

18. Noise and vibration

This chapter provides a summary of the Noise and Vibration Assessment. A full copy of the report is included in Appendix L.

18.1 Approach

The following environmental impacts were assessed in accordance with:

- ▶ NSW Department of Environment and Climate Change and Water (DECCW) *Interim Construction Noise Guidelines, 2009*;
- ▶ NSW Department of Environment, Climate Change and Water (DECCW) *Environmental Criteria for Road Traffic Noise (ECRTN), 1999*;
- ▶ NSW Department of Environment and Climate Change and Water (DECCW) *Assessing Vibration: A Technical Guideline, 2006*;
- ▶ Australian and New Zealand Environment Council (ANZEC), *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration, 1990*; and
- ▶ Australian Standard AS 2436 – 1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*.

18.1.1 Background noise monitoring

A background noise survey was undertaken from 11 to 23 November 2009 at five locations to quantify the ambient noise environment in the vicinity of the pipeline route and potentially impacted receivers (Figure 18.1).

Background noise monitoring was conducted at the following locations:

- ▶ **Location 1** – located at Lot 32 DP 620820, River Street, Goulburn NSW. This location was selected as a representative location for the pipeline route and discharge into the existing tanks in Goulburn.
- ▶ **Location 2** – located at Lot 204 DP 750050, off Gorman Road, Goulburn NSW. This location was selected as a representative location of the alternative pipeline route and discharge point.
- ▶ **Location 3** – located at 658 Carrick Road, Towrang NSW. This location was selected as a representative location along the pipeline route for the rural areas not affected by Hume Highway traffic noise.
- ▶ **Location 4** – located at 488 Hanging Rock Road, Sutton Forest NSW. This location was selected as representative location long the pipeline route for rural areas affected by road traffic noise from the Hume Highway.
- ▶ **Location 5** – located at the existing Wingecarribee Reservoir, Sheepwash Road, Glenquarry NSW. This location was selected due to its proximity to the proposed pump station.



18.2 Existing environment

18.2.1 Potentially impacted receivers

Pump station potentially impacted receivers

There are residential receivers located nearby to the pump station that may be potentially affected by noise and vibration from the low lift pump station and high lift pump station operation and construction. The Wingecarribee Reservoir is considered as a recreational receiver.

Pipeline route potentially impacted receivers

There are residential receivers located along the pipeline that may be potentially affected by noise and vibration from the pipeline construction and operation.

Receivers along the Project route are located at a variety of distances from the works area, including within 50 m from the proposed pipeline corridor. Using aerial photography and information provided, the number of habitable dwellings was estimated to be 16 dwellings within 50 m of the pipeline route. Therefore, rock hammer and thrust/underboring activities are the most likely construction activities to have the potential to exceed the *highly noise affected* criteria of 75 dB(A) at these identified dwellings.

18.2.2 Noise monitoring results

Table 18.1 and Table 18.2 summarise the calculated noise level indices LA90 (Period) and LAeq (Period) respectively for the monitoring locations which are relevant for the operational and construction noise assessments.

Table 18.1 Summary of the RBL LA90(Period) Noise Monitoring Results, dB(A)

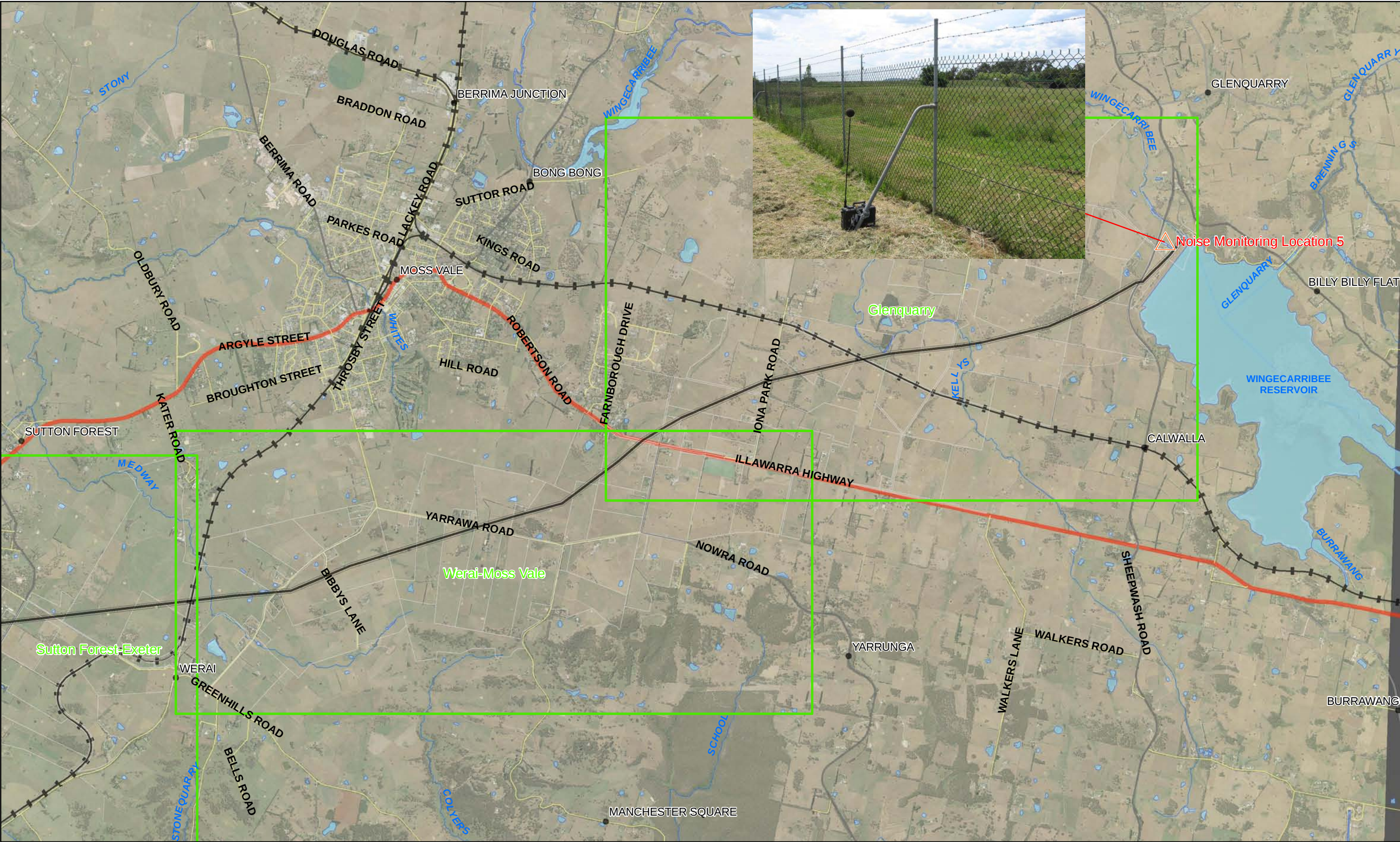
Monitoring Location	L _{A90} (Day) 7am to 6pm	L _{A90} (Evening) 6pm to 10pm	L _{A90} (Night) 10pm to 7am
Location 1 – River Street, Goulburn	32	31	28
Location 2 – Off Gorman Rd, Goulburn	31	31	29
Location 3 – 658 Carrick Road, Towrang	30	29	26
Location 4 – 488 Hanging Rock Road, Sutton Forest	36	38	32
Location 5 – Sheepwash Road, Glenquarry	36	36	32

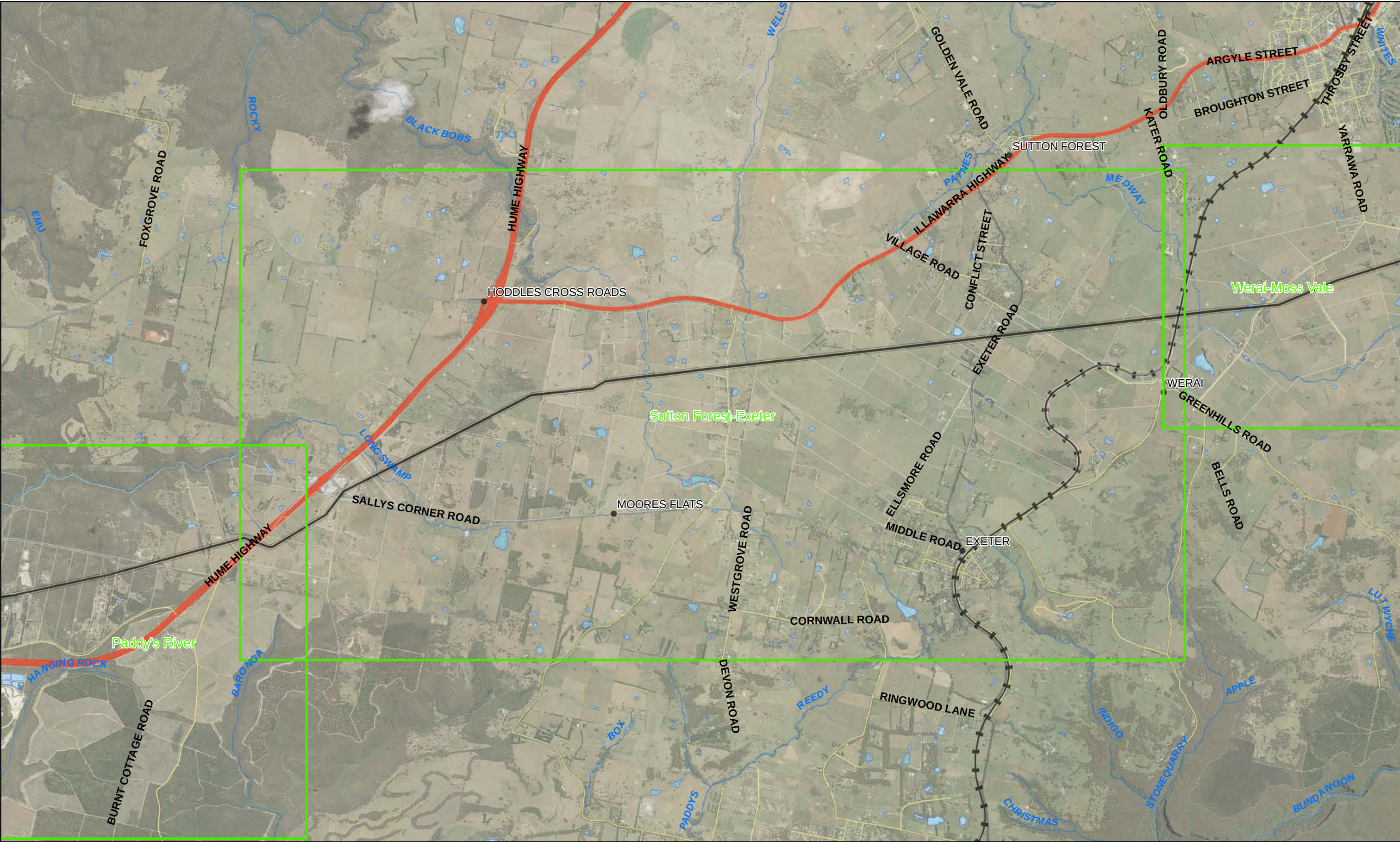


Table 18.2 Summary of the LAeq(Period) Noise Monitoring Results, dB(A)

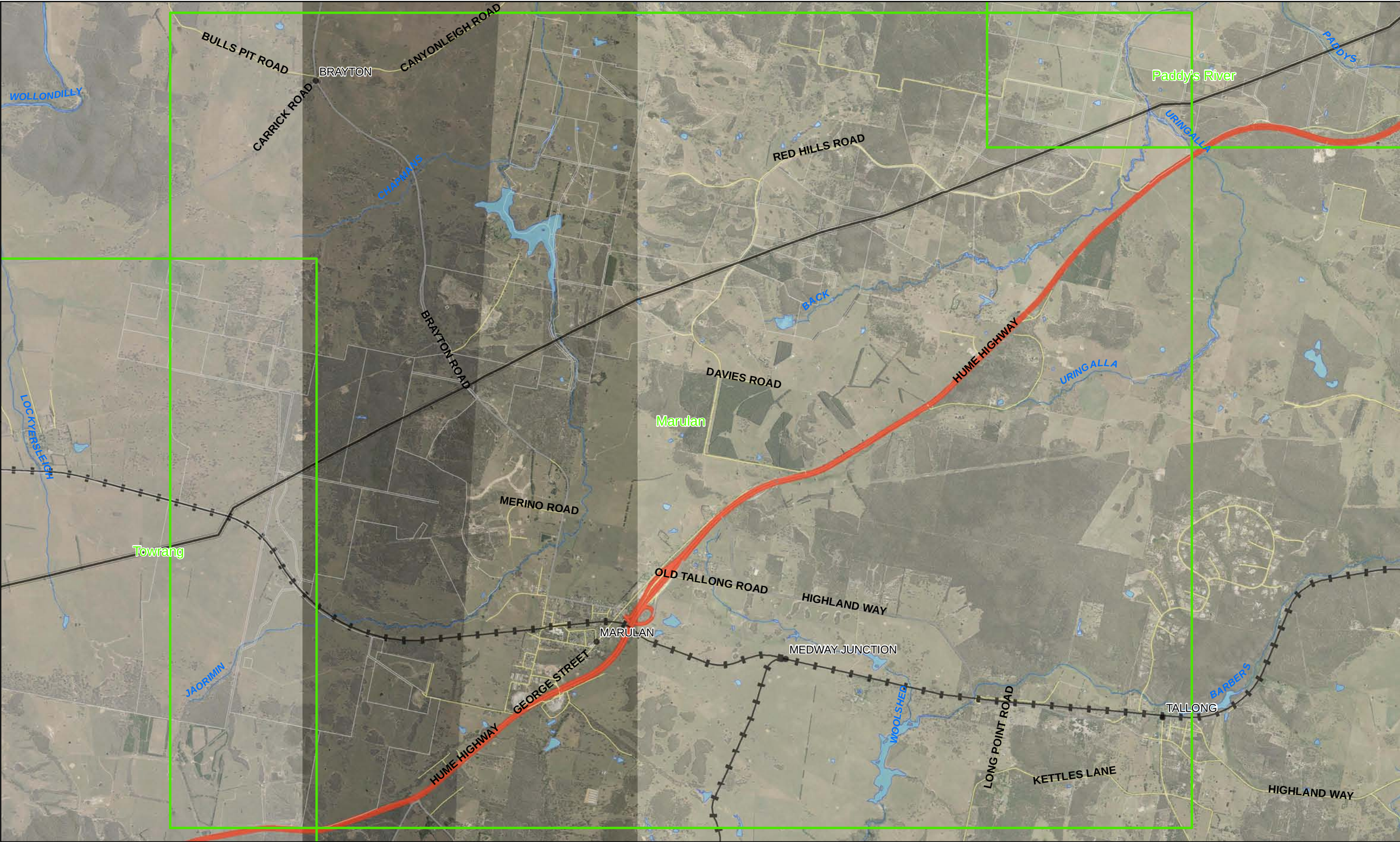
Monitoring Location	L _{Aeq} (Day) 7am to 6pm	L _{Aeq} (Evening) 6pm to 10pm	L _{Aeq} (Night) 10pm to 7am
Location 1 – River Street, Goulburn	56	52	46
Location 2 – Off Gorman Rd, Goulburn	44	43	42
Location 3 – 658 Carrick Road, Towrang	45	40	43
Location 4 – 488 Hanging Rock Road, Sutton Forest	51	50	45
Location 5 – Sheepwash Road, Glenquarry	51	46	45

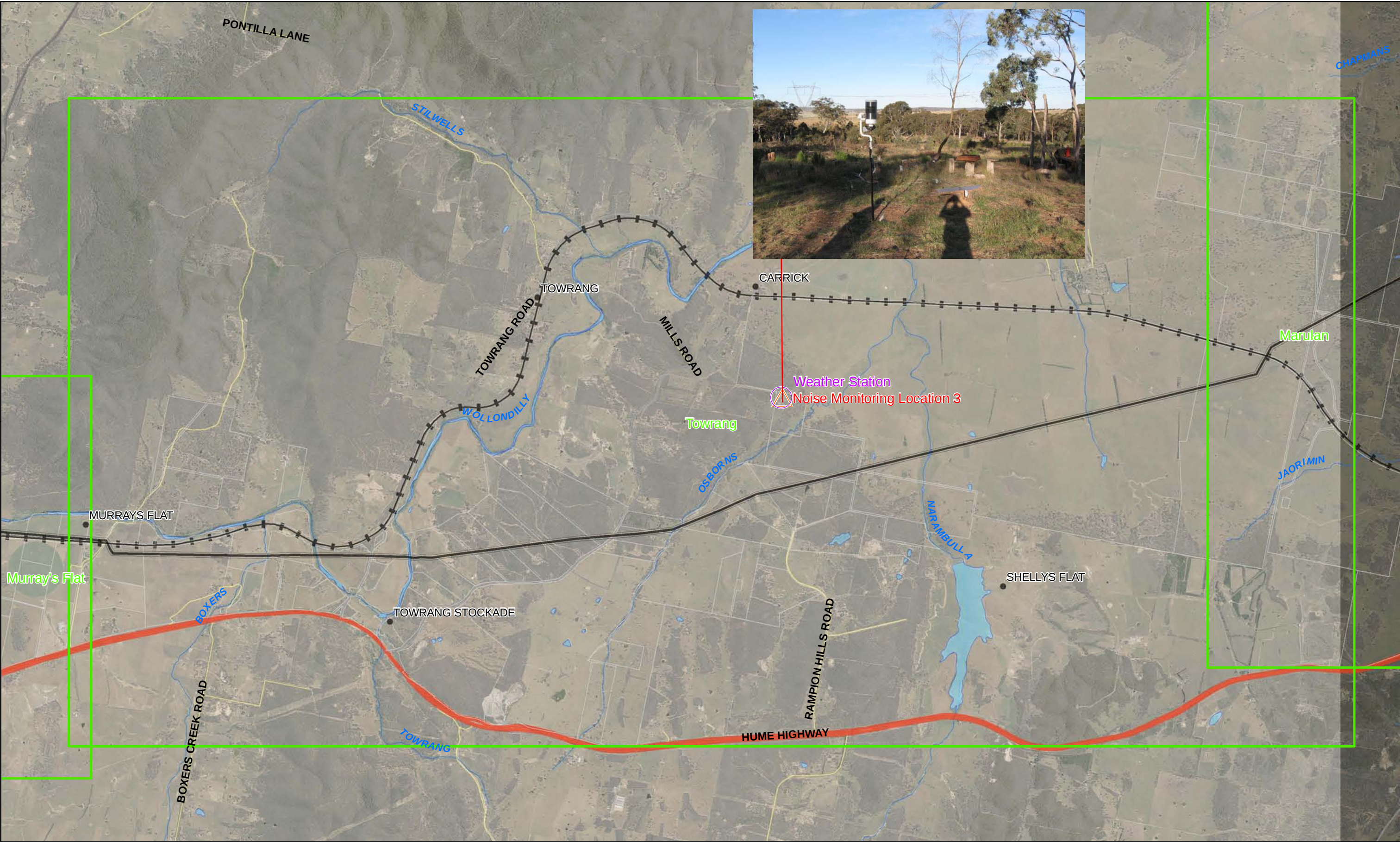
The background monitoring results indicate that the ambient noise environment is typical of a rural environment with low levels of transportation noise as defined by AS 1055.2: 1997 *Acoustics : Description and measurement of environmental noise – Part 2: Application to specific situations*.















18.3 Noise goals

18.3.1 Construction noise

Construction noise in NSW is assessed with consideration to the Department of Environment and Climate Change *New South Wales Interim Construction Noise Guidelines (CNG): July 2009*.

The recommended standard hours for construction activity as specified in the construction noise guidelines are as follows:

- ▶ Monday to Friday: 7 am to 6 pm;
- ▶ Saturday: 8 am to 1 pm; and
- ▶ No work on Sunday or public holidays.

For HSP, construction work may potentially occur during extended hours, including 24 hours work during certain periods.

Table 18.3 details the adopted construction noise goals for the proposed construction works in NSW.

The *noise affected level* represents the point above which there may be some community reaction to noise. The *highly noise affected level* represents the point above which there may be strong community reaction to noise.

Table 18.3 NSW construction noise criteria, dB(A)

Time period	Management level L_{Aeq} (15 min)
Recommended standard hours	<i>Noise affected level: RBL + 10</i> <i>Highly noise affected level: 75 dB(A)</i>
Outside recommended standard hours	<i>Noise affected level: RBL + 5</i>

Based on the above and the RBL determined from site monitoring (see Table 18.1, construction noise goals have been derived at various logging locations, as shown in Table 18.4.



Table 18.4 Construction Noise Goals $L_{Aeq(15min)}$

Monitor ID	Within Recommended Standard Hours	Outside Recommended Standard Hours	
		Evening (6pm-10pm)	Night (10pm-7am)
L1	42	36	33
L2	41	36	34
L3	40	34	31
L4	46	43	37
L5	46	41	37

18.3.2 NSW road traffic noise criteria

For NSW roads the road traffic noise associated with the construction works and operation is sourced from the Department of Environment, Climate Change and Water (DECCW) Environmental Criteria for Road Traffic Noise (ECRTN). Recommended noise levels associated with land use developments are shown in Table 18.5. Where noise criteria levels are already exceeded, construction and operational traffic arising from the project should not lead to an increase in existing noise levels of more than 2 dB(A).

Table 18.5 NSW road traffic noise criteria

Type of development	Day (7 am – 10 pm)	Night (10 pm – 7 am)
Land use development with potential to create additional traffic on local roads	$L_{Aeq,1hour}$ 55 dB(A)	$L_{Aeq,1hour}$ 50 dB(A)
Land use development with potential to create additional traffic on collector roads	$L_{Aeq,1hour}$ 60 dB(A)	$L_{Aeq,1hour}$ 55 dB(A)
Land use development with potential to create additional traffic on freeways and arterial roads	$L_{Aeq,15hour}$ 60 dB(A)	$L_{Aeq,9hour}$ 55 dB(A)

18.3.3 Operational noise

There is potential for residential receivers to be exposed to operational noise from the pipeline booster station and pump stations. The operational noise goals are provided in Table 18.6 for the residential receivers.

Table 18.6 Operational noise criteria

Location	Time Period	Project Specific Criteria
Location 1	Day	37
	Evening	36
	Night	35
Location 2	Day	36
	Evening	36
	Night	35
Location 3	Day	35
	Evening	35
	Night	35
Location 4	Day	41
	Evening	41 ¹
	Night	37
Location 5	Day	41
	Evening	41
	Night	37

Note: Daytime is 7am to 6pm, evening time is 6pm to 10pm and night-time is 10pm to 7am.

¹ Evening time to be assessed as not higher than daytime.

Table 18.6 indicates the rating background levels for all locations are relatively low, typical of a rural environment. Locations 4 and 5 are slightly higher due to the proximity to the Hume Highway and Sheepwash Road, respectively.

Given the pump station would potentially operate during night-time, a criteria of 35 dB(A) has been adopted for all locations. This also provides measure of conservatism for Receivers in the vicinity of Locations 4 and 5.

18.4 Vibration goals

18.4.1 Human comfort

Vibration criteria have been set with consideration to the NSW DECC's 'Assessing Vibration: A Technical Guideline' 2006. The human comfort vibration goals are summarised in Table 18.7.

Table 18.7 Human comfort vibration goals (mm/s PPV)

Receiver type	Period	Continuous vibration		Intermittent and impulsive vibration	
		Preferred	Maximum	Preferred	Maximum
Residential	Day	0.28	0.56	8.6	17
	Night	0.2	0.4	2.8	5.6

18.4.2 Structural vibration

Guidance of limiting vibration values is attained from reference to German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures*.

Short-term vibration guideline values are presented in Table 18.8.

Table 18.8 Guideline Values - Effects of Short-Term Vibration on Structures

Line	Type of Structure	Guideline Values for Velocity, $v_i(t)$ ¹ [mm/s]		
		Vibration at the Foundation at a Frequency of:		
		1Hz to 10 Hz	10Hz to 50Hz	50Hz to 100Hz ²
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

Notes:

¹ The term v_i refers to vibration levels in any of the x, y or z axes.

² At frequencies above 100 Hz the values given in this column may be used as minimum values.

18.5 Blasting criteria

Typically, when dealing with potential blasting noise and vibration, DECC refers to Australian and New Zealand Environment Council (ANZEC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (1990). This guideline recommends the following noise and vibration limits:



Table 18.9 Recommended ANZEC 1990 Blasting Limits

Airblast Overpressure	Ground Vibration
115 dB(lin) peak	5 mm/s PPV
The level of 115 dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 120 dB(lin) peak.	The level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 10 mm/s.

18.6 Impact assessment

18.6.1 Construction noise

An indicative list of construction equipment/plant that would be used during construction and corresponding sound power levels is provided in Table 18.10

Table 18.10 Indicative construction plant / equipment

Stage/Task	Location	Equipment	Estimated Sound Power Level L_{Aeq} dB
Excavation	Pipeline	65T, 45T, 30T and 20T excavators	99 -107
		Vermeer tracked trencher	105
		Loader	107
		Dump trucks and articulated dump trucks	109
		Prime mover and pipe trailer	108
		Dual cabs	84
		Water cart	109
		Fuel trailer	104
		Mobile cranes	99
		Tracked bobcats	96
		Backhoe	96
		Tipper	107
	Pump station	30T, 20T, 8T, 3T excavators	83-103
	Booster pump station	Small plant	98
Site preparation	Structures and pipeline route	Road trucks	108
		Articulated dump trucks	109
		Grader	105
		Dozer	108



Stage/Task	Location	Equipment	Estimated Sound Power Level L_{Aeq} dB
		Dump trucks	109
		Loader	107
Rock hammer	Structures and pipeline route various locations	30T excavator with hammer	118
Formwork	Structures and pipeline route various locations	Small tools	101
		Generators	88
		Trucks	108
		Utes	84
Building works	Pump station	20 – 80 T cranes	105
		Concrete boom pump	106
		Tool handler	93
Blasting	Various locations along pipeline route	Drilling rigs	114
		Utes	84
		Explosives truck	108
Under boring	Major river crossings	Drilling rigs (100 T, 300 T and 500 T)	114
	RTA roads	Water truck	109
	Railways	45T, 30T and 20T excavators	103-107
	Some services	Utes	84
		Cranes	105
		Loader	107
		Dump truck	109
		Hand tools	101

Based on the above equipment and sound power levels, the predicted construction noise for each stage of the project has been estimated for different distances and is shown in Table 18.11.

Table 18.11 Predicted Pipeline Construction Noise for Different Distances, dB(A)

Construction Stage	Distance (m)						
	50	100	250	500	1000	2000	3000
Excavation (Pipeline)	70	63	55	49	42	34	29
Excavation (Pump Stations)	66	59	51	45	38	30	25
Site Preparation	68	61	53	47	40	32	27
Rock Hammer	72	65	57	51	44	36	31
Formwork	63	56	48	42	35	27	22
Building Works	63	56	48	42	35	27	22
Blasting	69	62	54	48	41	33	28
Underboring	71	64	56	50	43	35	30

The magnitude of noise impacts associated with construction would be dependent upon a number of factors including:

- ▶ The intensity of construction activities;
- ▶ The location of construction activities;
- ▶ The type of equipment used;
- ▶ Existing local noise sources;
- ▶ Intervening terrain; and
- ▶ The prevailing weather conditions.

In addition, mobile machinery would likely move about, variously altering the directivity of the noise source with respect to individual receivers. During any given period the machinery items to be used on site would operate at maximum sound power levels for only brief stages. At other times the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time. Finally, certain types of construction machinery would be present on site for only brief periods during construction.

Assuming construction activities would primarily be undertaken between 7am and 6pm Monday to Friday, and 8am to 1pm Saturdays, construction noise impacts may exceed the most stringent criteria of 40 dB(A) (ICNG daytime construction noise goal) within approximately 1350 m from the noisiest construction activities. However, construction noise impacts are expected to be under the 75 dB(A) highly noise affected criteria at distances greater than 50 m from the pipeline. Given the mobile nature of construction activities, it is expected that sensitive receptors would only be exposed to elevated noise levels for relatively short periods.



18.6.2 Residential receivers

Approximately 40 dwellings are located within 100 metres of the alignment with 16 dwellings located within 50 metres. The nearest of these dwellings are two dwellings located approximately 10 metres from the alignment. These dwellings are located in the northwest corner of Ivy Lea Place in Goulburn and a property located off the Hume Highway west of the second crossing of the Wollondilly River, therefore it is recommended that the mitigation measures detailed in Section 18.8 should be considered and implemented where feasible and reasonable to reduce noise impacts.

Given the construction activities are expected to occur at very short distances from these locations identified in the table above, it is possible that the highly noise affected construction noise criteria will be exceeded at these locations.

In order to assess the noise impacts of the various pipeline construction activities, noise emission calculations were carried out to determine sideline distances at which the construction criteria presented in Table 18.4 are achieved. The calculations assume propagation over flat, soft ground (*i.e.* open grassland) to a typical receiver. The predicted offset distances for each construction scenario in each period are shown below in Table 18.12.

It should be highlighted that due to the intermittent and mobile nature of construction noise, the estimates are conservative. Essentially, they represent the maximum possible distances over which an acoustic impact may be observable during quiet ambient conditions. If such impacts were to occur, they would likely be intermittent and infrequent. Furthermore, the construction of the pipeline is expected to occur at a rate of 1.5 km per week per construction team depending on the site location and constraints. This translates to approximately 250 m per day per team, which suggests that the highly noise affected criteria would only be potentially exceeded for less than a day.

Nevertheless, noise sensitive receivers may potentially be impacted by construction activities. This issue is not uncommon with construction activities and is practically best addressed by the implementation of construction noise management measures to be incorporated in the Environmental Management Plan (EMP) for the Project. Construction noise management measures have been recommended and are outlined in Section 18.8 of this report. These mitigation measures should be implemented and all potentially impacted residence should be informed of the nature of the works, expected noise levels, duration of works and a method of contact.



Table 18.12 Offset Distances to Receivers to Comply with Construction Noise Criteria

Receiver Area	Period	Offset Distance to Receivers to Comply with ICNG Criteria							
		Excavation (Pipeline)	Excavation (Pump Stations)	Site Prep	Rock Hammer	Formwork	Building Works	Blasting	Under-Boring
L1	Day	1000	700	850	1200	500	500	900	1100
	Evening	1700	1200	1450	2000	900	900	1600	1850
	Night	2200	1600	1850	2550	1200	1200	2000	2350
L2	Day	1100	750	900	1350	550	550	1000	1200
	Evening	1700	1200	1450	2000	900	900	1600	1850
	Night	2000	1450	1700	2350	1100	1100	1850	2200
L3	Day	1200	850	1000	1450	600	600	1100	1350
	Evening	2000	1450	1700	2350	1100	1100	1850	2200
	Night	2550	1850	2200	2950	1450	1450	2350	2750
L4	Day	700	450	550	850	350	350	700	850
	Evening	900	600	750	1100	450	450	850	1000
	Night	1600	1100	1350	1850	850	850	1450	1700
L5	Day	700	450	550	850	350	350	700	850
	Evening	1100	750	900	1350	550	550	1000	1200
	Night	1600	1100	1350	1850	850	850	1450	1700

18.6.3 Traffic generation

The traffic generation rates and number of movements is based on the following:

- ▶ Pipe delivery to a laydown location would be in the order of 6 vehicles a day or 12 movements per day for a period of 6 months.
- ▶ Crew movements are estimated at 12 vehicles per day (assuming light vehicles with 5 person occupancy) or 24 movements per day.
- ▶ Imported backfill material is expected to be brought to site with 120 small truck movements or 60 large truck movements a day.

The Traffic Impact Assessment assigned traffic volumes to the road network as shown in Table 18.13. This represents the expected maximum traffic volume during the construction period.

Table 18.13 Predicted construction traffic

Light vehicle trips per day	Heavy vehicle trips per day	Total traffic per day
24	192	216

The predicted increase in noise levels are based on the assumption that the traffic generation volumes given in Table 18.13 apply to all the identified roads. This represents the worst case scenario, therefore provides a measure of conservatism.

The conservatively estimated increase in traffic noise levels is shown below in Table 18.14.

Table 18.14 Predicted traffic noise increase on roads

Sector	Affected Road	AADT	Date	Estimated 2009 Volumes (3% growth)	Increase in noise level dB(A)
Goulburn	Clinton Street	NDA	-	-	-
	Chinaman's lane	282	2006	308	2
	Crookwell Road	1700	2006	1858	1
	Middlearm Road	747	2006	816	1
	Taralga Road	1060	2005	1193	1
Murray's Flat	Hume Highway	27411	2003	32730	0
	Murrays Flat Road	43	2004	50	8
	Towrang Road	349	2006	381	2
	Carrick Road	157	2006	172	4
Marulan	Brayton Road 5km from village	266	2003	318	3

Sector	Affected Road	AADT	Date	Estimated 2009 Volumes (3% growth)	Increase in noise level dB(A)
	Red Hills Road 1	53	2003	63	7
	Red Hills Road 2	47	2003	56	7
Paddys River	Wollombi Road	18	2004	21	11
	Inverary Road	25	1993	40	10
Sutton Forest	Old Argyle Road	200	1995	303	3
	Sally's corner Road	616	1995	932	1
	Hume Highway	20250	2003	24180	0
	Nowra Road	1242	2005	1398	1
Moss Vale	Yarawa Road	1193	2009	1193	1
	Mt Broughton Road	1768	1993	2837	1
	Bibbys Lane	NDA	-	-	-
Glenquarry	Iona Park Road	115	1991	196	5
	Illawarra Highway	3416	2003	4079	0
	Sheepwash Road	4007	2003	4785	0

Note: NDA denotes no traffic data available.

Table 18.14 indicates that the potential increase in traffic noise levels on identified affected roads ranges from no change in traffic noise up to 11 dB(A) increase in traffic noise levels. Roads that already possess high traffic volumes such as the Hume Highway are predicted to have no increase in noise levels. On the other hand, local roads which have low volumes such as Wollombi Road are expected to see higher traffic noise level increases.

As such, it is recommended construction traffic, heavy vehicles in particular on local roads with low existing volumes occur during standard construction hours if possible to minimise the risk of sleep disturbance.

18.6.4 Construction vibration

The majority of construction activities along the pipeline are not expected to produce perceptible levels of vibration due to the distance from the receivers. However, some activities such as excavation, rock breaking, rolling and compacting may produce levels of vibration that are perceptible and potentially intrusive when construction activities are located within 50 m of residences.

Vibration levels produced by pipeline construction activities, except for pile-driving, are expected to be well below the most stringent structural damage criteria of 3 mm/s at receivers located at distances greater than 50 metres. For the two identified receivers located within 10 metres of the alignment,



vibration levels are expected to exceed the most stringent structural damage criteria. As such, vibration mitigation measures detailed in Section 18.8 should be considered for these receivers.

Based on information provided, it is estimated that the pipeline construction rate is one to two kilometres per week depending on terrain. Based on this calculated rate of construction residential receivers should only be exposed to vibration for less than one day, which is considered only a short duration and is likely to significantly mitigate the reaction to construction vibration.

The most stringent building vibration damage lower limit of three millimetres per second is normally not exceeded by general construction activities at distances greater than 50 m from the nearest sensitive receivers. Piling may occur during construction of the pump station if required. It is anticipated that the bored piling technique would be used, which generates minimal vibration levels as it is essentially a drilling activity. If pile driving were to occur, then vibration impacts may occur, however these would not normally cause structural damage when carried out further than 30 m from a sensitive structure. The minimum distance between residents and the pump stations in the Project is greater than 100 m and so vibration impacts from pile driving are not expected to cause structural damage.

18.6.5 Construction blasting

Based on a charge mass of 50 kg, the distance between blasting areas and the receivers are expected to be restricted by the blast overpressure and not the ground vibration. Given a blast overpressure criteria of 120 dBL, the required separation distance to the nearest receivers would be approximately 800 m. This offset distance in most cases would not be feasible. Measures to manage and mitigate the potential impacts from blasting are discussed in Section 18.8.2. Alternative methods to blasting may be used where required.

18.6.6 Operational noise

The pump stations assumed to be configured as follows:

- ▶ Two duty pumps and one standby pump located in the pump room;
- ▶ One transformer located outside in the transformer yard;
- ▶ One externally located air conditioner (AC) unit; and
- ▶ Forced ventilation system.

A worst-case scenario with all three centrifugal pumps operating along with all other noise generating equipment stated above. The predicted noise levels at the nearest identified receivers are shown below in Table 18.15.



Table 18.15 Predicted Pump Station Operational Noise at Receivers, dB(A)

Pump Station Operation	Receiver(s)	Predicted Noise Level dB(A) at Receiver	
		Neutral Conditions	F Class Inversion and 2 m/s Wind Source to Receiver
Raw and Treated Water Pump Stations	280 m west southwest of treated water station	15	21
	270 m north of raw water pump station	12	17
	290 m northwest of treated water station ¹	20	25
Booster Pump Station	200 m northwest of booster pump station	24	27

¹ Classified as commercial receiver

Modelling results indicate operational noise levels of the pump stations are expected to be well under the noise criteria of 35 dB(A) at the nearest sensitive receivers for all assessed weather conditions.

18.6.7 Operational vibration

Operational equipment with a potential to generate vibration such as pumps and mechanical plant are typically designed to incorporate requirements for vibration isolation. The nearest sensitive receivers were located approximately 280 m to the NW of the pump station. The Project is not expected to generate any appreciable vibration impacts at vibration sensitive receivers provided that design incorporates requirements for vibration isolation. Appropriate vibration isolation details can generally be obtained from the plant manufacturer, with 90 to 95 per cent isolation suggested to ensure minimal vibration would be transmitted to the supporting structure.

18.7 Summary of results

Noise and vibration disturbing nearby residents and affecting health and amenity have been included as part of the Environmental Assessment. These emissions are commonly associated with developments of this kind. Although they are likely to occur, they would be relatively short-lived, as construction of the Pipeline is expected to take less than two years. During this time, construction sites would move along the pipeline corridor and therefore impacts on any one location would be short-term.

Excavation work, under-boring, and rock hammering are predicted to produce the highest noise levels at sensitive receivers and have the potential to exceed the highly noise affected noise level of 75 dB(A) when operating within 50 m of residential receivers. As such, these activities should be restricted to standard hours if possible when located within 50 m of a residence.

Approximately 16 dwellings have been identified as being located within 50 m of the proposed pipeline route. Of those 16 dwellings, 2 dwellings are expected to be within 10 m of the pipeline route, therefore it is recommended that the mitigation measures detailed in Section 18.8 should be considered and implemented where feasible and reasonable to reduce noise impacts.



It is unlikely that implementation of all reasonable and feasible noise mitigation measures would reduce noise levels to below the *noise affected level* of 40-46 dB(A). Therefore all potentially impacted residents would need to be informed of the nature of the works, expected noise levels, duration and contact details.

The majority of construction activities along the pipeline are not expected to produce perceptible levels of vibration due to the distance from the receivers. However, some activities such as excavation, rock breaking, rolling and compacting may produce levels of vibration that are perceptible and potentially intrusive when construction activities are located within 50 m of residence. For the two identified receivers located within 10 metres of the alignment, vibration levels are expected to exceed the most stringent structural damage criteria, therefore it is recommended that the mitigation measures detailed in Section 18.8 should be considered and implemented where feasible and reasonable to reduce vibration impacts.

Though blasting is not anticipated, it remains a possibility and as a consequence blasting mitigation techniques have been provided to reduce the magnitude of the noise and vibration levels as well as the perception of vibration at sensitive locations. It is recommended that blast monitoring be considered to assess compliance and confirm the predictions and all residential receivers be informed when blasting is to be undertaken.

18.8 Mitigation measures

A noise and vibration management plan would be prepared as part of the construction environmental management plan, including the following measures to avoid, minimise, mitigate, offset, manage and/or monitor potential impacts:

- Adherence to standard DECCW recommended hours for any blasting activities required;
- Where possible avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers;
- Where possible, the offset distance between noisy plant items and nearby noise sensitive receivers should be as great as possible;
- Regular compliance checks on the noise emissions of all plant and machinery to minimise noise emissions;
- In cases where construction activities are carried out in close proximity to sensitive receivers or where there is potential for adverse impact, a site specific construction noise and vibration management plan may be prepared to detail how construction noise and vibration impacts would be minimised and managed at that location;
- The construction sites should be laid-out in such a way that the primary noise sources are at a maximum distance from residences, with solid structures (sheds, containers, etc) placed between residences and noise sources (and as close to the noise sources as is possible);
- All equipment on site would be operated in accordance with the manufacturer's instructions;
- Fixed equipment (*i.e.* pumps, generators, compressors) would be located as far as possible from the nearest residences;
- Material dumps would be located as far as possible from the nearest residences;

- ▶ Whenever possible, loading and unloading areas would be located as far as possible from the nearest residences;
- ▶ Equipment which is used intermittently would be shut down when not in use;
- ▶ All engine covers would be kept closed while equipment is operating;
- ▶ As far as possible, materials dropped from heights into or out of trucks would be minimised;
- ▶ Regular maintenance of all plant and machinery used for the project would assist in minimizing noise emissions; and
- ▶ As the chain/wheel trenchers have been identified as a dominant source during trenching contractual specifications for controlling noise emission would be considered.

Table 18.16 presents noise control methods, practical examples and expected noise reductions according to Australian Standard AS 2436 – 1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*.

Table 18.16 Relative Effectiveness of Various Forms of Noise Control dB(A)

Noise Control Method	Practical Examples	Typical noise reduction dB(A)	Maximum noise reduction dB(A)
Screening	Acoustic barriers such as earth mounds, temporary or permanent noise barriers	7 to 10	15
Acoustic Enclosures	Engine casing lagged with acoustic insulation and plywood	15 to 30	50
Engine Silencing	Residential class mufflers	5 to 10	20
Substitution by alternative process	Use electric motors in preference to diesel or petrol	15 to 25	60

18.8.1 Construction vibration

A noise and vibration management plan would be prepared as part of the construction environmental management plan, including the following measures to avoid, minimise, mitigate, offset, manage and/or monitor potential impacts:

- ▶ Choose low impact equipment and methods in noise sensitive areas along the route such as:
 - Use smaller capacity dampened rock breakers and vibratory rollers;
 - Consider the use of static rollers opposed to vibratory roller where possible;
 - Consider the use of hydraulic rock splitters opposed to rock breakers where possible;
- ▶ Time awareness for vibration intensive activities would be implemented through scheduling these activities during the least sensitive time periods;
- ▶ Sequence operations so that vibration intensive activities do not occur simultaneously;
- ▶ Where possible locate vibration intensive activities as far away from sensitive areas as possible;



- ▶ Building condition surveys would be undertaken on all houses within 30 m of the proposed work prior to commencement of vibration generating works (such as pile-driving). These would be repeated at works completion; and
- ▶ Any noise and vibration monitoring would be undertaken by a qualified professional and with consideration to the relevant standards and guidelines. Attended noise and vibration monitoring would be undertaken in the following circumstances:
 - If vibration-generating activities are conducted within 30 m of a residence. If a building damage risk is identified, alternative work methods would be implemented so the vibration impacts are reduced to acceptable levels; and
 - Upon receipt of complaint from sensitive receivers.

18.8.2 Construction blasting

A noise and vibration management plan would be prepared as part of the construction environmental management plan, including the following measures to avoid, minimise, mitigate, offset, manage and/or monitor potential impacts:

If required, blasting noise and vibration levels may be reduced by application of the following:

- ▶ Investigate alternative rock-breaking techniques;
- ▶ Establish times of blasting to suit local conditions;
- ▶ Direction of detonator initiation away from near residences;
- ▶ Building condition surveys would be undertaken at all potentially impacted dwellings (within 50 m of the pipeline), prior to commencement of blasting. These would be repeated at works completion;
- ▶ Reducing the maximum instantaneous charge (MIC) by using delays, reduced hole diameter and/or deck loading;
- ▶ Changing the burden and spacing by altering the drilling pattern and/or delay layout, or altering the hole inclination;
- ▶ Exercise strict control over spacing and orienting all blast drill holes; and
- ▶ Use minimum practicable sub-drilling which gives satisfactory toe conditions;

18.8.3 Operational noise and vibration

Based on the Project description regarding pump station building design and pump sound power levels given in the air, noise and vibration report, operational noise from raw and treated water pump stations and the booster pump station is expected to be under the noise criteria at sensitive receptors.

Site equipment with a potential to generate vibration such as pumps and mechanical equipment would be selected and assessed with consideration to ISO 10816.3, *“Mechanical Vibration – evaluation of machine vibration by measurements on non-rotating parts: Part 3 – Industrial machines with nominal power above 15 kW and nominal speeds between 12 rpm and 15 000 rpm when measured in situ”*, which provides maximum vibration velocity limits for centrifugal pumps and motors.