will be $63 \text{ dB(A)} L_{10} (12\text{hr})$ measured between 6 am and 6 pm,

- **Where the noise level adjacent to Category A or B buildings prior to road improvements is less than 50 \text{ dB(A) } L_{10} (18\text{hr})**, consideration will be given to limiting the noise level increase to 12 dB(A).

The proposed changes to Wanganui Rd and Ford Rd as part of Stage 1 of the Shepparton Bypass do not trigger the objectives above, as the road changes do not involve building a road on a new alignment and the changes to the existing roads do not involve removal of buildings required for widening that would expose buildings previously protected from traffic noise to the traffic stream.

The VicRoads Traffic Noise Policy noise objectives can be used to provide a context for increased traffic noise levels associated with the project.

Consideration can also be given to traffic noise level increases based on the following generally accepted subjective responses to increases in noise level:

- An increase of 1-2 decibels is commonly not perceptible.
- An increase of 3 decibels is commonly perceived as a ‘just noticeable difference’.
- An increase of 5 decibels is commonly perceived as a ‘clearly noticeable difference’.
- An increase of 10 decibels is commonly perceived as a doubling of loudness.
5. TRAFFIC NOISE MEASUREMENTS AND NOISE LOGGING

As part of the assessment, Watson Moss Growcott has carried out attended hand held noise measurements, and unattended noise logging at the subject site. The attended and unattended noise measurements were carried out during the following times:

1. Site attended noise survey including hand held noise level measurements between 2:00pm and 4:00pm on Thursday 10th August 2017;
2. A total of four unattended noise loggers were deployed at the residential premises along the relevant roads during the period Thursday 10th August until Tuesday 15th August 2017.

A mark-up of the assessment locations is attached below:

A summary of the measurement locations and noise measurement equipment is set out below.

Table 2: Noise Monitoring Details

<table>
<thead>
<tr>
<th>Noise Measurement Location</th>
<th>Latitude and Longitude of Microphone Position</th>
<th>Noise Logging Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Location 1</td>
<td>Latitude: 36° 20' 49.6&quot; S</td>
<td>ARL Ngara Environmental Noise Logger</td>
</tr>
<tr>
<td>80 Wanganui Road (front of dwelling)</td>
<td>Longitude: 145° 23' 34.6&quot; E</td>
<td></td>
</tr>
<tr>
<td>Measurement Location 2</td>
<td>Latitude: 36° 20' 52.1&quot; S</td>
<td>ARL Ngara Environmental Noise Logger</td>
</tr>
<tr>
<td>38 Ford Road (middle of front yard, representative of the setback of the house at 50 Ford Rd from the road)</td>
<td>Longitude: 145° 24' 20.1&quot; E</td>
<td></td>
</tr>
<tr>
<td>Measurement Location 3</td>
<td>Latitude: 36° 20' 52.4&quot; S</td>
<td>ARL Ngara Environmental Noise Logger</td>
</tr>
<tr>
<td>1 Rosina Court (middle of rear yard)</td>
<td>Longitude: 145° 25' 2.6&quot; E</td>
<td></td>
</tr>
<tr>
<td>Measurement Location 4</td>
<td>Latitude: 36° 20' 52.1&quot; S</td>
<td>ARL Ngara Environmental Noise Logger</td>
</tr>
<tr>
<td>190 Ford Road (front of dwelling)</td>
<td>Longitude: 145° 25' 25.6&quot; E</td>
<td></td>
</tr>
</tbody>
</table>
The locations were selected as locations on the subject site which receive representative exposure to noise associated with vehicle movements along the Wanganui Road and Ford Road, road reservations.

5.1 Weather Conditions During Unattended Noise Monitoring

Unattended noise logging was carried out at the site in the period Thursday 10th August until Tuesday 15th August 2017.

VicRoads traffic noise measurement guidelines for acoustic consultants require that a minimum of three days are recorded as part of any noise measurement assessment.

In addition, the document indicates that wind speeds during noise level measurements ‘shall not exceed 3 m/s for any significant period/s during the conduct of the measurements’.

In practice, satisfying each of these requests is challenging.

In previous projects including the involvement of VicRoads, breeze conditions with marginally higher speeds have been accepted provided that the breeze is blowing from the relevant road reservation in the direction of the subject site.

Further to the above, VicRoads have been accepting of fewer than three days of noise logging provided that the measurement days are relatively consistent.

For the purposes of this assessment, Watson Moss Growcott has used the noise measurements obtained for Monday 14th August. This period was selected as exact traffic counts were available to correlate with the noise measurements.

During this day, the wind speeds were typically in the range 0.0-6.1 m/s. The upper end of this range is slightly above typical targets, however due to the close proximity of the road to the unattended noise logging devices and the fact the wind speeds were highest during the times of traffic peaks and calm during time of low traffic, these weather conditions are considered suitable for traffic noise analysis.

Based on consideration of the above, a summary of the weather conditions at Shepparton during the assessed day considered suitable for traffic noise analysis is set out below:

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Wind Speeds (m/s)</th>
<th>Direction of Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday 14th August</td>
<td>9:00am</td>
<td>4.7</td>
<td>NE</td>
</tr>
<tr>
<td></td>
<td>3:00pm</td>
<td>3.6</td>
<td>N</td>
</tr>
</tbody>
</table>

5.2 Measurement Data Recorded as Part of Unattended Noise Logging

The measured noise levels at logging location one were dominated by noise associated with vehicle movements along Wanganui Road. The measured noise levels at logging locations two to four inclusive were dominated by vehicle movements along Ford Road.

At locations one and four, the noise logger was located within close proximity of the external wall of the residential dwelling which causes what is referred to as façade build up, compared with locations two and three where the logger was located in a free field environment.
VicRoads methodology requires that a façade reflection adjustment of 2.5 dB(A) is applied to measurements which are measured in a free field environment, to account for the increase of measured noise level in close proximity to acoustically reflective surfaces.

The table below sets out the measured $L_{10,18\text{hour}}$ results for the four locations over the four full days of noise monitoring:

**Table 4: Measured Traffic Noise Levels dB(A) $L_{10,18\text{hour}}$ over noise logging period August 2017**

<table>
<thead>
<tr>
<th>Date</th>
<th>Measurement Location</th>
<th>80 Wanganui Road*</th>
<th>38 Ford Road</th>
<th>1 Rosina Court</th>
<th>190 Ford Road*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friday 11</td>
<td></td>
<td>52.6</td>
<td>60.9</td>
<td>52.0</td>
<td>55.4</td>
</tr>
<tr>
<td>Saturday 12</td>
<td></td>
<td>52.0</td>
<td>59.3</td>
<td>50.0</td>
<td>52.7</td>
</tr>
<tr>
<td>Sunday 13</td>
<td></td>
<td>49.4</td>
<td>57.7</td>
<td>49.3</td>
<td>54.3</td>
</tr>
<tr>
<td>Monday 14</td>
<td></td>
<td>52.6</td>
<td>59.1</td>
<td>51.4</td>
<td>56.5</td>
</tr>
</tbody>
</table>

* Measurement result includes façade reflection adjustment of 2.5 dB(A)

These results fit the commonly observed pattern that weekend traffic noise levels are lower than those on weekdays.

The following summarised data has been attached in Appendix One:

1. Measured Hourly dB(A) $L_{eq}$ and dB(A) $L_{10}$ values;
2. Measured dB(A) $L_{10,18\text{Hour}}$ (Arithmetic Average 6am to Midnight);
3. Measured dB(A) $L_{eq\ 15\text{Hour}}$ (Logarithmic Average 7am to 10pm);
4. Measured dB(A) $L_{eq\ 16\text{Hour}}$ (Logarithmic Average 6am to 10pm);
5. Measured dB(A) $L_{eq\ 9\text{Hour}}$ (Logarithmic Average 10pm to 7am);
6. Measured dB(A) $L_{eq\ 8\text{Hour}}$ (Logarithmic Average 10pm to 6am)

6. **ROAD TRAFFIC NOISE PREDICTIONS**

As per VicRoads requirements, traffic predictions have been carried out using procedures described in Calculation of Road Traffic Noise - Department of Transport Welsh office (CoRTN)

**6.1 TRAFFIC NOISE MODELLING**

Watson Moss Growcott has considered the following inputs:

1. Measured Traffic flow volumes (vehicles per 18-hours);
2. Measured Proportion of heavy vehicles;
3. Measured Traffic speeds;
4. Measured Noise levels;
5. Predicted future traffic flow volumes (vehicles per 18-hours);
6. Predicted future proportion of heavy vehicles;
7. No allowance has been made for changes in road surface type;
8. No allowance has been made for changes in road traffic speed.

Information regarding the traffic flow volumes, proportion of heavy vehicles, traffic speeds, both measured and predicted has been provided by the client.

A summary of the measured traffic results for Monday 14th August 2017 is presented in the table below.
**Table 5: Measured Traffic Noise Levels dB(A) \( L_{10,18\text{hour}} \) and Traffic Volume on Monday 14th August 2017**

<table>
<thead>
<tr>
<th>Measurement Location</th>
<th>80 Wanganui Road</th>
<th>38 Ford Road</th>
<th>1 Rosina Court</th>
<th>190 Ford Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured Traffic Volume 18h</td>
<td>1644</td>
<td>3446</td>
<td>2653</td>
<td>2621</td>
</tr>
<tr>
<td>Measured Traffic Speed Mean km/h</td>
<td>71.8</td>
<td>60.7</td>
<td>61.9</td>
<td>62.0</td>
</tr>
<tr>
<td>Measured Proportion Heavy Vehicles %</td>
<td>6.1</td>
<td>8.1</td>
<td>9.3</td>
<td>8.2</td>
</tr>
<tr>
<td>Measured Noise Level ( L_{10,18\text{h}} )</td>
<td>53</td>
<td>62*</td>
<td>54*</td>
<td>57</td>
</tr>
</tbody>
</table>

Includes façade reflection adjustment as per VicRoads measurement methodology.

### 6.2 Future Traffic Noise Level Predictions

No information has been provided with regards to current or future road surface conditions at the subject site, therefore the initial traffic noise modelling has been based on the existing conditions.

The existing road surface appears to be a significantly worn stone seal with the stones protruding little above the surface for much of the route under consideration. With this degree of wear the road surface is expected to be similar to dense graded asphalt in terms of traffic noise generation, which is consistent with the comparison of calculated and measured levels.

Increased traffic noise levels at residential premises along Wanganui and Ford Roads will be influenced most significantly by the traffic flow increases and the proportion of heavy vehicle travelling along the Wanganui Road and Ford Road reservations.

The proposed road alignment drawings, attached as an Appendix, indicate that the east-bound lanes will move to the north. This will tend to moderate traffic noise increases at residential locations on the southern side of the road and accentuate traffic noise increases at residential locations on the northern side of the road.

A summary of the predicted traffic flow conditions used for 2031 and the resulting predicted traffic noise levels for the locations at which noise monitoring was conducted are presented in the table below.

**Table 6: Predicted Traffic Noise Levels dB(A) \( L_{10,18\text{hour}} \) in 2031**

<table>
<thead>
<tr>
<th>Measurement Location</th>
<th>80 Wanganui Road</th>
<th>38 Ford Road</th>
<th>1 Rosina Court</th>
<th>190 Ford Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted Traffic Volume 18h</td>
<td>10,800</td>
<td>5,400</td>
<td>3,700</td>
<td>3,700</td>
</tr>
<tr>
<td>Predicted Traffic Speed Mean km/h</td>
<td>80</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Predicted Proportion Heavy Vehicles %</td>
<td>12.0</td>
<td>13.0</td>
<td>18.9</td>
<td>18.9</td>
</tr>
<tr>
<td>Predicted Noise Level ( L_{10,18\text{h}} )*</td>
<td>65</td>
<td>62</td>
<td>56</td>
<td>60</td>
</tr>
</tbody>
</table>

*Includes façade reflection adjustment as per VicRoads methodology.

Based on consideration of the predicted traffic flow parameters for 2031 and measured 2017 traffic flow parameters and noise levels, the predicted noise levels along the relevant road sections in the absence of noise shielding barriers will be up to 65 dB(A) \( L_{10,18\text{hr}} \).

A summary of the predicted traffic flow conditions used for 2041 and the resulting predicted traffic noise levels are presented in the table below.
Table 7: Predicted Traffic Noise Levels dB(A) L<sub>10,18h</sub> in 2041

<table>
<thead>
<tr>
<th>Measurement Location</th>
<th>80 Wanganui Road</th>
<th>38 Ford Road</th>
<th>1 Rosina Court</th>
<th>190 Ford Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted Traffic Volume 18h</td>
<td>12,500</td>
<td>7,100</td>
<td>4,700</td>
<td>4,700</td>
</tr>
<tr>
<td>Predicted Traffic Speed Mean km/h</td>
<td>80</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Predicted Proportion Heavy Vehicles %</td>
<td>12.0</td>
<td>11.3</td>
<td>14.9</td>
<td>14.9</td>
</tr>
<tr>
<td>Predicted Noise Level L&lt;sub&gt;10,18h&lt;/sub&gt;*</td>
<td>65</td>
<td>63</td>
<td>57</td>
<td>61</td>
</tr>
</tbody>
</table>

*includes façade reflection adjustment as per VicRoads methodology.

Traffic noise modelling has also been conducted in order to reach conclusions regarding traffic noise increases at houses along the Wanganui Rd/Ford Rd route other than those at which noise monitoring was conducted.

The Ford Rd section benefits from the 60 km/h speed limit and relatively low traffic volumes compared with Wanganui Rd, and based on a road surface no noisier than what appears to be a worn stone seal at present the modelling results for 2031 and 2041 remain below the 63 dB(A) L<sub>10</sub> (18 hour) VicRoads Traffic Noise Policy target without any noise barriers.

Based on a comparison of the existing measured levels and modelled future levels, traffic noise level increases in the range 3-5 dB(A) would be expected.

Changing to a fresh stone seal would likely increase noise levels by at least 2 dB(A). This would be enough to push some locations above 63 dB(A) L<sub>10</sub> (18 hour), but the majority would remain below 63. A dense graded asphalt road surface would be expected to achieve similar noise generation characteristics as the existing worn stone seal and similar to the noise modelling basis.

15 Freemans Rd and 80 Wanganui Rd have predicted future noise levels of 65-66 dB(A) L<sub>10</sub> (18 hour). 60 Wanganui Rd is sufficiently further removed from Wanganui Rd that it would not be above 63 dB(A) L<sub>10</sub> (18 hour).

The predicted increase in traffic noise level at 80 Wanganui Rd is 12 dB(A) compared with the existing measured level. This is a significant increase, due to both the significant increase in traffic volume and movement of the nearest traffic lanes closer to the house. This magnitude of noise level increase is approximately equivalent to a perceived doubling of loudness.

Future traffic noise levels could be kept at or close to 63 dB(A) at 15 Freemans Rd and 80 Wanganui Rd by the use of an open graded asphalt road surface without adding noise barriers.

Noise barriers would be problematic at 80 Wanganui Rd as access to the property is directly from Wanganui Rd. Any noise barriers would require gaps, which would reduce effectiveness but would still provide a noise reduction.

Extending the 60 km/h zone to the west of 80 Wanganui would reduce the traffic noise level at 80 Wanganui Rd, but only by a small margin.

Adoption of an open graded asphalt road surface would reduce the modelled noise levels by about 2 dB(A) at all locations within the extent of application of the open graded asphalt surface.
7. **NOISE CONTROL OPTIONS FOR CONSIDERATION**

The results for the Ford Rd section of the project, both in terms of the absolute level compared with the VicRoads Traffic Noise Policy objectives, and in terms of the relative change compared with existing conditions, indicate no need for consideration of noise control measures.

Houses along Wanganui Rd have been predicted to have traffic noise levels following the implementation of Stage 1 higher than the VicRoads Policy target and approximately twice as loud in subjective terms as the existing level. The specific conditions of the VicRoads Policy requiring implementation of noise control are not met by the project, so provision of noise control remains an option for consideration, not an obligation.

An option that would mitigate noise level increases wherever it is applied along the project, without any visual implications, would be a low noise open graded asphalt road surface. VicRoads information indicates this to be 2 dB(A) lower in noise level than dense graded asphalt.

There is a likelihood that the significance of low-noise road surfaces will become more significant over time as engine and exhaust noise levels of vehicles reduce.

Future traffic noise levels could be kept at or close to 63 dB(A) at 15 Freemans Rd and 80 Wanganui Rd by the use of an open graded asphalt road surface without adding noise barriers.

Noise barriers have the potential to provide the greatest noise reductions, but have visual and other implications.

Noise barriers would be problematic at 80 Wanganui Rd as access to the property is directly from Wanganui Rd. Any noise barriers would require gaps, which would reduce effectiveness but would still provide a noise reduction.

Extending the 60 km/h zone to the west of 80 Wanganui would reduce the traffic noise level at 80 Wanganui Rd, but only by a small margin.

8. **OVERVIEW**

Existing traffic noise levels have been measured at four locations along Wanganui and Ford Roads, which are expected to carry additional traffic as part of Stage 1 of the proposed Shepparton Bypass Link.

Noise modelling has been used to predict likely future noise levels following implementation of Stage 1 of the proposed bypass link.

The most significant factor contributing to increases in traffic noise level associated with Stage 1 is the expected increase in traffic volume, with a secondary factor being relocation of the east-bound traffic lanes further to the north than at present.

Ford Rd is expected to have a relatively small increase in traffic associated with Stage 1, and the increase in traffic noise levels is expected to be small. In decibel terms this is expected to be 3-5 dB(A), which translates to a ‘just detectable’ to ‘clearly detectable’ change in human perception terms.

The VicRoads Traffic Noise Policy Target Levels are not strictly speaking applicable to this project, but nevertheless the future predicted traffic noise levels along Ford Rd have been calculated to remain below the targets.
There are three houses along the Wanganui Rd section of the project that will be exposed to significantly greater increases in traffic volume and, being located on the northern side of the road, will be closer to the nearest traffic lanes under the proposed plans.

Consequently, calculated traffic noise level increases are higher along this section of road than Ford Rd. At the two houses nearest to the road in this section, traffic noise levels have been calculated to increase by more than 10 decibels, which translates to an approximate doubling of perceived loudness. In absolute terms, the calculated future levels are 2-3 dB(A) above the (strictly not applicable) VicRoads Traffic Noise Policy target level.

Adoption of a low-noise open graded asphalt road surface would reduce resultant noise levels by approximately 2 dB(A) compared with the base case, equivalent to dense graded asphalt or worn stone seal.

Construction of the Stage 1 bypass using a new stone seal would result in noise levels 2-5 dB(A) higher than discussed above.

Consideration could be given to the use of noise barriers to reduce the magnitude of the calculated noise level increases at houses along Wanganui Rd, but effectiveness would be limited by the need for direct access to Wanganui Rd from two out of the three houses.
APPENDICES

1. MAP OF PROPOSED SHEPPARTON BYPASS LINK

Significant predicted traffic flow increase associated with Stage 1

Small predicted traffic flow increase associated with Stage 1
## Summary of Noise Level Data Recorded by Unattended Noise Loggers

**Monday 14th August 2017**

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Measured Noise Level</th>
<th>Measurement Location 1: 80 Wanganui Road</th>
<th>Measurement Location 2: 38 Ford Road</th>
<th>Measurement Location 3: 1 Rosina Court</th>
<th>Measurement Location 4: 190 Ford Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00 – 01:00</td>
<td>dB(A) L_{10}</td>
<td>36.3</td>
<td>40.3</td>
<td>40.6</td>
<td>37.8</td>
</tr>
<tr>
<td>01:00 – 02:00</td>
<td>dB(A) L_{10}</td>
<td>35.4</td>
<td>38.3</td>
<td>39.0</td>
<td>39.7</td>
</tr>
<tr>
<td>02:00 – 03:00</td>
<td>dB(A) L_{10}</td>
<td>35.2</td>
<td>37.3</td>
<td>39.5</td>
<td>47.6</td>
</tr>
<tr>
<td>03:00 – 04:00</td>
<td>dB(A) L_{10}</td>
<td>37.3</td>
<td>37.3</td>
<td>44.8</td>
<td>54.7</td>
</tr>
<tr>
<td>04:00 – 05:00</td>
<td>dB(A) L_{10}</td>
<td>40.2</td>
<td>44.7</td>
<td>44.8</td>
<td>47.4</td>
</tr>
<tr>
<td>05:00 – 06:00</td>
<td>dB(A) L_{10}</td>
<td>44.8</td>
<td>48.4</td>
<td>52.4</td>
<td>53.6</td>
</tr>
<tr>
<td>06:00 – 07:00</td>
<td>dB(A) L_{10}</td>
<td>50.6</td>
<td>51.5</td>
<td>58.1</td>
<td>56.9</td>
</tr>
<tr>
<td>07:00 – 08:00</td>
<td>dB(A) L_{10}</td>
<td>57.6</td>
<td>55.8</td>
<td>62.9</td>
<td>59.7</td>
</tr>
<tr>
<td>08:00 – 09:00</td>
<td>dB(A) L_{10}</td>
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<td>50.3</td>
<td>63.6</td>
<td>60.2</td>
</tr>
<tr>
<td>09:00 – 10:00</td>
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<td>55.4</td>
<td>53.3</td>
<td>62.1</td>
<td>59.2</td>
</tr>
<tr>
<td>10:00 – 11:00</td>
<td>dB(A) L_{10}</td>
<td>52.9</td>
<td>50.2</td>
<td>61.1*</td>
<td>59.2*</td>
</tr>
<tr>
<td>11:00 – 12:00</td>
<td>dB(A) L_{10}</td>
<td>51.9</td>
<td>52.1</td>
<td>60.6*</td>
<td>58.5*</td>
</tr>
<tr>
<td>12:00 – 13:00</td>
<td>dB(A) L_{10}</td>
<td>53.8</td>
<td>54.0</td>
<td>59.7*</td>
<td>56.8*</td>
</tr>
<tr>
<td>13:00 – 14:00</td>
<td>dB(A) L_{10}</td>
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<td>51.7</td>
<td>61.0*</td>
<td>56.0*</td>
</tr>
<tr>
<td>14:00 – 15:00</td>
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<td>50.1</td>
<td>60.7</td>
<td>57.2</td>
</tr>
<tr>
<td>15:00 – 16:00</td>
<td>dB(A) L_{10}</td>
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<td>51.3</td>
<td>62.6</td>
<td>59.3</td>
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<tr>
<td>16:00 – 17:00</td>
<td>dB(A) L_{10}</td>
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<td>52.4</td>
<td>62.2</td>
<td>59.1</td>
</tr>
<tr>
<td>17:00 – 18:00</td>
<td>dB(A) L_{10}</td>
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<td>55.9</td>
<td>63.2</td>
<td>60.0</td>
</tr>
<tr>
<td>18:00 – 19:00</td>
<td>dB(A) L_{10}</td>
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<td>57.1</td>
<td>62.1</td>
<td>58.9</td>
</tr>
<tr>
<td>19:00 – 20:00</td>
<td>dB(A) L_{10}</td>
<td>55.2</td>
<td>57.1</td>
<td>58.9</td>
<td>57.2</td>
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<tr>
<td>20:00 – 21:00</td>
<td>dB(A) L_{10}</td>
<td>51.5</td>
<td>53.1</td>
<td>55.1</td>
<td>53.8</td>
</tr>
<tr>
<td>21:00 – 22:00</td>
<td>dB(A) L_{10}</td>
<td>49.1</td>
<td>53.4</td>
<td>55.8</td>
<td>55.6</td>
</tr>
<tr>
<td>22:00 – 23:00</td>
<td>dB(A) L_{10}</td>
<td>45.5</td>
<td>51.0</td>
<td>49.5</td>
<td>51.8</td>
</tr>
</tbody>
</table>

* Measured value corrected to exclude noise associated with drive way works at the measurement location.

**Measurement Location 1: 80 Wanganui Road**

- Overall Measured L_{10} 15 Hour Value (Arithmetic 6am to midnight): 52.6
- Overall Measured Leq 15 Hour Value (Logarithmic 7am to 10pm): 53.8
- Overall Measured L_{10} 16 Hour Value (Logarithmic 6am to 10pm): 53.7
- Overall Measured Leq 24 Hour Value (Logarithmic 10pm to 7am): 46.4
- Overall Measured Leq 24 Hour Value (Logarithmic 10pm to 6am): 45.5

**Measurement Location 2: 38 Ford Road**

- Overall Measured L_{10} 15 Hour Value (Arithmetic 6am to midnight): 59.1
- Overall Measured Leq 15 Hour Value (Logarithmic 7am to 10pm): 58.4
- Overall Measured L_{10} 16 Hour Value (Logarithmic 6am to 10pm): 58.3
- Overall Measured Leq 24 Hour Value (Logarithmic 10pm to 7am): 50.9
- Overall Measured Leq 24 Hour Value (Logarithmic 10pm to 6am): 49.9

**Measurement Location 3: 1 Rosina Court**

- Overall Measured L_{10} 15 Hour Value (Arithmetic 6am to midnight): 51.4
- Overall Measured Leq 15 Hour Value (Logarithmic 7am to 10pm): 51.4
- Overall Measured L_{10} 16 Hour Value (Logarithmic 6am to 10pm): 51.3
- Overall Measured Leq 24 Hour Value (Logarithmic 10pm to 7am): 46.3
- Overall Measured Leq 24 Hour Value (Logarithmic 10pm to 6am): 45.1
3. **Drawings on which Traffic Noise Modelling has been Based**

![Diagram of road layout](image)

**Central Notes**

1. All line work, sidewalks, and kerbs are in vector and are to the scale.
2. Roads, vehicular and pedestrian access in detail, vegetation, and utilities are to the scale.
3. The road network is based on the proposed road layout and the study area.
4. All line work is to a scale of 1:1000, sidewalks and kerbs are to the scale of 1:2000.
5. The study area includes the following: road network, vegetation, and utilities.

**Legend**

- **Black**: Road network
- **Blue**: Vegetation
- **Orange**: Utilities
- **Green**: Proposed road layout

**Data**

- **Date**: [Date]
- **Scale**: 1:1000

**Notes**

- The study area includes the following: road network, vegetation, and utilities.
- All line work, sidewalks, and kerbs are in vector and are to the scale.
- The road network is based on the proposed road layout and the study area.
- All line work is to a scale of 1:1000, sidewalks and kerbs are to the scale of 1:2000.