

Existing noise environment

The existing noise environment for the project was categorised using existing monitoring data provided by the RTA. This data was collected in late 2009 and is provided as an appendix within Appendix F. A summary of the noise monitoring data at key locations along the corridor is presented in Table 8.17.

Table 8.17 Summary of existing 2009 measured L_{A90} background noise levels (dBA)

Noise catchment area and code	Representative address	Suburb	Measure L_{A90} noise level (dBA)		
			Day ¹	Evening ¹	Night ¹
NCA 2	45 Incense Place	Casula	52	49	38
CVW_HH_S	40A Ironbank Avenue	Casula	57	52	42
	55 Grove Street	Casula	57	52	39
NCA 3	43 Acacia Street	Prestons	54	50	38
M7_HH_N	15 Foveaux Avenue	Lurnea	57	54	45
	33 Mary Crescent	Liverpool	56	53	43
NCA 4	15 Barwon Court	Wattle Grove	57	55	42
MA_HLD_S	17 Fitzgerald Avenue	Hammondville	55	53	39
NCA 5	80 Renton Avenue	Moorebank	63	49	41
HR_HLD_N					
NCA 7	4 Meteren Close	Milperra	54	50	38
HLD_HR_N	4 Flanders Avenue	Milperra	49	49	45
NCA 8	64 Tracey Street	Revesby	55	53	47
HR_FR_S	23 Carrington Street	Revesby	54	53	40
	46 Louie Street	Revesby	52	51	39
NCA 9	32 Ely Street	Revesby	54	52	39
QS_GA_N					
NCA 10	24 Iris Avenue	Riverwood	50	51	44
BR_KGR_N					
NCA 11	2/62 Kentucky Road	Riverwood	52	52	39
BR_KGR_S	41 Earls Avenue	Riverwood	50	50	40
	60 Parry Avenue	Narwee	51	51	43
NCA 12	4 Arilla Avenue	Riverwood	57	56	45
BR_KGR_N					

1. Day (7am–6pm), Evening (6pm–10pm), Night (10pm–7am).

8.2.2 Assessment of operational impacts

Residential sensitive receivers

Exceedance of criteria outlined in the Environmental Criteria for Road Traffic Noise

As discussed in section 8.2.1, additional noise mitigation measures must be considered where exceedances of either of the following conditions occur for the M5 West widening project:

- The predicted 2023 noise levels exceed the Environmental Criteria for Road Traffic Noise base criteria for redeveloped roads and/or the noise level increase due to the project is greater than 2 dBA; or
- The predicted 2023 future design noise levels are acute (≥ 65 dBA $L_{Aeq,15hr}$ or ≥ 60 dBA L_{Aeq9hr}).

The noise mitigation measures that could be considered for the project are roadside noise barriers and architectural treatment of exposed buildings.

Noise modelling for the 2013 future existing scenario indicated that many residential dwellings along M5 South West Motorway would already experience noise levels exceeding the noise criteria (refer to Appendix D of the noise and vibration working paper at Appendix F).

Table 8.18 identifies the number of dwellings (by noise catchment area) that are predicted to experience night-time noise levels that exceed the night-time noise criteria 10 years after opening of the project (2023 future design scenario). Modelling indicates that about 285 dwellings would fall into this category.

Residential receivers that are located near intersections between the M5 South West Motorway and other arterial/secondary roads are exposed to road traffic noise from multiple sources. Where this situation is apparent and an exceedance of the relevant noise criteria was predicted, a detailed inspection was undertaken to determine which road source was the cause of the exceedance.

Table 8.18 Residences exceeding 2023 night time ($L_{Aeq,9hr}$) ECTRN criteria

Noise catchment area and code	Number of residences exceeding night time ($L_{Aeq,9hr}$) ECTRN criteria ¹	Number of residences acutely affected or exceeding the allowance goal ¹
NCA 1 (CVW_M7_W)	0	0
NCA 2 (CVW_HH_S)	49	49 (100%)
NCA 3 (M7_HH_N)	50	50 (100%)
NCA 4 (MA_HLD_S)	40	40 (100%)
NCA 5 (HR_HLD_N)	5	5 (100%)
NCA 7 (HLD_HR_N)	12	12 (100%)
NCA 8 (HR_FR_S)	74	74 (100%)
NCA 9 (QS_GA_N)	11	11 (100%)
NCA 10 (FR_BR_N)	6	6 (100%)
NCA 11 (BR_KGR_S)	13	13 (100%)
NCA 12 (BR_KGR_N)	25	25 (100%)
Total	285	285 (100%)

1. Numbers do not include residences where the total traffic noise level at the worst-affected façade is dominated by noise from a road other than the M5 South West Motorway.

An additional 182 residential receivers are located within the 300 metre noise modelling corridor that exceed the 2023 night-time ($L_{Aeq,9hr}$) noise criteria as a result of noise generated by road traffic from a road other than the M5 South West Motorway.

Proposed residential noise management approach

Where future exceedances of the operational noise criteria are predicted and where there are more than three dwellings affected, the introduction of new or modified (increased height) noise walls has been considered. According to the RTA's Environmental Noise Management Manual, noise walls are not considered as a reasonable approach to noise mitigation where there are three or less receivers exceeding the relevant criteria. In these cases architectural treatment of these receivers has been considered.

Considering these criteria, the locations of proposed new and augmented noise walls are listed in Table 8.19 and are shown indicatively (in addition to the location of existing noise walls) in Figure 8.7. The indicative heights and extents of noise walls would be reviewed during the detailed design phase. At all locations except one, increasing the height of existing noise walls was not considered reasonable because of the significant cost and the marginal additional noise benefit (much less than 5 dBA) the increased noise wall height would provide. One existing noise wall would be modified as part of the project. The existing noise wall between Beaconsfield Street and Queens Street, Revesby North would be increased in height from three metres to five metres for a length of about 950 metres.

Table 8.19 Locations of proposed new and augmented noise walls

Location	Height (metres)	Length (metres)
Northern side – East of Kurrajong Road (new)	4.5	275
Southern side – West of Box Road (new)	6.0	400
Northern side – Infill barrier between Hume Highway and railway (new)	4.5	240
Southern side – Between Horsley Road and Panania North Public School (new)	4.0	510
Southern side – Infill barrier behind Parry Avenue (new)	4.0	155
Southern side - Between Beaconsfield Street and Queens Street (augmented)	Increase to 5m	950

Where, after the introduction of noise walls, residences would be still predicted to experience noise levels that exceed the Environmental Criteria for Road Traffic Noise criteria, architectural treatment has been considered. Architectural treatments would include installing fresh air ventilation, sealing of wall vents, and checking window and door seals (and replacing these where necessary). Table 8.20 identifies the number of residences per noise catchment area that are identified as requiring architectural treatment.

Table 8.20 Residences identified as requiring architectural treatment

Noise catchment area and code	Residences requiring architectural treatment ¹
NCA 1 (CVW_M7_W)	0
NCA 2 (CVW_HH_S)	27
NCA 3 (M7_HH_N)	18
NCA 4 (MA_HLD_S)	40
NCA 5 (HR_HLD_N)	5
NCA 7 (HLD_HR_N)	12
NCA 8 (HR_FR_S)	31
NCA 9 (QS_GA_N)	11
NCA 10 (FR_BR_N)	6
NCA 11 (BR_KGR_S)	7
NCA 12 (BR_KGR_N)	25
Total	182

1. Numbers do not include residences where the total traffic noise level at the worst-affected façade is dominated by noise from a road other than the M5 South West Motorway.

Non-residential sensitive receivers

Outdoor recreation areas

The noise levels at other sensitive land uses and outdoor recreation areas was modelled as part of the noise assessment (refer to section 8.10 and Table 8-9 of Appendix F). All except one of the outdoor recreation areas would experience increases in noise as a result of operation of the project. All increases were within the Environmental Criteria for Road Traffic Noise criteria for 2023 except for the New Brighton Golf Club, where both the allowance goal and the target noise level would be exceeded at the nearest point within the area likely to be frequented by patrons.

The benefits of introducing a noise barrier three-to-four metres high at this location was considered (refer to section 8.10 of Appendix F). However, given the limited noise reduction benefit it would provide, the introduction of the noise wall was not considered reasonable and feasible.

Schools, childcare facility and church

Predicted 2023 internal noise levels at schools, childcare facilities and churches are identified in Table 8-10 of Appendix F. Both the target noise level and the 2 dBA allowance goal would be exceeded at the southern building of the Hammondville Public School that fronts the M5 South West Motorway. At the other schools, the church and the childcare facility, the internal noise levels would be above the Environmental Criteria for Road Traffic Noise criteria but would be within the 2 dBA allowance goal and therefore no further noise treatment has been considered at these locations.

At Hammondville Public School's southern building, mechanical ventilation is proposed to enable windows to be shut while still providing for ventilation. This architectural treatment would bring internal noise levels at this building within allowance criteria.

Sleep disturbance

No maximum noise level events were identified as the L_{Amax} noise level did not exceed the $L_{Aeq,1hr}$ noise level by 15 dBA or more. Furthermore, the road widening would not exacerbate the prevailing situation, as the traffic stream would generally be redistributed away from the dwellings and towards the centre of the M5 South West Motorway.

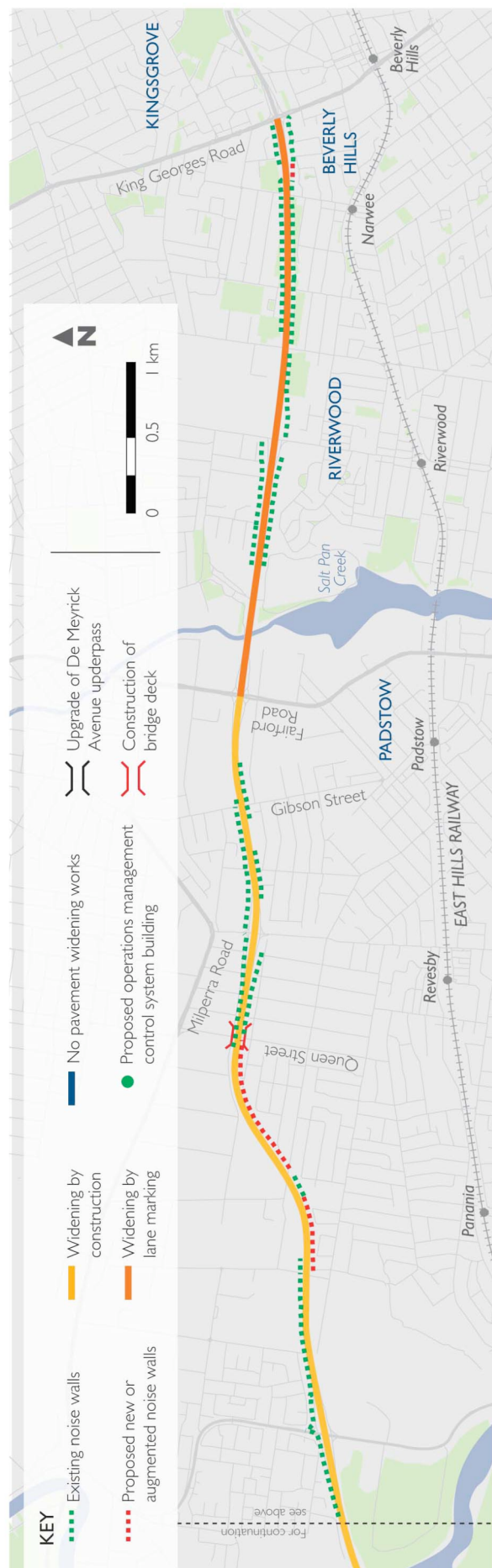
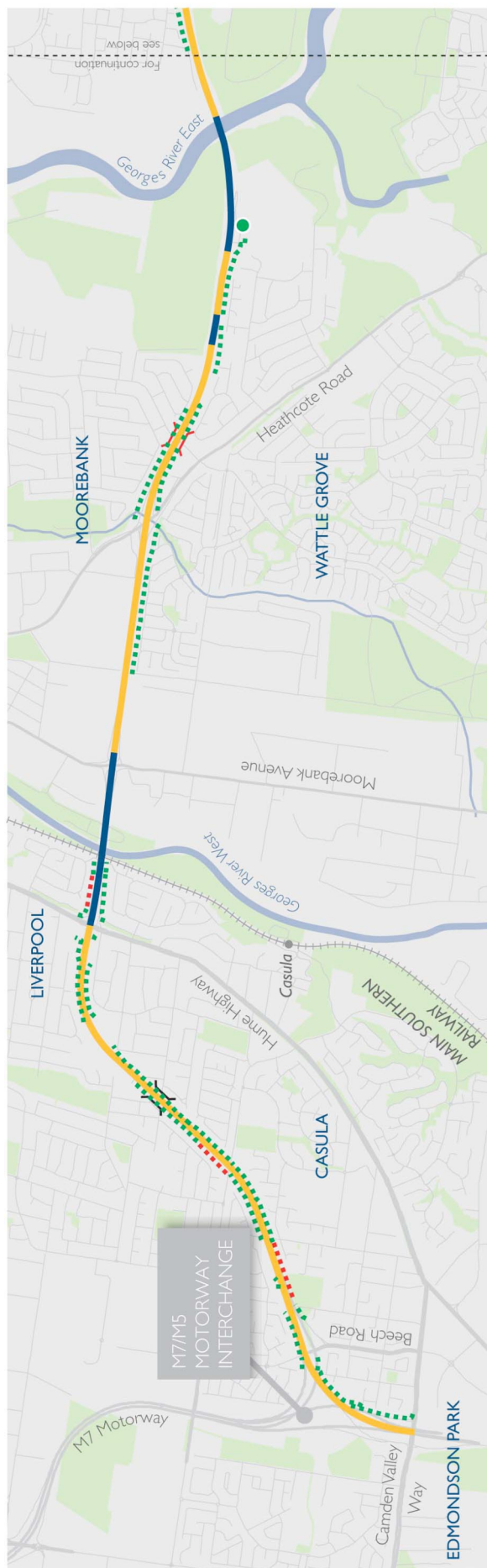


Figure 8.7 Location of existing and proposed new or augmented noise walls

Note: Project detail shown is indicative only, subject to detailed design

8.2.3 Assessment of construction noise impacts

This section presents construction noise management levels based on the background noise levels for sites along the corridor. It compares the predicted construction noise levels to the noise management levels for each noise catchment area to draw conclusions on where receivers would be affected by construction noise at levels above the noise management levels.

Construction noise levels within the road reserve

Construction noise management levels within the road reserve

Table 8.21 outlines the management levels for selected receivers along the corridor, representing each noise catchment area. The noise catchment area around Blue Gum Farm Zoo (noise catchment area six) has not been included in analysis because this business no longer operates and, as such, there are no receivers in the area. It has also been excluded from subsequent noise modelling.

The L_{Aeq} measurement represents the average amount of noise for a particular receiver over a 15-minute period. It can be considered to be the 'average' noise for a particular area, and is used to represent noise levels for day, evening and night-time periods. The L_{Amax} measurement represents the noise level exceeded for 60 seconds within the 15-minute measurement period. It is equivalent to the peak noise for an area, and is used to determine the site-specific sleep disturbance criteria. The reason this different measurement is used is that peak noises (or 'noisy events') are more likely to interrupt sleep than sustained noise at a lower level over a longer period.

Table 8.21 Construction noise management levels (dBA)

Noise catchment area and code	Address	Suburb	Construction noise management level, L_{Aeq} (15min), (dBA)			Sleep disturbance criteria L_{Amax} , (1 min)
			Day ¹	Evening ¹	Night ¹	
NCA 2 CVW_HH_S	45 Incense Place	Casula	62	54	43	53
NCA 3 M7_HH_N	43 Acacia Avenue	Prestons	64	55	43	53
NCA 4 MA_HLD_S	17 Fitzgerald Avenue	Hammondville	65	58	44	54
NCA 5 HR_HLD_N	80 Renton Avenue	Moorebank	62	54	46	56
NCA 7 HLD_HR_N	4 Meteren Close	Milperra	64	55	43	53
NCA 8 HR_FR_S	46 Louie Street	Padstow	62	56	44	54
NCA 9 QS_GA_N	32 Ely Street	Revesby	64	57	44	54
NCA 10 FR_BR_N	24 Iris Avenue	Riverwood	60	56	49	59
NCA 11 BR_KGR_S	41 Earls Avenue	Riverwood	60	55	45	55
NCA 12 BR_KGR_N	4 Arilla Avenue	Riverwood	67	61	50	60

1. Daytime (7am–6pm), evening (6pm–10pm) and night-time (10pm–7am).

Predicted construction noise levels within the road reserve

Construction noise for the project was predicted by combining typical noise levels for each piece of construction equipment used in a particular activity. This then enabled 'typical' noise levels to be calculated for certain types of construction activities (earthworks, clearing, concreting, landscaping, etc). These levels were then compared to the management levels within each noise catchment area to examine potential noise impacts.

Table 8.22 identifies the predicted construction noise levels within each noise catchment area and shows whether construction noise management levels would be exceeded for the daytime, evening and night-time periods.

The noise levels shown in Table 8.22 are the maximum predicted for each type of construction activity that would be undertaken within each noise catchment area (refer Table 10.4 in Appendix F for further detail).

Table 8.22 Predicted construction noise levels along the corridor ($L_{Aeq}(15min)$, (dBA))

Noise catchment area and code	Suburb	Day (7am–6pm)		Evening (6pm–10pm)		Night (10pm–7am)	
		Predicted	Exceed by	Predicted	Exceed by	Predicted	Exceed by
NCA 1 CVW_M7_W	Prestons	52	Nil	50	Nil	50	Up to 7dBA
NCA 2 CVW_HH_S	Prestons	68	Up to 6dBA	66	Up to 12dBA	66	Up to 23dBA
NCA 3 M7_HH_N	Casula	69	Up to 5dBA	67	Up to 12dBA	67	Up to 24dBA
NCA 4 MA_HLD_S	Hammondville	69	Up to 4dBA	67	Up to 9dBA	67	Up to 23dBA
NCA 5 HR_HLD_N	Moorebank	62	Nil	60	Up to 6dBA	60	Up to 14dBA
NCA 7 HLD_HR_N	Milperra	66	Up to 7dBA	64	Up to 10dBA	64	Up to 21dBA
NCA 8 HR_FR_S	Padstow	74	Up to 12dBA	72	Up to 16dBA	72	Up to 28dBA
NCA 9 QS_GA_N	Revesby	68	Up to 4dBA	66	Up to 9dBA	66	Up to 22dBA
NCA 10 FR_BR_N	Riverwood	66	Up to 6dBA	64	Up to 8dBA	64	Up to 15dBA
NCA 11 BR_KGR_S	Riverwood	70	Up to 10dBA	68	Up to 13dBA	68	Up to 24dBA
NCA 12 BR_KGR_N	Riverwood	69	Up to 2dBA	67	Up to 6dBA	67	Up to 17dBA

As can be seen from the predicted noise levels in Table 8.22, it is likely that construction of the project would exceed construction noise management levels in all noise catchments. Noise exceedances would typically be in the range 2–13 dBA for daytime and evening works, which would be manageable through the application of appropriate mitigation measures. However, night-time construction noise levels could exceed noise management levels by up to 28 dBA.

The assessment above is deliberately conservative and shows the predicted noise levels for the most affected residents. Tables 10-4 to 10-17 in Appendix F contain more information related to the predicted noise levels for commercial and industrial areas adjoining the corridor. The results for those areas show that management levels for commercial and industrial areas would be complied with except for the most noisy construction activities in noise catchment area eight.

The noise management levels would predominantly be exceeded during earthworks, clearing, cutting and concreting. Other construction activities would not be likely to exceed noise management levels during the daytime and evening periods, but may exceed them at night. Construction phase noise management measures are presented in section 8.2.4, which reflect the scheduling of noisy activities to minimise impacts.

The rationale for the need to undertake works outside standard working hours and further detail regarding the typical activities that would be undertaken outside standard working hours is discussed in section 6.5.2.

Construction noise levels for construction site compounds

Construction noise management levels for construction site compounds

The locations of proposed construction site compounds have been identified during the development of the project's concept design. These locations are indicative only and may change if assessment shows them to be unfeasible or have significant impacts. The proposed locations are identified in section 6.7.1.

Construction site compounds would be fenced and covered in hardstand. Offices would generally be prefabricated and material storage areas would include purpose-built temporary structures as required. Access to construction site compounds would be via the motorway or the arterial road network where possible to minimise impacts on local roads.

The major sources of noise from construction site compounds would be from the operation and access of plant and construction machinery. Some construction site compounds would be required to operate 24 hours per day to support night works. The night-time uses would typically relate to:

- Traffic management launch areas.
- Storage and laydown areas.
- Office and amenities.

The noise management level for construction site compounds operating over a 24-hour period near residences has been set at 40 dBA, reflecting the sensitivity of night-time construction noise.

Predicted construction noise from construction site compounds

Contours showing the predicted noise from construction site compounds are included in section 10.6 of Appendix F. They show that noise management levels would be exceeded at the 24-hour construction site at M5/Graham Avenue (1). The M5/Graham Avenue (1) site would be expected to comply with night-time criteria given the application of mitigation measures in section 8.2.4 without using hoardings.

Mitigation measures to reduce noise levels at these sites would be required for 24-hour operation during the construction phase, or alternative sites not near residences would be required. Mitigation measures are presented in section 8.2.4.

Construction traffic noise

Construction traffic noise management levels

The DECCW guideline, Environmental Criteria for Road Traffic Noise, sets out criteria for assessing noise from vehicles on public roads.

The document sets out noise criteria for arterial, sub-arterial, collector and local roads. Most of the roads surrounding the construction site compounds would be classified as either collector roads or local roads. Criteria for land use developments with potential to create additional traffic on collector and local roads are as follows:

- Daytime (7am–10pm) $L_{Aeq,1hr}$ 60dBA (collector road), $L_{Aeq,1hr}$ 55dBA (local road).
- Night-time (10pm–7am) $L_{Aeq,1hr}$ 55dBA (collector road), $L_{Aeq,1hr}$ 50dBA (local road).

Where existing traffic noise levels already exceed the above noise levels the development should not increase existing levels by more than 2 dBA.

Predicted construction traffic noise

An assessment of traffic noise has been made by comparing the expected increase in traffic movements along each of the relevant collector or local roads that apply to each of the construction site compounds. This enabled the expected increase in noise to be modelled based on typical values for construction traffic. The predicted increase in noise for each construction site compound was then compared to the background noise levels for the relevant noise catchment area (as described in Table 8.17).

Daytime and night-time construction traffic flows have been predicted as part of the traffic and transport working paper (refer to Appendix E). The predicted construction traffic flows represent the expected number of additional vehicle movements each peak hour. These values would vary both throughout each day and as construction works progress along the road corridor.

Table 8.23 presents predicted traffic noise levels from construction traffic (vehicles per hour) at all construction site compounds. It shows that traffic noise levels as a result of the increases in traffic due to construction of the project would produce minor increases in noise levels of up to 0.7 dBA and typically not over 0.3 dBA. As such no specific mitigation measures for construction road traffic noise have been proposed.

Table 8.23 Predicted traffic noise increases from construction traffic at construction site compounds

Construction site compound ¹	Existing traffic ² (% heavy vehicles)	Additional traffic ² (no. of heavy vehicles)	Predicted traffic noise increase (dBA)
Moorebank Avenue (24-hour use)	470 (5.0%)	13 (2)	0.2
M5/Graham Avenue-1 (24-hour use)	717 (13.9%)	5 (3)	0.1
M5/Graham Avenue-2	198 (1.0%)	4 (2)	0.3
M5/Graham Avenue-3	198 (1.0%)	4 (2)	0.3
Bransgrove Road (24-hour use)	127 (1.9%)	4 (2)	0.7
Henry Lawson Drive	1369 (6.6%)	4 (2)	0.1
Beaconsfield Road (24-hour use)	229 (5.2%)	4 (2)	0.3
Heathcote Road (north)	425 (48.2%)	6 (2)	0.1

1. Where a construction site compound is proposed for 24-hour use, the predicted night-time traffic volumes and traffic noise increase are provided. Other construction site compounds reflect predicted day time traffic volumes and traffic noise increases.

2. Traffic volumes provided reflect combined light and heavy vehicle movements per hour.

Construction of the operations management control system building

The construction of the operations management control system building would involve laying concrete foundations with a frame and cladding building construction. Services such as power, water and communications would also be installed. The most noise-intensive works would be earthworks and concreting. Noise levels during these phases are expected to be about 70 dBA at the nearest residences (this is about five dBA above the relevant noise management level of 65 dBA). These works are expected to be of short duration (ie completed within a few weeks at most) and would be limited to daytime hours. Management of construction noise in line with the measures outlined in section 8.2.4 would be required to minimise the impact at the nearest and most affected dwellings.

Construction of variable message signs

A number of variable message signs would be installed outside the M5 South West Motorway corridor, generally on major roads leading to or from the M5 South West Motorway. Installing these signs would involve earthworks for footings (using an excavator, backhoe or similar), concreting associated with the footings (using a concrete truck) and use of a crane to lift the variable message sign into position. Work is likely to occur during the night in order to minimise impacts on traffic. The construction would be of short duration (completed in about two nights at any site).

Typical noise levels from the construction and installation process are outlined in section 10.5 of Appendix F. Night-time noise management levels and sleep disturbance criteria would depend on the area in which the installation is taking place, but would vary from 43–50 dBA for the noise management level ($L_{Aeq,15min}$) and 53–60 dBA for sleep disturbance ($L_{Amax,1min}$).

Residences are typically located between 15 and 35 metres from cross roads where variable message signs would be installed. Although works would be of very limited duration, installing the signs would exceed the relevant noise management levels and management of the noise levels to minimise impacts would therefore be necessary.

Construction vibration

Construction vibration management levels

An assessment of vibration has been made using the DECCW's Assessing Vibration: A Technical Guideline (DEC, 2006). Appendix C of this guideline sets maximum allowable levels for vibration from construction activities for continuous and impulsive vibration in the range 1–80Hz.

The night-time human comfort level for vibration is 0.14 millimetres per second (continuous vibration) and 2.8 millimetres per second (impulsive vibration).

The above limits relate to a continuous (16-hour) exposure. Where exposure to vibration is intermittent, a vibration 'dose' is calculated based on the time and intensity of exposure. The vibration dose values for human comfort at night are between 0.13 millimetres per second (preferred) and 0.26 millimetres per second (maximum).

Guideline levels for structural vibration adopted for this project are:

- 15 to 20 millimetres per second for residential buildings.
- Three millimetres per second (with a range of predominant pulse between 1–10Hz) for heritage buildings (based on German standard DIN 4150 – Part 3 *Structural Vibration in Buildings - Effects on Structures*).

Predicted construction vibration levels

A worst-case assessment of potential vibration impact has been made by applying human comfort levels (rather than structural vibration levels) to the analysis of typical vibration values for different types of machinery, with reference to the identified distances between construction areas and residences.

Ground vibration may potentially be caused by piling, rock hammering, drilling and ground compaction operations associated with construction of the road. Vibration levels generated by these activities depend on the exact equipment to be used and the type of ground. Typical vibration levels for construction equipment are shown in Table 8.24.

Table 8.24 Typical worst-case values for vibration from construction equipment at different offset distances

Source	Peak particle vibration levels (mm/s) – distance from residences					
	5 m	10 m	20 m	30 m	40 m	50 m
Vibratory roller	-	4.1	2.6	2.4	2.2	1.9
Heavy rock breaker	4.5	1.3	0.4	0.2	0.12	0.085
Rock drill (estimate)	-	0.5	0.2	0.1	0.05	0.04
Light rock hammer (eg 600 kg)	0.2	0.06	0.02	0.01	-	-
Impact piling	11	3.5	1.0	0.5	0.2	0.05
Bored piling	-	0.2	<0.1	-	-	-

Due to the proximity of the construction activities to most noise catchments, some vibration from construction may be perceptible at the closest residences. The levels for human comfort would only be met where vibratory rollers are used within 50 metres of residences. The vibration management levels for human comfort could be complied with by reducing the time in which vibration-causing activities are undertaken, thereby reducing the dose.

The offset distances from construction work areas to buildings would be sufficient that there would be little risk of damage to buildings from vibration.

Replacement of existing operational noise barriers

There may be a need to remove sections of existing barrier for the section of noise wall which would be augmented at Queen Street, Revesby. This would occur before the upgraded barrier is replaced. During this time there would be the potential for increased traffic noise to propagate to residences previously shielded by the barrier. Removing large sections of barrier at a time may increase traffic noise levels at sensitive receivers by up to 10 dBA in some locations.

The mitigation measures to minimise impacts during the augmentation of noise walls are outlined in section 8.2.4. These measures would be expected to reduce exposure for residents behind the noise barriers to around a 2–3dBA increase for only a few hours, and only during daytime periods.

8.2.4 Mitigation measures

Operational noise

Residential sensitive receivers

Where future exceedances of the operational noise criteria are predicted and where there are more than three dwellings affected, the introduction of new or modified (increased height) noise walls has been considered. According to the RTA's *Environmental Noise Management Manual*, noise walls are not considered as a reasonable approach to noise mitigation where there are three or less receivers exceeding the relevant criteria. In these cases architectural treatment of these receivers has been considered.

The location of proposed new and augmented noise walls are identified in Table 8.19. Details on the number of proposed architectural treatments are provided in Table 8.20. The location, height and extent of new and augmented noise walls would be refined as part of the detailed design process.

Non-residential sensitive receivers

As identified in section 8.2.2, there would be consideration given to the installation of architectural treatments, such as mechanical ventilation (to enable windows to be shut while still allowing ventilation), for the Hammondville Public School.

Construction noise

The following mitigation and management measures would be implemented during the construction phase of the project. All these measures would be documented in a construction noise management plan, as a sub-plan to the construction environmental management plan. The rationale surrounding the need to undertake out-of-hours construction is provided in section 6.5.

As a minimum, the construction noise management plan would:

- Identify nearby residences and other sensitive land uses where there is a potential for noise impacts, and develop noise management levels in a manner consistent with the *Interim Construction Noise Guidelines* (DECCW, 2009).
- Assess the potential noise impact from the proposed construction methods and where noise management levels are exceeded examine of feasible and reasonable noise mitigation.
- Develop reactive and proactive strategies for dealing with any noise complaints, including identification of a site contact person to follow up complaints.
- Describe where noise monitoring will occur and procedures for managing noise on site if monitoring indicates that management levels are exceeded.

All construction employees will receive training as part of their environmental induction. Education and training strategies would focus on:

- Ensuring work occurs within approved hours wherever possible.
- Locating noisy equipment away from sensitive receivers.
- Using noise screens for mobile plant and equipment.
- Ensuring plant and equipment are well maintained and not making excessive noise.
- Turning off machinery when not in use.

The following administrative controls would be employed on site to minimise noise:

- Noise would be monitored in areas identified with the potential for noise impacts.
- Respite periods would be implemented for noisy activities.
- Residents would receive advance notification of works.
- Nearby affected residents would be consulted and would be given contact details of project staff should they have issues or complaints.
- Noise monitoring would be carried out in affected areas in response to complaints.
- Construction scheduling and planning would seek to minimise the potential for noise impacts on residents. Noisy activities would be minimised at night-time and would cease by midnight.
- Should alternative construction site compounds be required, those sites will be located away from residential receivers and assessed to determine whether they comply with identified noise management levels.
- Noise from construction site compounds will be monitored during the construction phase of the project, and additional mitigation will be put in place if management levels are exceeded.

A range of noise management approaches would be adopted to mitigate potential impacts for out of hours work. These may include:

- The scheduling of noise-intensive activities to occur between 9pm and 11pm, where reasonable and feasible.
- Time restrictions on the most noise-intensive activities.
- For activities in the vicinity of sensitive receivers, advanced notice of high noise activities would be provided.
- The community would be kept informed as to the nature, timing and duration of impending works, the nearest sensitive receivers likely to be affected and the monitoring program associated with the impending works.

To minimise noise propagation to residents during replacement or augmentation of noise walls, the following construction techniques may be employed:

- The provision of new higher posts directly in front of or behind the existing wall, while panels are swapped or added.
- Short sections of barriers would be removed (typically 10-20m at a time), new posts installed and panels replaced within a single construction shift.

Table 8.25 presents noise mitigation strategies and techniques that would be employed during construction. It also shows noise range reductions for certain techniques.

Table 8.25 Noise mitigation strategies and typical reduction values

Management measure	Typical noise reduction (dBA)
Turn off machinery when not in use	0-5
Use portable temporary screens.	5-10
Use screens or enclosures for stationary equipment.	10-15
Maximise the offset distance between noisy plant items and sensitive receivers.	3-6
Avoid using noisy plant simultaneously and/or close together, adjacent to sensitive receivers.	2-3
Orientate equipment away from sensitive receivers.	3-5
Load and unload away from sensitive receivers.	3-5
Use dampened tips on rock breakers.	3-6
Use noise source controls, such as residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks.	5-10
Select site access points and roads as far away as possible from sensitive receivers.	3-6
Utilise non noise-generating structures such as site offices, storage sheds, stockpiles and tanks as noise barriers.	5-10

Construction road traffic noise

As per the assessment in section 8.2.3, noise impacts from construction road traffic noise would have a negligible affect on residents. Therefore, no specific mitigation measures for road traffic noise have been proposed. Standard mitigation measures for construction vehicles and administrative controls would be implemented as outlined above.

Construction vibration

As per the assessment in section 8.2.3, it is unlikely that there would be significant vibration impacts. The following mitigation measures would be employed in response to complaints, or where the most potential harmful activities (ie use of vibratory rollers) occur within 30 metres of buildings:

- Continuous vibration monitoring would be undertaken in areas where vibratory rollers are used within 30 metres of buildings. Where the measured vibration levels exceed the appropriate limit applying to the measurement, construction activities or equipment will be modified (eg using a lighter or smaller vibratory roller) to ensure ongoing compliance with the limits.
- Vibration monitoring would be undertaken in response to complaints, with the monitoring occurring at the place where the complaint originated.

In addition, construction planning and scheduling would consider respite periods for vibration-causing activities when within 30 metres of residents to reduce the overall vibration dose.

8.3 Biodiversity

Director General's requirements	Where addressed
The Environmental Assessment must include an assessment of the potential ecological impacts of the project, with specific reference to vegetation and habitat clearing, connectivity, edge effects, riparian and aquatic habitat impacts and soil and water quality impacts.	
The assessment must make specific reference to impacts on threatened species including Downy Wattle (<i>Acacia pubescens</i>) (including impacts to compensatory offset measures implemented as part of the original M5 project), the Green and Golden Bell Frog (<i>Litoria aurea</i>), and endangered ecological communities including the Cumberland plain woodland, Sydney coastal river-flat forest, and Coastal saltmarsh, and the native fauna that may utilise those communities.	Section 8.3.2
The assessment must consider impacts to adjoining waterways (including the Georges River and Salt Pan Creek), riparian vegetation and aquatic habitats. This must include consideration of water quality, marine vegetation, fish passage, soil types (including salinity), erosion and sedimentation, and ongoing water management.	Section 8.3.2
The assessment must be consistent with the <i>Draft Guidelines for Threatened Species Assessment</i> (DEC/DPI, 2005) and <i>Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities</i> (DEC) and the <i>Guidelines for Aquatic Habitat Management and Fish Conservation</i> (DPI, 1999).	Section 8.3
The assessment shall include details of any offset measures that may be required, including demonstration that the measures are consistent with the <i>Principles for the use of biodiversity offsets in NSW</i> (DECCW, 2008a).	Section 8.3.3

A thorough assessment of the biodiversity impacts of the project has been undertaken and is presented below. This assessment is supported by the biodiversity working paper attached as Appendix G. Throughout this section the term 'subject site' is used to describe the area directly affected by the project. This area is defined as the lands on which the project is proposed, which includes the central median, the outside shoulder of the motorway, drainage basin locations, permanent spoil re-use areas and the construction site compounds. The subject site is illustrated in Figure 1 (a–g) of the biodiversity working paper. The term 'study area' refers to the subject site and its immediate surrounds that may be indirectly affected by the project.

This assessment has been undertaken in accordance with the *Draft Guidelines for Threatened Species Assessment* (DEC/DPI, 2005), *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC, 2004), the *Guidelines for Aquatic Habitat Management and Fish Conservation* (DPI, 1999) and *Principles for the use of biodiversity offsets in NSW* (DECC 2008a).

The M5 West widening project has been considered against potential *Environment Protection and Biodiversity Act 1999* triggers and the project has been referred to the Department of Environment, Water, Heritage and the Arts. The referral has concluded that the project is not likely to have a significant impact on matters of national environmental significance, nor on the environment of Commonwealth land. The RTA is currently waiting for a determination from the Department of Environment, Water, Heritage and the Arts on the M5 West widening project.

8.3.1 Existing environment

Overview

The subject site was highly modified during construction of the M5 South West Motorway in 1992. The typical cut-and-fill motorway construction has completely altered the soil profile within much of the subject site to the extent that limited stands of remnant vegetation remains. Some native vegetation is likely to occur behind noise walls and barriers where original soil profiles remain, but the long history of disturbance since the construction of the original M5 Motorway has left most of these areas subject to moderate to high levels of weed invasion, rubbish dumping or structural modification. Vegetation present within the M5 South West Motorway corridor, including that present behind noise walls, is discussed in section 3.2.6 of Appendix G. The vegetation of the subject site is now characterised by landscaped batters and regularly maintained grass medians with occasional shrub and tree planting (most noticeably around bridge abutments).

Key biodiversity features are shown in Figure 8.8(a)–(d).

Flora and fauna species richness

Ecological surveys of the M5 South West Motorway have been undertaken to gain an understanding of the variety of flora and fauna species within the study area (ie the existing biodiversity). The surveys encompassed the median strip (where vegetation is proposed to be cleared) and surrounding batters, road verges and construction site compounds. Remnant vegetation outside of the road corridor was also visited to develop an understanding of surrounding vegetation communities and biodiversity values.

A total of 222 species (107 local native, 105 exotic and 10 non-local natives) from 48 plant families were recorded across the subject site and the proposed construction site compounds. Three of these are threatened plant species:

- *Acacia pubescens* (Downy Wattle) – listed as vulnerable under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). While it is native to the study area, it was planted as part of the original landscaping of the M5 South West Motorway and is generally located around bridge abutments east of Moorebank Avenue.
- *Doryanthes palmeri* (Giant Spear Lily) – listed as vulnerable under the TSC Act. This species is native in northern NSW in the Northern Rivers bioregion and has been included as part of the landscaping adjoining bridge abutments in the west of the subject site.
- *Eucalyptus nicholii* (Narrow-leaved Black Peppermint) – listed as vulnerable under the TSC Act and is a commonly planted street and garden tree. This species would have been planted as part of the original landscaping of the site and was recorded at the proposed location of the Moorebank Avenue construction site compound.

Four species of listed threatened fauna are deemed to have the potential to occur within the subject site, namely:

- *Chalinolobus dwyeri* (Large-eared Pied Bat).
- *Mormopterus norfolkensis* (Eastern Freetail Bat).
- *Miniopterus orianae oceanensis* (Eastern Bent-wing Bat).
- *Litoria aurea* (Green and Golden Bell Frog).

The first three species are insectivorous bats that apparently tolerate relatively high levels of disturbance (having been recorded via ANABAT detection and trapping within environments with frequent traffic-generated noise). Lighting from the M5 South West Motorway could potentially attract prey for these species, allowing the potential for the species to occur within the subject site.

Two areas of potential Green and Golden Bell Frog habitat were identified during a site inspection (refer to Figure 8.8(a)–(d)). One area is on the southern side of the M5 South West Motorway at Panania, near the Georges River. It includes an extensive wetland area dominated by *Typha orientalis* (Broad-leaved Cumbungi) and *Casuarina glauca* (Swamp She-oak) adjoining a tip site, and is connected to the Georges River by a series of wetland and vegetated areas. The other area of potential habitat is on either side of the M5 South West Motorway at Heathcote Road.

Although no targeted surveys for the Green and Golden Bell Frog were undertaken as part of this project, a conservative habitat assessment approach was followed for this species. While a key population of the Green and Golden Bell Frog has been identified in the vicinity of the subject site (DECC, 2008b), the species is most likely to utilise significant wetland habitat on adjoining lands such as Hammondville Golf Course. The Green and Golden Bell Frog could still be present within the subject site in low numbers, or otherwise transiently or periodically occupy habitat during migrations from other areas downstream in the catchment on occasion. A precautionary approach has therefore been taken by assuming presence on the basis of potential habitat, although the potential habitat identified within the subject site is considered minor in terms of the long-term conservation of the species.

A small number of common native fauna species including a number of bird species, *Pseudechis porphyriacus* (Red-bellied Black Snake) and a species of eel (*Anguilla sp.*) were also observed during the field investigations.

The exotic invasive fish *Gambusia holbrooki* (Plague Minnow) was also recorded in a number of drainage basins along the subject site and in Anzac Creek at the proposed Moorebank Avenue construction site compound. Predation by the Plague Minnow is listed as a key threatening process under the TSC Act. The presence of this species in drainage basins within the study area is likely to reduce the ability of the Green and Golden Bell Frog to successfully breed in these habitats.