

Appendix L

Noise and vibration assessment and addendum

Environmental impact statement

Murrumbidgee to Googong Water Transfer

Noise and Vibration Assessment

July 2009



Bulk Water Alliance



ACTEW in partnership with ActewAGL

Contents

GLOSSARY – ACOUSTIC TERMS	1
EXECUTIVE SUMMARY	3
1 INTRODUCTION	5
1.1 Purpose of this report	5
1.2 Overview	5
1.3 The location of the project	5
1.4 Limitations	6
2 EXISTING ENVIRONMENT	7
2.1 Potentially impacted receivers	7
2.2 Noise Monitoring Methodology	11
3 NOISE AND VIBRATION CRITERIA	18
3.1 NSW noise and vibration criteria	18
3.2 ACT noise regulations	22
3.3 Blasting Criteria	26
4 OPERATIONAL NOISE AND VIBRATION ASSESSMENT	27
4.1 Operational Noise	27
4.2 Operational Traffic Noise	40
4.3 Operational Vibration	40
4.4 Operation Mini-Hydro Noise	40
5 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT	41
5.1 Construction Noise	41
5.2 Construction compound noise	51
5.3 Construction Traffic Noise	54
5.4 Construction Vibration	56
5.5 Construction Blasting	57
6 PROPOSED MITIGATION MEASURES	62
6.1 Operational Noise and Vibration	62
6.2 Construction Noise and Vibration	62
6.3 Blasting Mitigation Measures	63
7 CONCLUSION	64
BIBLIOGRAPHY	66
Appendix A Noise Monitoring Charts	67

Glossary – Acoustic Terms

Abbreviation	Definition
dB	Decibel, which is 10 times the logarithm (base 10) of the ratio of a given sound pressure to a reference pressure; used as a unit of sound.
dB(A)	Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies.
L_N	Statistical sound measurement recorded on the linear scale.
L_{AN}	Statistical sound measurement recorded on the "A" weighted scale.
L_{A10} (Period)	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{A10} (1 hour)	The L_{10} level measured over a 1-hour period.
L_{A10} (18 hour)	The arithmetic average of the L_{10} levels for the 18-hour period between 0600 and 2400 hours on a normal working day. It is a common traffic noise descriptor.
L_{Aeq} (Time)	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
L_{Aeq} (15 hr)	The L_{Aeq} noise level for the period 7 am to 10 pm.
L_{Aeq} (9 hr)	The L_{Aeq} noise level for the period 10 pm to 7 am.
L_{Aeq} (1 hr)	The L_{Aeq} noise level for a one-hour period. In the context of the NSW DECC environmental criteria for road traffic noise, it represents the highest tenth percentile hourly A-weighted L_{eq} during the period 7 am to 10 pm, or 10 pm to 7 am, (whichever is relevant). If this cannot be defined accurately, use the highest A-weighted L_{eq} noise level.
L_{A90} (Period)	The A-weighted sound pressure level that is exceeded for 90 per cent of the time over which a given sound is measured. This is considered to represent the background noise e.g. L_{A90} (15 min)
L_{A10} (Period)	The A-weighted sound pressure level that is exceeded for 10 per cent of the time over which a given sound is measured.
L_{Amax} (Period)	The maximum sound level recorded during a specified time interval
L_{Amin} (Period)	The minimum sound level recorded during a specified time interval
L_w	Sound power level of the noise source
Potentially Impacted Receiver	A <i>potentially impacted receiver</i> means any of the following places— (a) a dwelling; (b) a library, childcare center, kindergarten, school, college, university or other educational institution;

Abbreviation	Definition
	<p>(c) a hospital, surgery or other medical institution;</p> <p>(d) a protected area, or an area identified under a conservation plan as a critical habitat or an area of major interest, under the <i>Nature Conservation Act 1992</i>;</p> <p>(e) a marine park under the <i>Marine Parks Act 1982</i>;</p> <p>(f) a park or garden that is open to the public (whether or not on payment of money) for use other than for sport or organised entertainment.</p>
Residential Receiver	A dwelling potentially affected by noise or vibration.
Recreational Receiver	A recreational area potentially affected by noise or vibration
Rating Background Level (RBL)	<p>The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24 hour period used for the assessment background level). This is the level used for assessment purposes. It is defined as the median value of:</p> <p>All the day assessment background levels over the monitoring period for the day; (7 am to 6 pm);</p> <p>All the evening assessment background levels over the monitoring period for the evening; (6 pm to 10 pm) or</p> <p>All the night assessment background levels over the monitoring period for the night. (10 pm to 7 am).</p>
Sound Pressure Level (SPL)	20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level of 20 micropascals.
Affected person¹	<p>For an affected place, means an occupier of the affected place, and includes a person who is lawfully in an affected place that is on</p> <p>Unleased land; or</p> <p>Public land under the crown lands act 1989 (NSW), Section 153, as in force from time to time.</p>
Compliance Point¹	<p>The compliance point for a parcel of land held under territory lease is any point as near as practicable to the boundary of the parcel of land.</p> <p>The compliance point for unleased land is any point as near as practicable to 5m from the source of noise.</p>

¹From the ACT Environment Protection Regulation 2005

Executive Summary

This report provides a noise and vibration assessment of the potential operational and construction noise impacts on the surrounding environment from the proposed infrastructure to transfer water from the Murrumbidgee River to Googong Reservoir.

Background noise monitoring was undertaken at selected locations along the pipeline route. The background monitoring results indicate that the ambient noise environment is typical of a rural environment with low levels of road transportation as defined by AS 1055.2.

The assessment was undertaken with consideration to ACT and NSW noise and vibration guidelines, legislation and standards.

Modelling was undertaken to predict the effects of noise and vibration generated by the construction and operations of the project. Based on the results of the modelling, it is concluded that:

- The operations of the high lift pump station (HLPS), low lift pump station (LLPS) and discharge structure are not predicted to exceed adopted noise and vibration goals at the surrounding residential receivers;
- Operational noise due to air valve operation is predicted to be below the noise goal of 35 dB(A) at identified residential receivers. It should be noted that the air valve noise calculations are based on exit velocities outlined in this report. If the design or operation of air valves deviates from this information, it is recommended that the valve noise predictions be checked to confirm compliance with the noise criteria;
- The construction of the LLPS and HLPS is predicted to comply at the surrounding residential and recreational receivers with respect to noise and vibration;
- The construction of the pipeline may potentially exceed construction noise goals at residential receivers. There is the potential for a strong reaction to noise for residential receivers in close proximity to construction activities i.e 40 m. The community reaction to noise will reduce with distance from the construction activities to a point where there is unlikely to be a reaction to construction noise at 1200 m. Up to 10 residential receivers have the potential to exceed *the highly noise affected level* where there is likely to be a reaction to construction noise. Approximately 100 residential receivers have the potential to exceed *the noise affected level* where there may be some reaction to construction noise though to a lesser extent. Residential receivers should only be exposed to the *highly noise affected level* for less than 1 day, which is considered only a short duration and is likely to significantly mitigate the reaction to construction noise. There is the potential for residential receivers to be exposed to the *noise affected level* for up to 37 days. It is recommended potentially impacted residents be informed of the nature of the works, expected noise and vibration levels, duration of works and a method of contact. Possible noise mitigation measures are detailed in Section 6.2.1 and should be considered;
- The construction of the pipeline may potentially exceed construction vibration goals at residential receivers within 50 m of the construction activities. Ten residential receivers have the potential to exceed vibration goals. Residential receivers should only be exposed to vibration for less than 1 day, which is considered only a short duration and is likely to significantly mitigate the reaction to construction vibration. It is recommended potentially impacted residents be informed of the nature of the works, expected noise and vibration levels, duration of works and a method of contact. Possible vibration mitigation measures are detailed in Section 6.2.2 and should be considered;
- The construction of the discharge structure may exceed noise goals at residential receivers. There is unlikely to be a strong reaction to discharge construction noise as the *highly noise affected level* is not expected to be exceeded at the surrounding residential receivers. Approximately 20 residential receivers have the potential to exceed *the noise affected level* where there may be some reaction to construction noise. The community reaction to noise will reduce with distance from the construction activities to a point where there is unlikely to be any reaction to construction noise at 1200 m. All potentially impacted residents should be informed of the nature of the works, expected noise levels, duration of works and a

method of contact. Recommended noise mitigation measures are detailed in Section 6.2.1 and should be considered;

- It is recommended that the mitigation measures detailed in Section 6.2.1 should be implemented and all potentially impacted residents should be informed of the nature of the works, expected noise levels, duration of works and a method of contact.
- Construction of the discharge structure is expected to comply with the vibration criteria at the surrounding residential receivers;
- Construction traffic is expected to comply at the surrounding residential receivers however in general, heavy vehicles attending the site should be restricted, where possible, to between 7:00 am and 6:00 pm to minimise the risk of sleep disturbance. Early morning oversized deliveries may be required on occasion for some of the construction works and would occur outside the recommended construction hours. All drivers should be sensitised to the potential for sleep disturbance on local residents and encouraged to take practical and reasonable measures to minimise the impact during the course of their delivery activities;
- Construction compound noise may potentially exceed the noise criteria at the following residential receivers:
 - One residence in close proximity to Chainage 2000 (CH 2000) Main Office Compound Area;
 - One residence in close proximity to CH 6950 Spoil and Pipe Storage Compound Area; and
 - Two residents in close proximity to CH 10800 Pipe Lay Down and Material Storage Area.
- Areas along the pipeline have been identified where blasting is likely to be required. There are up to 22 residents within 800 m of the blast location, where there is the potential to exceed the ANZECC blasting criteria. Details of blasting requirements are not yet known, once these become available detailed ground vibration and airblast overpressure estimates should be undertaken and appropriate control measure be implemented by the blast contractor. It is recommended that blast monitoring be considered to assess compliance and confirm the predictions and all potentially impacted residential receivers be informed when blasting is to be undertaken.

As stated above, the potential exists for construction activities to exceed the noise and vibration goals for the project in some circumstances. Construction activities will move from one area to another as the construction of the pipeline progresses. Consequently, construction noise at residential receivers will occur on a temporary basis. Ongoing consultation with affected landholders during the construction phase of the project will help to mitigate against any potential noise impacts.

Possible noise and vibration mitigation measures are detailed in Section 6.2 and should be considered where it has been identified for potential noise and vibration non-compliance circumstances.

1 Introduction

1.1 Purpose of this report

ACTEW Corporation Limited (ACTEW) proposes to undertake the Murrumbidgee to Googong Water Transfer Project (referred to in this report as 'the project'). This report has been prepared to provide an assessment of the noise and vibration impacts of the project as an input to the environmental impact assessment. The environmental impact assessment is being prepared with consideration to the requirements of Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *ACT Planning and Development Act 2007*.

The report addresses the requirements of the Director-General of the NSW Department of Planning (the Director-General's Requirements) dated 7 October 2008 and the Final Scoping Document prepared by the ACT Planning & Land Authority (the Scoping Document) dated 16 December 2008.

1.2 Overview

In recent years the Australian Capital Territory (ACT) region has been experiencing severe drought conditions coupled with increased demand for water. Canberra and Queanbeyan have been subject to level three water restrictions since 2006. The current drought, together with predicted climate change and population growth, is driving the search for a more reliable water supply for the ACT. In response to this need, the ACT Government developed the Water Security Program, which identified a range of new water supply projects.

The project is one of the preferred options for delivering improved security to the ACT's water supply. It involves pumping water from the Murrumbidgee River (within the ACT) and transferring it via a pipeline to the Googong Reservoir via Burra Creek (in NSW). The Googong Reservoir supplies water treated to drinking quality standards to the ACT and Queanbeyan.

The project involves construction and operation of infrastructure required to transfer approximately 100 ML/day of water a distance of approximately 13 km from the Murrumbidgee River to Burra Creek.

The infrastructure required to transfer the water includes an intake/low lift pump station; a high lift pump station; an underground pipeline; a discharge structure and a power supply.

1.3 The location of the project

The intake/low lift pump station would be located on the east bank of the Murrumbidgee River, in the ACT, approximately 34 km south of Canberra. It would be located in an area known as Angle Crossing, approximately 4 km west of Williamsdale on the Monaro Highway.

The high lift pump station would be located within the ACT, approximately 290 m to the east of the intake/low lift pump station.

The pipeline would cross rural land in an east/north-east direction for approximately 13 km. It is located in the vicinity of Williamsdale and Burra Roads, within the districts of Williamsdale and Burra. The majority (approximately 10.2 km) of the pipeline would be located in NSW, with approximately 2.8 km located in the ACT.

The pipeline would discharge to the discharge structure, located on the banks of Burra Creek, just downstream of an existing flow measuring station approximately 10 km south of Googong Reservoir. The discharge structure is located within land known as the Googong Foreshores, which is Commonwealth land within NSW.

1.4 Limitations

This report has been prepared for ACTEW. The purpose of the report is to provide an independent review of the proposal.

It is not the intention of the assessment to cover every element of the acoustical environment, but rather to conduct the assessment with consideration to the prescribed work scope.

The findings of the acoustic assessment represent the findings apparent at the date and time of the monitoring and the conditions of the area at that time. It is the nature of environmental monitoring that not all variations in environmental conditions can be assessed and all uncertainty concerning the conditions of the ambient noise environment cannot be eliminated. Modelling has been based on and stated assumptions and available data provided at the time of the assessment and should only be used as a guide. Professional judgment must be exercised in the investigation and interpretation of observations.

In conducting this assessment and preparing the report, current guidelines for noise and vibration were referred to. This work has been conducted in good faith with GHD's understanding of the client's brief and the generally accepted consulting practice.

No other warranty, expressed or implied, is made as to the information and professional advice included in this report. It is not intended for other parties or other uses.

2 Existing Environment

2.1 Potentially impacted receivers

2.1.1 LLPS and HLPS potentially impacted receivers

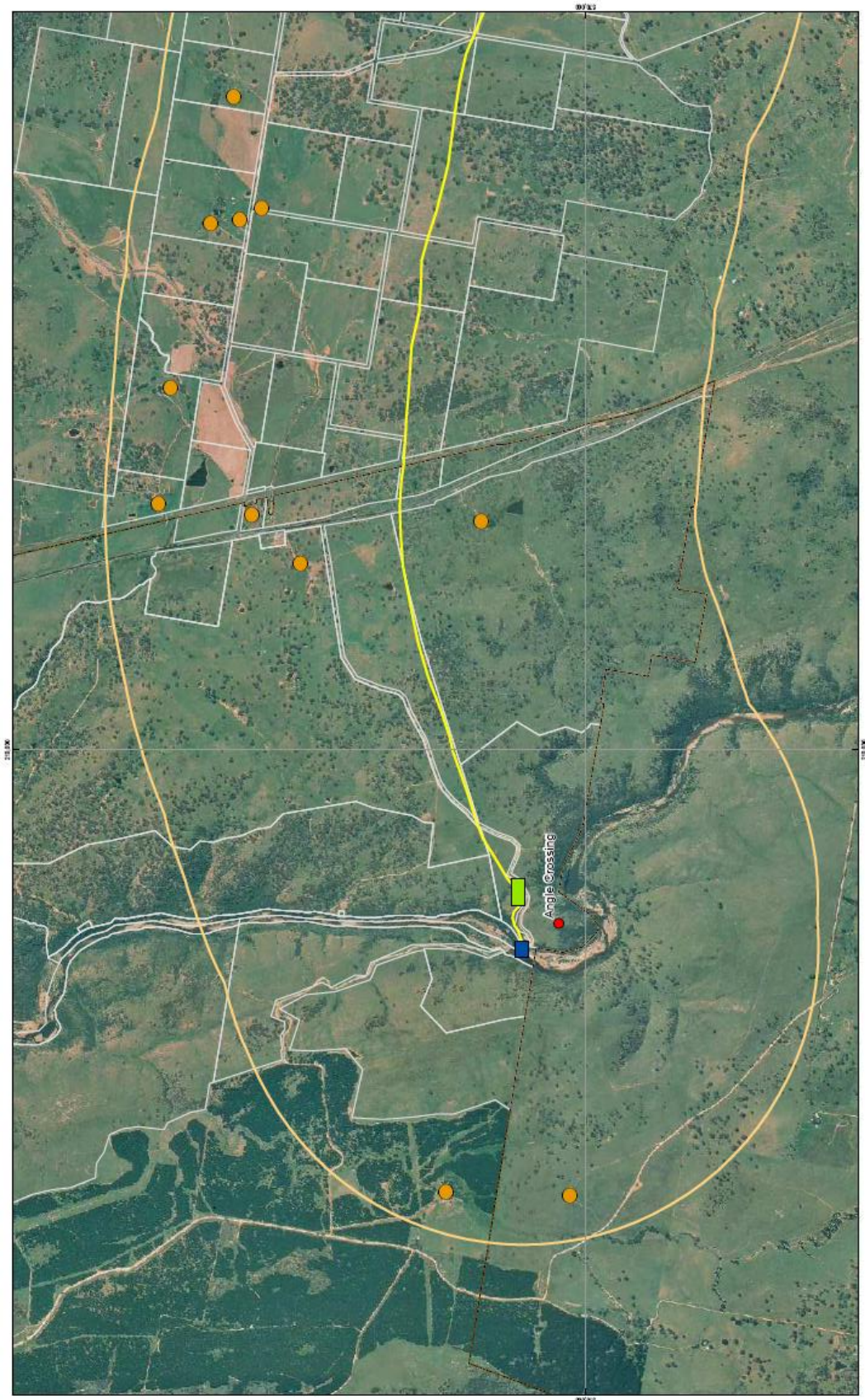
Residential receivers potentially impacted by noise and vibration from the LLPS and HLPS at Angle Crossing are located in the ACT and NSW. The closest ACT residential receivers to the Angle Crossing area are located approximately 2200 m to the north-east and 1700 m to the west. The closest NSW residential receivers to the Angle Crossing area are located approximately 2300 m to the east and 1700 m to the south-west. The Angle Crossing beach is considered a recreational receiver, which is located 300 m from the HLPS and 30 m from the LLPS. A map showing the potentially impacted receivers in the Angle Crossing area is shown in Figure 2.1.

2.1.2 Pipeline route potentially impacted receivers

Residential receivers along the pipeline route are potentially affected by noise and vibration. The distance of the residence from the pipeline varies for each residence. The property ownership and locations are shown in Figure 2.2.

2.1.3 Discharge structure potentially impacted receivers

Residential receivers potentially affected by noise and vibration from the discharge are located in NSW. The closest NSW residential receivers to the discharge are located approximately 400 m to the south-east, 300 m to the south west and 400 m to the north-west. A map showing the residential receivers near the discharge is shown in Figure 2.3.



Murrumbidgee to Googong Water Transfer Project

Project Reference: CHD-MCC-PIP-GS-MAP-056-A-0
 Report:
 Date: 24 February 2009

Figure 2-1
 LLPS and HLPS sensitive receptors

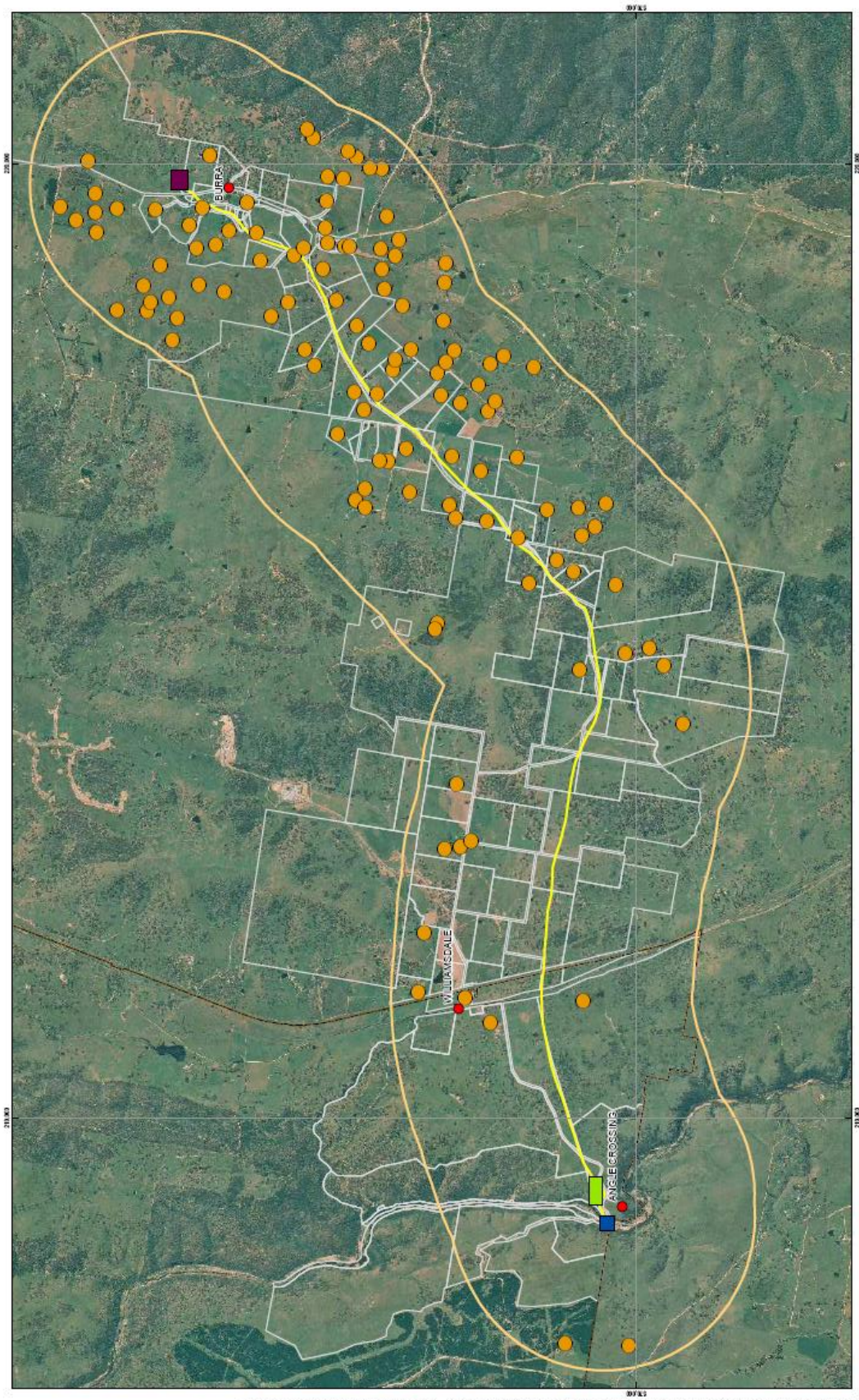


BULK WATER ALLIANCE

Map Prepared: Transverse Recorder
 Author: GIS Australia Copyright 2008

- Locality
- Sensitive receptor
- High lift pump station
- Low lift pump station
- Proposed pipeline alignment
- Buffer (1600m)
- ACT & NSW cadastral (2008)
- ACT & NSW border

Figure 2.1 Residential receivers near the LLPS and HLPS



Murrumbidgee to Goongong Water Transfer Project

Project Reference: GHD-M2C-PIP-GS-MAP-066-A-0
 Revision: C
 Date: 24 February 2009

ACTEW
 CORPORATION

BULK WATER ALLIANCE

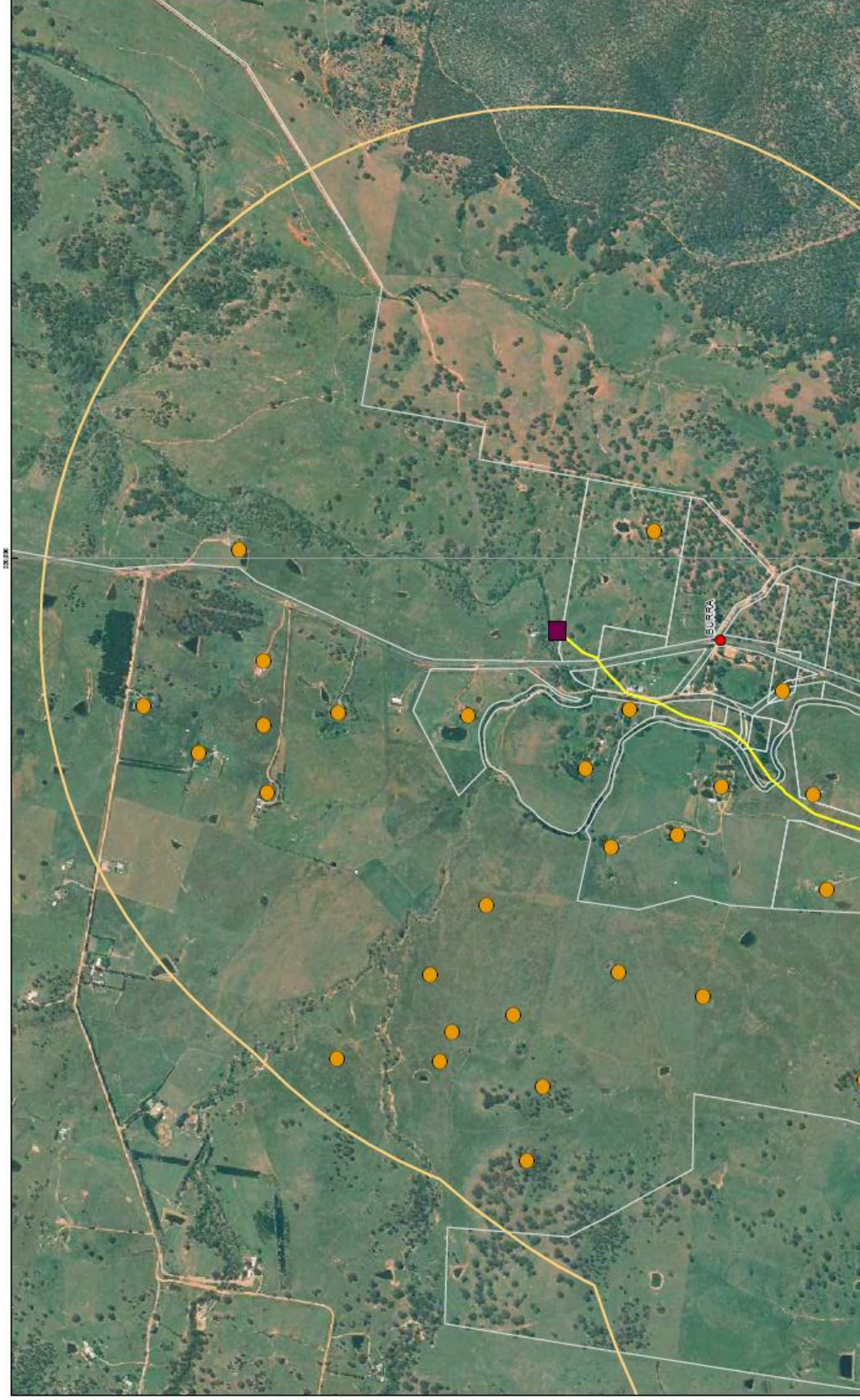
Figure 2-2
 Sensitive receptors near pipeline route

Legend:

- Locality: Red dot
- Sensitive receptor: Orange circle
- Proposed pipeline alignment: Blue line
- Buffer (1000m): Yellow line
- High lift pump station: Green rectangle
- Low lift pump station: Blue rectangle
- Discharge point: Purple rectangle
- ACT & NSW border: White line
- ACT & NSW cadastre (2008): White outline

Scale: 0 300 600 900 Meters (M AS)
 Map Projection: Transverse Mercator
 Horizontal Datum: Australian Geodetic Datum 1984
 GDA: Australian Capital Territory GDA

Figure 2.2 Residential receivers near the pipeline route



DATE: 2009-02-24 10:00:00 AM. PROJECT: Murrumbidgee to Googong Water Transfer Project. DRAWING: Sensitive receptors near the discharge structure. SCALE: 1:10000. AUTHOR: GHD. CHECKED: GHD. APPROVED: GHD. PROJECT NO: GHD-M2G-PIP-GS-MAP-055-A0. REVISION: C. DATE: 24 February 2009.

Murrumbidgee to Googong Water Transfer Project
 Project Reference: GHD-M2G-PIP-GS-MAP-055-A0
 Revision: C
 Date: 24 February 2009



BULK WATER ALLIANCE

Map Projection: Australian Geometric Datum 1986
 GCS: Australian Capital Territory Grid

- Locality
- Sensitive receptor
- Proposed pipeline alignment
- Buffer (1000m)
- Discharge structure
- ACT & NSW border
- ACT & NSW cadastre (2008)

Figure 2.3 Residential receptors near the discharge structure

2.2 Noise Monitoring Methodology

The NSW Industrial Noise Policy and NSW Construction Noise Guidelines recommends that background noise monitoring be undertaken in an area representative of the local noise environment. The ACT Environmental Protection Policy does not require background noise monitoring however it is general practice for background monitoring to be undertaken.

A background noise survey was undertaken from 2 December 2008 to 9 December 2008 in order to quantify the ambient noise environment in the vicinity of the pipeline route and potentially impacted receivers. Noise monitoring was undertaken with consideration to Australian Standard AS1055.1, "Acoustics – Description and measurement of environmental noise – Part 1: General Procedures".

Background noise monitoring was undertaken using four ARL EL-215 Type 2 noise loggers. The noise loggers were programmed to record 15-minute A-weighted 'Fast' sound levels, L_{A90} and L_{Aeq} , which are described as follows:

The L_{A90} values refer to noise levels that are exceeded 90% of the time. This is representative of the lower noise levels in the environment and is commonly referred to as the background noise level; and

The L_{Aeq} is the equivalent continuous noise level which would have the same total acoustic energy over the measurement period as the varying noise actually measured, so it is in effect an energy average.

All equipment used carries current calibration certification. A calibration check was performed before and after the noise logging and was within the acceptable limits of +/-0.5dB(A).

Noise monitoring data was filtered to remove data influenced by adverse weather conditions, which were recorded at the Bureau of Meteorology (BOM) Tuggeranong weather station site. Tuggeranong weather station was the closest BOM weather station, situated approximately 17 km north of the site. This data was considered to be representative of the site because there is no significant intervening terrain.

2.2.1 Noise Monitoring Locations

A site inspection was conducted to determine appropriate noise monitoring locations for the assessment that are representative of the ambient noise environment. The following four locations shown in Figure 2.4 were selected:

Location 1 – Located at 7845 Monaro Highway in the ACT. This location was selected due to its proximity to the LLPS and HLPS. Details of location 1 are shown in Figure 2.5.

Location 2 – Located at 366 Williamsdale Road in NSW. This location was selected as a representative location along the pipeline route. Details of location 2 are shown in Figure 2.6.

Location 3 – Located at 68 Williamsdale Road in NSW. This location was selected as a representative location along the pipeline route. Details of location 3 are shown in Figure 2.7.

Location 4 – Located at 1167 Burra Road in NSW. This location was selected due to its proximity to the discharge. Details of location 4 are shown in Figure 2.8.



Murrumbidgee to Googong Water Transfer Project

Project Reference: SMD-M2G-PIP-GS-MA2-052-A-0
 Project Title: Murrumbidgee to Googong Water Transfer Project
 Date: 24 February 2009

BULK WATER ALLIANCE

ACTEW CORPORATION

Figure 2-4 Background noise monitoring locations

Scale: 0 300 600 900 Meters (at ASL)
 Map Prepared: Transvaco International
 Date: 14 February 2009
 Client: ACTEW CORPORATION

Legend:

- Locality
- Assessment location
- ▭ Proposed pipeline alignment
- ▭ High lift pump station
- ▭ Low lift pump station
- ▭ Discharge structure
- ▭ ACT & NSW cadastral (2002)

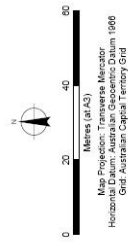
Figure 2.4 Background Noise Monitoring Locations



LOCATION INFORMATION
 ADDRESS: 366 WILLIAMSDALE ROAD
 LAND PARCEL: 56/1754889
 DATE DEPLOYED: 2/12/2008
 LOGGER SERIAL: 194688
 LOGGER TYPE: ARL EL215



Assessment location



BULK WATER ALLIANCE



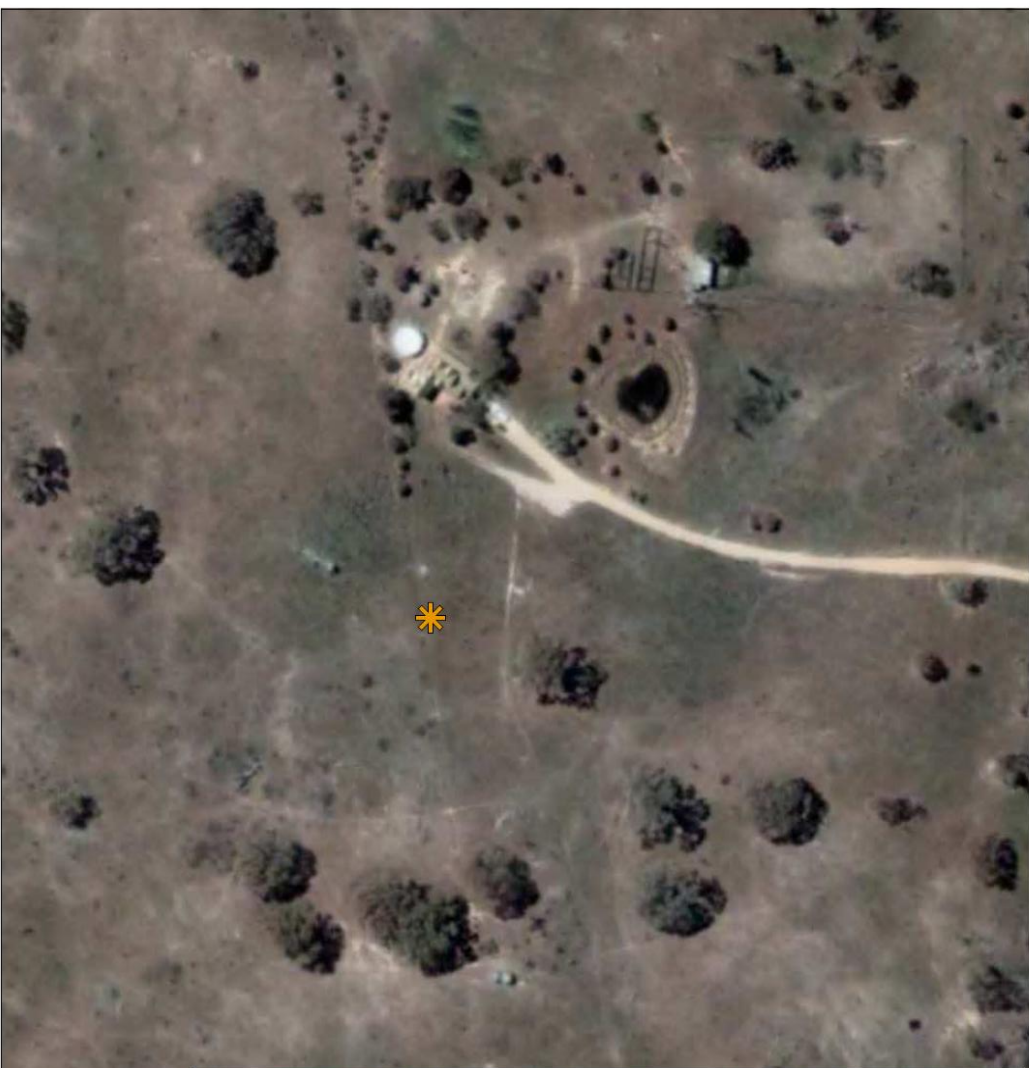
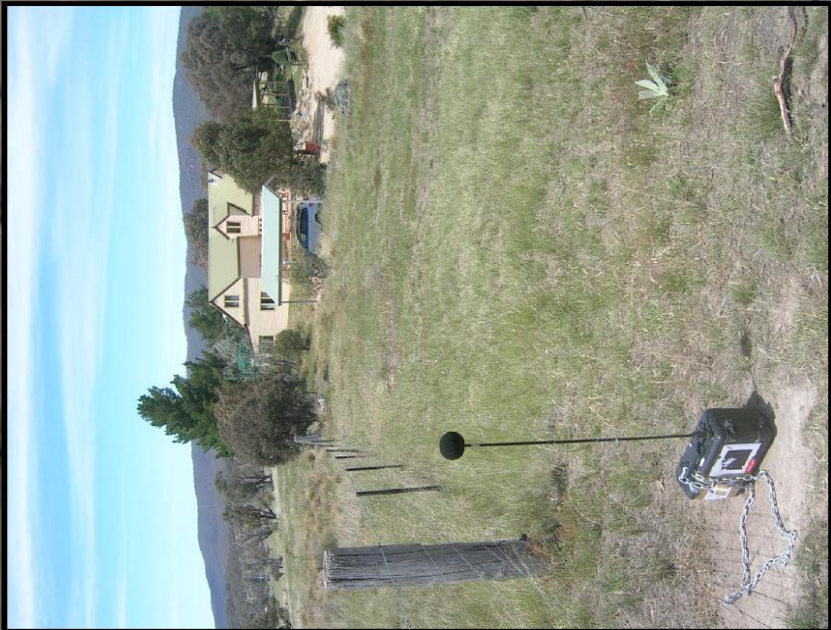
Murrumbidgee to Googong Water Transfer

Figure 2-6
 Location 2 at 366 Williamsdale Road in NSW

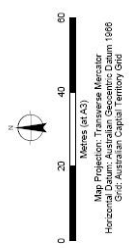
Project Reference: GHD-M23-PIP-GS-MAP-002
 Revision: A
 Date: 15 December 2008

Figure 2.6 Location 2 at 366 Williamsdale Road in NSW

LOCATION INFORMATION
ADDRESS: 68 WILLIAMSDALE ROAD
LAND PARCEL: 3/246930
DATE DEPLOYED: 2/12/2008
LOGGER SERIAL: 194801
LOGGER TYPE: ARLEL215



 Assessment location



BULK WATER ALLIANCE



Murumbidgee to Goongong Water Transfer

Project Reference: GHD-M2G-PIP-GS-MAP-092
 Revision: A
 Date: 15 December 2008

Figure 2-7
 Location 3 at 68 Williamsdale Road in NSW.

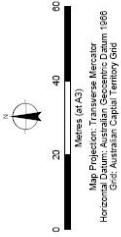
Figure 2.7 Location 3 at 68 Williamsdale Road in NSW



LOCATION INFORMATION	
ADDRESS:	1167 BURRA ROAD
LAND PARCEL:	28/754913
DATE DEPLOYED:	2/12/2008
LOGGER SERIAL:	194603
LOGGER TYPE:	ARLEL215



Assessment location



BULK WATER ALLIANCE



Murumbidgee to Googong Water Transfer

Project Reference: GHD-MZG-PIP-GS-MAP-092
 Revision: 1
 Date: 15 December 2008

Figure 2-8
 Location 4 at 1167 Burra Road in NSW

Figure 2.8 Location 4 at 1167 Burra Road in NSW

2.2.2 Noise monitoring results and discussion

Table 2.1 and Table 2.2 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. An explanation of the acoustic terms can be found in the glossary.

Table 2.1 Summary of the RBL LA90(Period) Noise Monitoring Results, dB(A)

Monitoring Location	L _{A90} (Day) 7 am to 6 pm	L _{A90} (Evening) 6 pm to 10 pm	L _{A90} (Night) 10 pm to 7 am
Location 1 7845 Monaro Highway	33.5	28.0	24.0
Location 2 366 Williamsdale Rd	28.8	26.5	24.5
Location 3 68 Williamsdale Rd	28.3	28.0	28.0
Location 4 1167 Burra Road	31.0	27.5	25.5

Table 2.2 Summary of the LAeq(Period) Noise Monitoring Results, dB(A)

Monitoring Location	L _{Aeq} (Day) 7 am to 6 pm	L _{Aeq} (Evening) 6 pm to 10 pm	L _{Aeq} (Night) 10 pm to 7 am
Location 1 7845 Monaro Highway	45.3	42.9	40.5
Location 2 366 Williamsdale Rd	42.3	43.0	37.0
Location 3 68 Williamsdale Rd	43.6	43.3	41.2
Location 4 1167 Burra Road	45.6	43.7	38.5

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.

Attended observations noted that existing levels of industrial noise in the area is not a significant contributor to the existing ambient noise level in the vicinity of the development.

Appendix A shows a graphical summary of the background noise monitoring.

2.2.3 Attended measurements at Angle Crossing

Attended measurements were undertaken at the northern end of Angle Crossing Beach using a Bruel and Kjaer 2250 Type 1 sound level meter. Long term unattended monitoring was not undertaken as there was no secure location for the equipment. The measurements were undertaken on the 2 December 2008 at 12:30 pm, which is considered a representative time in which the beach would be in use.

Attended observations noted that the ambient noise environment was typically described by river noise from water flowing over the crossing and bird noise. A background L_{A90} noise level of 40 dB(A) was measured, which is typical of a rural area.

3 Noise and Vibration Criteria

3.1 NSW noise and vibration criteria

3.1.1 NSW operational noise criteria

The NSW Environment Protection Authority's (EPA) Industrial Noise Policy (INP) provides guidance on the assessment of operational noise impacts. The guidelines include both Intrusive and Amenity criteria that are designed to protect receivers from noise significantly louder than the background level and to limit the total noise level from all sources near a receiver.

Intrusive noise limits set by the INP control the relative audibility of operational noise compared to the background level. The amenity criteria limit the total level of extraneous noise. Both sets of criteria are calculated and, in the case of steady noise sources, the lower of the two in each time period normally apply. For noise sources with intermittent characteristics both noise criteria should be assessed independently. Table 2.2 in the INP provides modifications to the amenity criteria for existing levels of industrial noise, however the existing level of industrial noise in the area are not a significant contributor to the existing ambient noise level in the vicinity of the proposal. Therefore no Table 2.2 adjustments are necessary for the amenity noise criteria.

Amenity criteria are determined based on the overall acoustic characteristics of the receiver area and the existing level of noise excluding other noises that are uncharacteristic of the usual noise environment. Residential receiver areas are characterised into 'urban', 'suburban', 'rural' or other categories based on land uses, the existing level of noise from industry, commerce, and road traffic. The INP classifies the residential receivers as follows:

- Rural – An area with an acoustical environment that is dominated by natural sounds, having little or no road traffic;
- Suburban – An area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry;
- Urban – An area dominated by urban hum' ' or industrial source noise or has through traffic with continuous traffic flows during peak periods or is near a commercial district.

For the purpose of the assessment all the surrounding residential receivers have been classified as 'rural'.

The Intrusive criteria are determined by a 5 decibels addition to the adopted background level with a minimum of 35 dB(A). The INP recommends that for the intrusive noise goals the evening period should not exceed the daytime period and the night-time period should not exceed the evening period.

The residential receivers in NSW are going to be exposed to operational noise from the pipeline air release valves and discharge structure. The operational noise goals are provided in Table 3.1 for the residential receivers in NSW.

Table 3.1 Operational noise criteria

Criteria	Day: 7 am to 6 pm	Evening: 6 pm to 10 pm	Night: 10 pm to 7 am
Rating Background Level, $L_{A90(Period)}$	28 to 34	27 to 28	24 to 28
Intrusiveness Criteria, $L_{Aeq(15min)}$	35	35	35
Amenity Criteria, $L_{Aeq(Period)}$	50	45	40

The minimum INP noise goal of 35 dB(A) is recommended for all time periods due to the low background noise levels in the area.

3.1.2 NSW construction noise criteria

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

The CNG guidelines recommend standard hours for construction activity as follows:

- Monday to Friday: 7 am to 6 pm;
- Saturday: 8 am to 1 pm; and
- No work on Sundays or Public Holidays.

GHD understand that the proposed activities generally occur during the standard construction hours, however there is the potential for activities to occur outside of these hours. The CNG acknowledges that the following activities have justification to be undertaken outside the recommended construction hours:

- The delivery of oversized plant or structure;
- Emergency work; and
- Works for which it can be demonstrated that there is a need to operate outside the recommended standard hours.

The project is considered a major infrastructure project therefore a “quantitative” assessment has been undertaken with consideration to the CNG.

The CNG provides noise management levels for construction noise at potentially impacted receivers. These management levels are to be calculated based on the adopted rating background level (RBL) at nearby residential locations. Based on the noise monitoring an adopted day-time background noise level (during all periods) of 30 dB(A) has been recommended. Monitoring results suggest that background noise levels may be less than 30 dB(A), however 30 dB(A) is generally accepted by the NSW DECC as the minimum noise level that is used for establishing criteria.

Table 3.2 details the CNG construction noise goals at the potentially impacted residential receivers for the proposed construction works in NSW. Table 3.3 details the CNG construction noise goals for other types of potentially impacted receivers.

The *noise affected level* represents the point above which there may be some community reaction to noise. Where the *noise affected level* is exceeded all feasible and reasonable work practices to minimise noise should be applied 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. The *noise affected level* is the background noise level plus 10 dB(A) during recommended standard hours and the background noise level plus 5 dB(A) outside of recommended standard hours.

The *highly noise affected level* represents the point above which there may be strong community reaction to noise. Where noise is above this level any feasible and reasonable ways to reduce noise below this level should be carefully considered. If no quieter work method is feasible and reasonable the impacted residence should be clearly explained the duration and noise levels of the works and any respite periods that will be provided. The *highly noise affected level* is set at 75 dB(A).

The assessment point is 30 m from the residence, or the resident boundary, whichever is the closer.

Table 3.2 NSW construction noise criteria at residential receivers, dB(A)

Time period	RBL $L_{A90(\text{period})}$	CNG Management Level $L_{Aeq(15 \text{ min})}$
Recommended standard hours	30	Noise affected level – 40 dB(A) Highly noise affected level - 75 dB(A)
Outside recommended standard hours	30	Noise affected level – 35 dB(A)

Table 3.3 NSW CNG construction noise criteria at other potentially impacted receivers, dB(A)

Time period	Management Level ² $L_{Aeq(15 \text{ min})}$
Classrooms at schools and other educational facilities	Internal Noise Level 50 dB(A)
Hospital wards and operating theatres	Internal Noise Level 40 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreational areas (such as sports grounds or playgrounds)	External noise level 65 dB(A)
Passive recreational areas	External noise level 60 dB(A)

3.1.3 NSW road traffic noise criteria

For NSW roads the road traffic noise associated with the construction works and operation is sourced from the DECC's Environmental Criteria for Road Traffic Noise (ECRTN). Recommended noise levels associated with land use developments are shown in Table 3.4. Where noise criteria levels are already exceeded, construction and operational traffic arising from the proposal should not lead to an increase in existing noise levels of more than 2 dB(A).

² Applies when land use is being utilised

Table 3.4 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)

The classifications of roads on the existing road network can be used as an indication of the functional role each road plays with respect to the volume of traffic they should appropriately carry. The Roads and Traffic Authority (RTA) have developed a set of road hierarchy classifications detailed in Table 3.5 indicating typical nominal volumes expressed in terms of average annual daily traffic (AADT) serviced by various classes of roads.

Table 3.5 Functional Classifications of Road

Type of Road	Traffic Volume (vpd)	Peak Hour Volume (vph)
Arterial Road	>20,000	>2,000
Sub –Arterial Road	10,000 – 20,000	1,000 – 2,000
Collector Road	2,000 – 10,000	200 – 1,000
Local Road	<2,000	0 - 200

3.1.4 NSW Sleep Disturbance Criteria

The NSW DECC publication ENCM, Chapter 19 provides consideration for sleep disturbance levels.

The purpose of a sleep criteria is to address short high-level noise likely to cause awakening during the night-time period 10:00 pm to 7:00 am (8:00 am on Sundays and Public Holidays). To achieve this, the $L_{A1(1minute)}$ noise level of any specific noise source should not exceed the background noise level $L_{90(15minute)}$ by more than 15 dB(A) when measured externally 1m outside a bedroom window. Assuming a background noise level of 30 dB(A) the sleep disturbance noise goal for the night-time period is $L_{A1(1minute)}$ 45 dB(A) for all the surrounding residential receivers.

3.1.5 NSW vibration criteria

Vibration criteria have been set with consideration to the DECC “Assessing Vibration: A technical Guideline, 2006”. BS 6472 – 1992, “Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)” is recognised by the DECC as the preferred standard for assessing the “human comfort criteria” for residential building types. The standard defines vibration limits in terms of Peak Particle Velocity (PPV) (mm/s). The BS 6472 human comfort peak vibration limits are shown in Table 3.6 for the frequency range of 8 Hz to 80 Hz which is applicable to construction works. These values are limits that may cause loss of amenity to the occupant. BS 6472 also recognises that higher vibration levels are tolerable for short term construction projects as undue restriction on vibration levels can significantly prolong construction works and result in greater annoyance.

Table 3.6 BS 6772 human comfort vibration limits from 8 Hz to 80 Hz (mm/s PPV³)

Receiver Type	Period ⁴	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

3.2 ACT noise regulations

3.2.1 ACT operational noise criteria

The ACT noise regulations are specified in the *ACT Environment Protection Regulations 2005; Part 3 – Noise*.

The ACT is divided into various zones based on the land use policies outlined in the Territory Plan. Schedule 2, Part 2.1, Table 2.1 of the *ACT Environment Protection Regulations 2005*, designates the noise zones for ACT land and is shown below in Table 3.7.

Schedule 2, Part 2.2, Table 2.2 of the *ACT Environment Protection Regulation 2005* details the noise level for each noise zone and is shown below in Table 3.8. The noise levels are assessed at the compliance point as an $L_{A10(\text{Period})}$ noise level. Noise is taken to cause environmental harm if the noise level at the compliance point for the place from which the noise is emitted is louder than the noise standard for the place. Section 28 of the Regulations provides for an opportunity to consider that noise does not cause environmental harm at an affected place harm where an approval to do so are in force.

The compliance point for a parcel of land held under territory lease is any point as near as practicable to the boundary of the parcel of land and for unleased land is any point as near as practicable to 5m from the source of noise. Section 34 to 36 of the Regulations allows for the unleased territory land compliance point to be exempted where an environmental protection agreement, environmental authorisation or approval for emitting noise from public land are in place and state a different compliance point.

The potentially impacted receivers in the ACT is likely to be exposed to operational noise from the LLPS, HLPS and pipeline air release valves. The proposed site and surrounding receivers (including receivers in NSW) are zoned by the territory plan as ZU2 – Rural and ZU4 – River corridor as shown in Figure 3.1, which is subject to the Zone G noise standard. For these zonings the allowable operational noise level, not to cause environmental harm, is 45 dB(A) during the day-time period and 35 dB(A) during the night-time period assessed at the compliance point.

The LLPS will be located on unleased Territory Land and is subject to a compliance point located as near as practicable to a point 5m from the LLPS. Given the remote location of the proposed structure, in the context of the fixed sensitive receivers (residences) in this vicinity it is proposed to adopt a compliance point the northern end of Angle Crossing Beach. The Beach is considered to be the closest sensitive location to the LLPS and compliance at this point is critical. The proponent intends to request that this compliance point be adopted as part of the consideration of the operational licence for the proposed infrastructure.

³ Based on sinusoidal vibration sources

⁴ Day is between 7 am and 10 pm and night is between 10 pm and 7 am.

Table 3.7 Noise Zone: Table 2.1 of the ACT Environment Protection Regulations 2005

Column 1 Item	Column 2 Noise zone	Column 3 ACT land	Column 4 NSW land
1	Zone A	Land in an industrial zone	Land in the Queanbeyan city industrial zone
2	Zone B	Land in the city centre and town centre Land in the central national area (City)	Land in the Queanbeyan city business zone
3	Zone C	Land in group centres and office sites Land in the National area (The Parliamentary Zone; Barton; section 39, 40 and 41 of Yarralumla; Acton; Anzac Parade and Constitution Avenue; Russell; Duntroon; ADFA and Campbell Park; Development Nodes and Clubs of Lake Burley Griffin and Foreshores)	
4	Zone D	Land in commercial CZ4 zone	
5	Zone E	Land in: A restricted access recreation zone A broadacre zone	
6	Zone F	Land in: A commercial CZ5 zone A TSZ2 service zone A community facility zone A leisure and accommodation zone	Land in the Queanbeyan city special use zone
7	Zone G	All areas other than Central National Area (Fairbairn)	Other NSW land

Table 3.8 Noise Standard: Table 2.2 of the ACT Environment Protection Regulations 2005

Column 1	Column 2	Column 3	Column 4
		Monday – Saturday 7 am – 10 pm Sunday and Public holiday 8 am – 10 pm	Monday – Saturday 10 pm – 7 am Sunday and Public holiday 10 pm – 8 am
1	Zone A	65	55
2	Zone B	60	50
3	Zone C	55	45
4	Zone D	50	35
5	Zone E	50	40

Column 1	Column 2	Column 3	Column 4
6	Zone F	Same as the noise standard for the adjoining noise zone with the loudest noise standard for the time period	
7	Zone G	45	35

3.2.2 ACT construction noise criteria

Section 29 of the *ACT Environment Protection Regulation 2005* states noise is not taken to cause environmental harm in an affected place if it is noise mentioned in Schedule 2, Part 2.3, Table 2.3 column 2 and the conditions mentioned in column 3 for the noise are met.

Relevant sections of Schedule 2, Part 2.3, Table 2.3 are shown in Table 3.9 which relate to construction noise.

Table 3.9 Noise Conditions: Table 2.3 of the ACT Environment Protection Regulations 2005

Column 1 Item	Column 2 Noise	Column 3 Conditions
6	Noise emitted in the course of building works for which a building approval under the Building Act 2004, division 3.3 is required.	(c) All of the following: <ul style="list-style-type: none"> • The noise is emitted from a place other than a place in noise zone A or B; and • The building works will not be finished in 2 weeks after the day it started; and • All relevant noise reduction measures mentioned in Australian Standard 2436; as in force from time to time, are implemented; and • The noise is emitted between 7 am and 6 pm on Monday to Saturday, excluding public holidays.
17	Noise emitted in the course of constructing or maintaining a road, other than a major road	The noise is emitted: <ul style="list-style-type: none"> • Between 7 am and 8 pm on Monday to Saturday • Between 8 am and 8 pm on Sunday or a Public Holiday

Therefore for the proposal construction works should take place between 7 am and 6 pm on Monday to Saturday and all mitigation measures mentioned in Australian Standard 2436 should be implemented. A list of mitigation measures recommended by Australian Standard 2436 are detailed in Section 6.2.1 of this report.

If construction work is to be undertaken outside of these hours the standard noise levels for Zone G of 45 dB(A) during the day-time period and 35 dB(A) during the night-time period need to be met at the lease boundary.

Constructing, maintaining or upgrading of roads can also be undertaken between 8 am and 8 pm on Sunday or a Public Holiday.

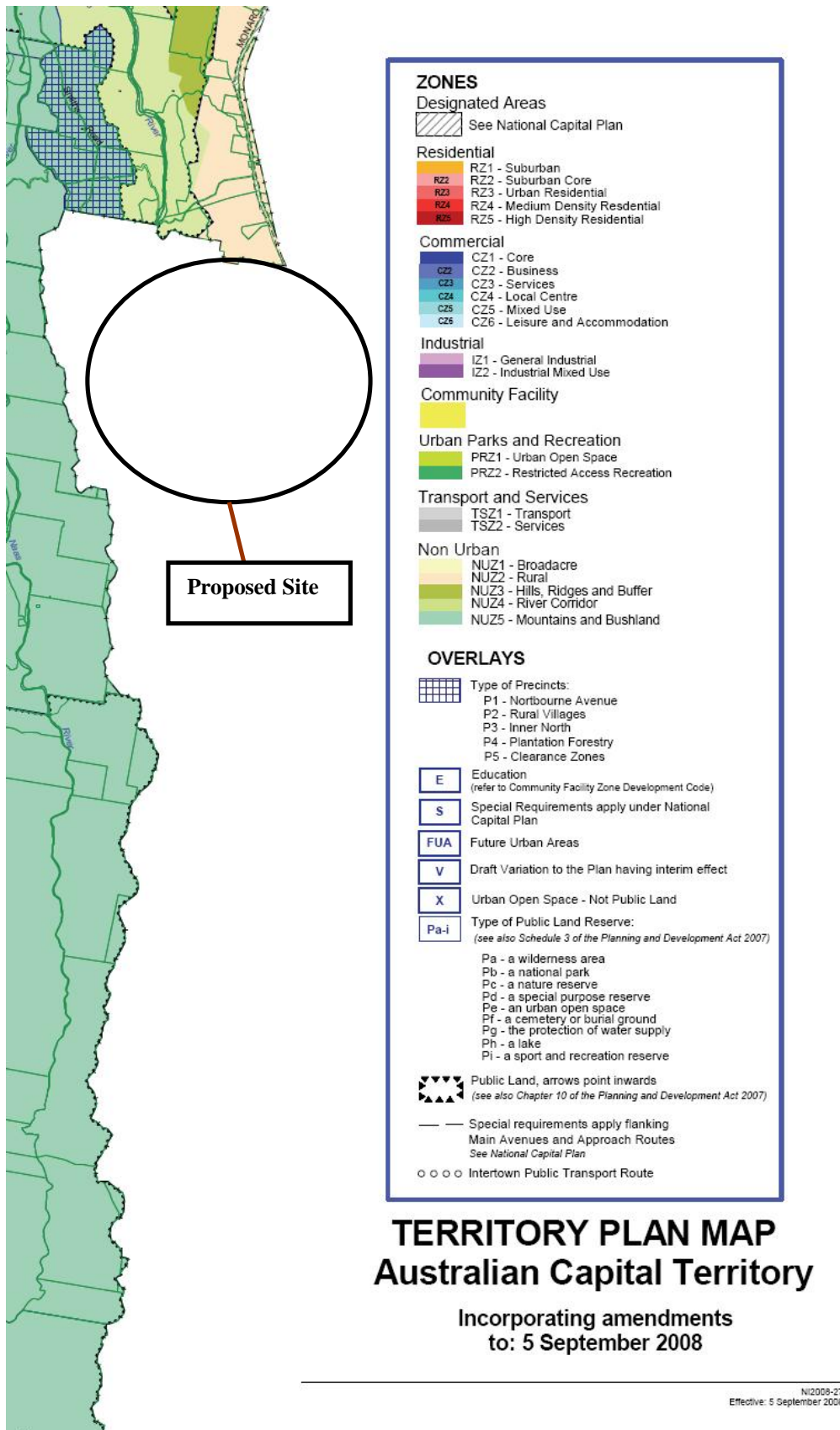


Figure 3.1 Territory plan and proposed site. The territory plan is available at www.actpla.act.gov.au.

3.2.3 ACT road traffic noise criteria

The *ACT Draft Noise Management Guidelines (1996)* sets road traffic noise criteria in the ACT. For no noise mitigating treatment to be required, the maximum $L_{A10(18\text{hour})}$ traffic noise level should be 63 dB(A) at 1 metre from the façade of residential buildings and that, irrespective of any mitigating acoustic treatment, the maximum $L_{A10(18\text{hour})}$ traffic noise level in a recreational courtyard or private open space, should not exceed 58 dB(A).

3.2.4 ACT vibration guidelines

No specific vibration guidelines are available in the ACT. It is proposed that vibration be assessed with consideration to the NSW DECC Assessing Vibration a Technical Guideline (February 2006).

3.3 Blasting Criteria

The impact from blasting should be assessed with consideration to the following:

- Australian and New Zealand Environment Conservation Council (ANZECC), “Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration” (1990);
- Australian Standard AS 2187.2 – 2006, “Explosives – Storage, transport and use. Part 2: Use of explosives”; and
- British Standard BS 7385.2 – 1993, “Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration”.

Blasting should only occur from 9:00 am to 5:00 pm (Monday to Friday) and 9:00 am to 1:00 pm (Saturday). Blasting should generally take place no more than once per day. The magnitude of ground vibration and airblast overpressure should be assessed against the relevant criteria at a location within 30 m of the building footprint.

3.3.1 Airblast overpressure

ANZECC recommends a human comfort level for airblast overpressure of 115 dB(L). This level may be exceeded on up to 5% of the total number of blasts over a period of 12 months though should not exceed 120 dB(L).

AS 2187.2 recommends that for operations lasting less than 12 months a human comfort level for airblast overpressure of 120 dB(L) is acceptable. If an agreement with the occupier is reached a higher limit can apply. Since construction blasting is likely to be of a short duration it is proposed that a 120 dB(L) limit be used for this assessment.

AS 2187.2 recommends a maximum airblast overpressure level of 133 dB(L) to prevent structural damage. Blasts will not cause damage at levels below 133 dB(L) but the probability of damage increases as airblast overpressure increases from 133 dB(L).

3.3.2 Ground vibration

ANZECC recommends a human comfort level for ground vibration of 5 mm/s PPV. This level may be exceeded on up to 5% of the total number of blasts over a period of 12 months though should not exceed 10 mm/s PPV.

AS 2187.2 recommends that for operations lasting less than 12 months a human comfort level for ground vibration of 10 mm/s PPV is acceptable. If an agreement with the occupier is reached a higher limit can apply. Since construction blasting is likely to be of a short duration it is proposed that a 10 mm/s PPV limit be used for this assessment.

The BS7385.2 guidelines can be used to assess the impact from blasting with consideration to structural damage. The BS7385-2 vibration limit for the prevention of minor or cosmetic damage is 15 mm/s ppv at 4 Hz increasing to 20 mm/s ppv at 15 Hz for un-reinforced light frame structures.

4 Operational Noise and Vibration Assessment

4.1 Operational Noise

Acoustic modelling was undertaken using CadnaA to predict the effects of operational noise generated by the LLPS, HLPS and pipeline air release valves.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to ISO 9613-2, "Acoustics – Attenuation of sound during propagation outdoors". Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations.

Modelling has been based on available data. Layout, building structures and noise generating equipment were based on information provided at the time of the assessment.

4.1.1 LLPS Assessment of Potential Impacts

The LLPS shown in Figure 4.2 and Figure 4.3 consists of three pump wells, one of them being for a potential future expansion. Each pump well contains 2 submersible 300 kW pumps.

KSB, "Questions on acoustics when using centrifugal pumps, 1.4.86 issue" provides noise source sound power level estimates for submersible pumps based on the operating power. The submersible 250 kW pump sound power level spectrum is shown in Table 4.1. The sound power level represents the noise level corresponding to the design based operating point in-situ.

Each pump well is separated by 750 mm concrete with penetrations below water level. Therefore it is assumed that noise is primarily contained within the pump well module.

Each pump well has two removable steel pump covers and two removable steel spindle covers. The covers will be fabricated from approximately 10 mm steel chequer plate. The pump well covers are assumed to be the primary noise transmission path from the pump well to the external noise environment. The pump well covers are designed to provide an air-tight seal, however over time the seal can be degraded due to dirt and corrosion. The estimated transmission loss of the pump and spindle covers for an air-tight seal and degraded seal are shown in Table 4.2. The transmission loss predictions were made using INSUL v6.2 Sound Insulation Prediction Software. The degraded seal predictions assumed a 0.5 mm gap in the seal.

Table 4.1 LLPS submersible pump sound power level, L_w dB(A)

	Octave Band Centre Frequency (Hz)									L_w
	31.5	63	125	250	500	1k	2k	4k	8k	
300 kW Submersible Pump	50	64	75	84	90	90	87	83	77	94

Table 4.2 LLPS Transmission Loss (TL) of pump well covers, R_w dB

Cover	Octave Band Centre Frequency (Hz) Sound transmission loss									
	31.5	63	125	250	500	1k	2k	4k	8k	R_w
Cover – Airtight Seal	30	30	34	38	42	39	42	51	51	42
Cover – Degraded Seal	22	22	22	25	28	31	34	36	36	32

The north end of Angle Crossing Beach is located 30 m from the LLPS and is in the ACT. Where there is no site boundary the *ACT Environment Protection Regulation 2005* requires that the compliance point for unleased land is any point as near as practicable to 5m from the source of noise. As described in Section 3.2.1 it is considered that the Angle Crossing Beach is the closest noise sensitive location and the proponent proposes to adopt the northern end of Angle Crossing Beach as the ACT compliance point. This is subject to the approval of this location as the compliance point for this operation in an instrument such as the operational license.

Considering topography the most affected ACT residential receiver to the LLPS is located 2200 m to the north-east. However the *ACT Environment Protection Regulation 2005* requires the noise levels to be assessed at the compliance point which is on the property boundary. The nearest ACT residential property boundary to the LLPS is located 500 m to the north-east. Considering topography the most affected NSW residential receiver to the LLPS is located 2300 m to the east. The ACT and NSW residences to the west of the LLPS are shielded by steep terrain and are not as exposed to noise.

The LLPS location is shown in Figure 4.1.

The design scenario where 4 submersible pumps are operating has been modelled. The pump well covers have been modelled with air-tight seals and degraded seals. The LLPS noise predictions at the residential and recreational receivers detailed in Table 4.3 have been made for the following scenarios:

- LLPS Scenario 1 – Neutral meteorological conditions and air-tight pump well cover seals;
- LLPS Scenario 2 – Neutral meteorological conditions and degraded pump well cover seals;
- LLPS Scenario 3 – Noise enhancing F-Class temperature inversion coupled with a light breeze and air-tight pump well cover seals; and
- LLPS Scenario 4 – Noise enhancing F-Class temperature inversion coupled with a light breeze and degraded pump well cover seals.



Figure 4.1 LLPS and HLPS location

Table 4.3 Predicted operation noise from the LLPS at the ACT and NSW receivers, dB(A)

Receiver	LLPS Scenario 1	LLPS Scenario 2	LLPS Scenario 3	LLPS Scenario 4
5 m from LLPS	35	35	47	47
Angle Crossing Beach, North End	19	19	31	31
Angle Crossing Beach, South End	8	10	20	21
Nearest ACT Residential property boundary	0	0	4	8
Most affected NSW residential receiver	0	0	0	0

Operational noise levels of the LLPS are expected to comply with noise criteria at the surrounding residence as the predicted noise levels for the worst-case scenario are below the ACT and NSW noise goal of 35 dB(A).

At a distance of 5 m from the LLPS, when considering degraded pump well cover seals, the night-time and day-time ACT noise standard of 35 dB(A) and 45 dB(A) may be exceeded. However, day-time and night-time noise standards at the north end of Angle Crossing Beach will be met. It is not expected that any recreational receivers are located 5 m from the LLPS but rather at Angle Crossing Beach therefore no adverse impacts of the LLPS are expected.

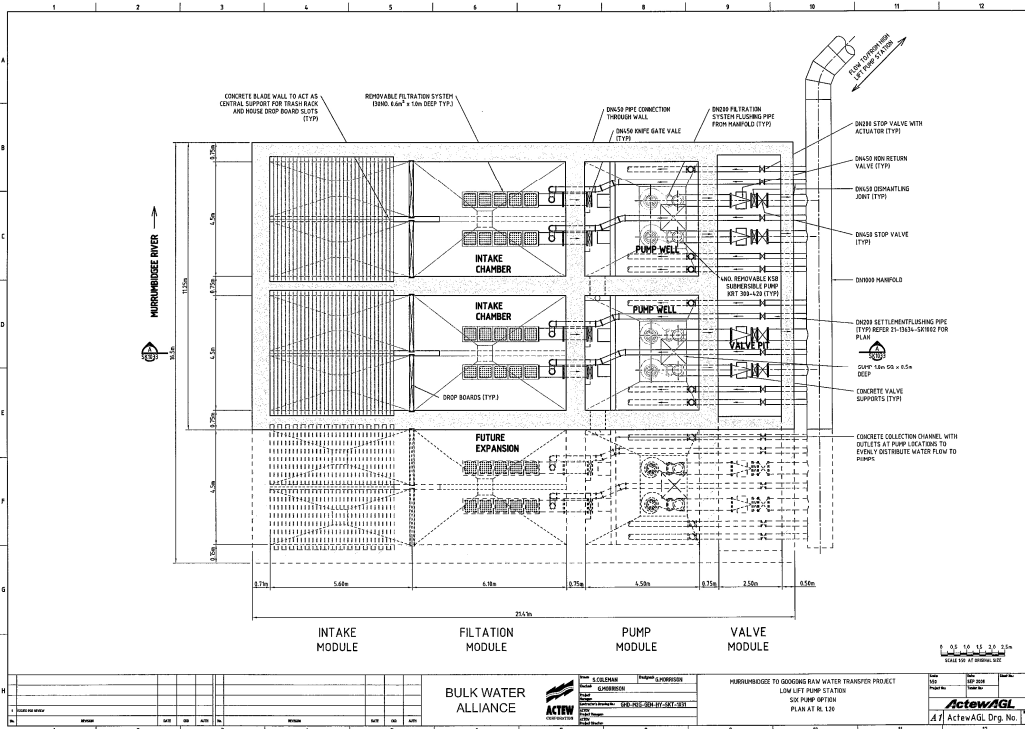


Figure 4.2 LLPS plan drawing

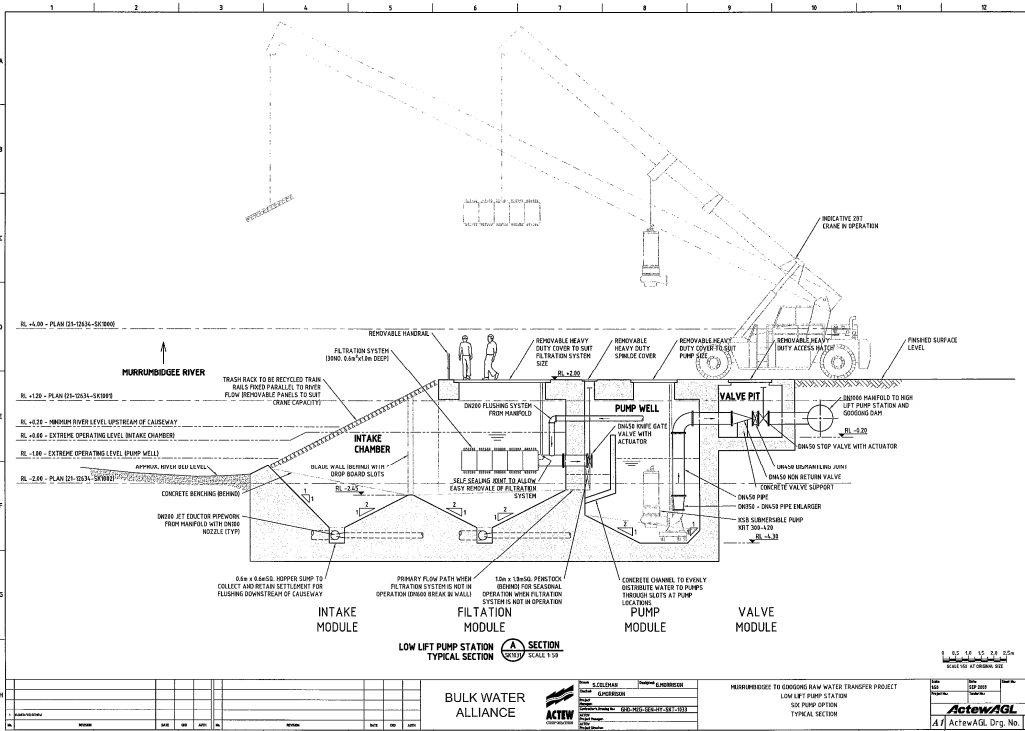


Figure 4.3 LLPS section drawing

4.1.2 HLPS Assessment of Potential Impacts

The HLPS shown in Figure 4.4 consists of the following noise generating equipment:

- Three centrifugal pumps located in the pump room;
- Two transformers located outside in the transformer yard;
- 1 externally located air conditioner (AC) unit; and
- Forced ventilation system.

Of the three centrifugal pumps, two pumps are rated at 1600 kW and one pump is rated at 750 kW. A worst-case scenario with all 3 pumps operating has been modelled. Heckl and Müller, "Pocket book of technical acoustics", 1995 and Schmidt, "Technical sound pocket book", VDI publications Düsseldorf 1996 provides noise source sound power level estimates for centrifugal pumps (including associated motor, casing and piping) based on the operating power. The estimated centrifugal pump sound power level spectrums are shown in Table 4.4.

The two transformers (11kV/3.3kV-10MVA and 11kV/415V-125KVA⁵) are located in the transformer yard. VDI 3739, "Emission benchmarks for acoustic sources, transformers" provides noise source sound power level estimates for standard transformers based on the power capacity, VA. The estimated transformer sound power level spectrums are shown in Table 4.4.

The air conditioning and forced ventilation system will comprise of the following:

- Ground Floor:
 - 3 supply air fans located in the pump area and 1 supply air fan located in the HL Pump Starter Room; and
 - 1 Exhaust fan and 1 Air Conditioning Condenser located in the Hydraulic Power Rack Room.
- First Floor:
 - 2 Return Air Grilles located in the Pump Hall and 1 Supply Air Fan located in the HV Switchboard Room.

Table 4.4 HLPS noise source sound power levels, L_w dB(A)

	Octave Band Centre Frequency (Hz)									L _w
	31.5	63	125	250	500	1k	2k	4k	8k	
1600 kW Centrifugal pump	68	82	92	101	109	110	108	105	100	114
750 kW Centrifugal pump	64	78	88	97	105	106	104	101	96	110
11kV/3.3kV-10MVA Transformer	31	41	73	79	76	73	75	74	70	84
11kV/415V-125KVA Transformer	11	21	53	59	55	40	36	36	36	61
SAFF 1 – supply air fans (Fantech CPD0353FHP)	-	68	72	72	65	68	67	60	47	73

⁵ Assumes a supplied power of 100kW and power factor of 0.8

	Octave Band Centre Frequency (Hz)									L _w
	31.5	63	125	250	500	1k	2k	4k	8k	
SAFF 3 – supply air fans (Fantech CPD0354F)	-	71	70	65	67	66	59	55	54	69
Hydraulic Power Pack Room Exhaust Fan (CPD0314F)	-	69	67	63	63	60	57	53	49	65
Hydraulic Room Air Conditioning Condenser (Mitsubishi PUHZ-RP140VHA)	-	-	-	-	-	-	-	-	-	71

(-) Denotes data not available

The transformers and AC units have been modelled as external noise sources.

The main pump station building was modelled as area sources (eg. radiating walls, doors, fans, louvres and a radiating roof). The sound power of an area source is dependent on the indoor noise levels within the building, the transmission loss and area of the radiating surface. The building model was based on interpretations of the drawings shown in Figure 4.4.

Details of the building materials are provided below for each component. The transmission loss for each component is shown in Figure 4.5.

- Walls – 150 mm reinforced concrete tilt up panel walls supported on structural steel portal frames;
- Roof – 0.6mm metal sheet on steel purlins with 50 mm insulation;
- Doors – 44 mm solid core with full perimeter seal;
- Roller Doors - Flat sheet steel 1 mm thickness; and
- Louvres – standard weather louvre.

Other assumptions include the following:

- All pump station doors and roller doors assumed shut; and
- Pipe penetration through wall into pump station appropriately isolated.

The transmission loss of each of the building components is provided in Figure 4.5.

The predicted noise levels assume the following:

- All doors, including roller doors, should be kept closed at all times during operations;
- Internal acoustic absorption panels are used which provide at a minimum an average internal absorption of 0.5
- All doors, including roller doors, should be acoustically sealed; and
- Upon final equipment selection, equipment sound power levels should be checked against those detailed in this report to ensure modelling outcomes are still valid.

GHD have recently been involved with the design of the Goulbourn to Campaspe Link Pump project. During this project issues arose with vibration transfer from the centrifugal pumps to the building structure. It is

important to emphasize the requirement to minimise plant vibration transfer into the building structure to reduce the risk of structure-borne noise emissions. Site equipment with a potential to generate vibration such as pumps and mechanical equipment must be designed to incorporate requirements for vibration isolation. Appropriate vibration isolation details can generally be obtained from the plant manufacturer to ensure minimal vibration is transmitted to the supporting structure. Vibrating plant items should not be directly mechanically affixed to the walls of the surrounding structure. For this assessment predicted impacts at receivers have been based on the assumption that the design incorporates requirements for vibration isolation.

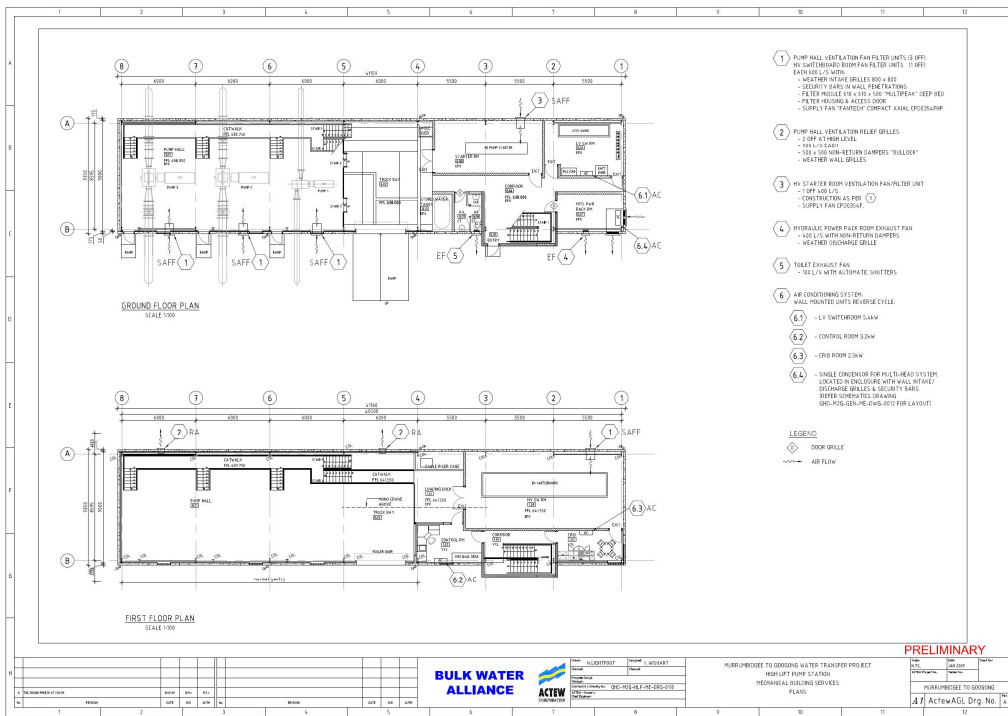


Figure 4.4 HLPS drawings

Table 4.5 Transmission Loss of HLPS Building Construction Materials, dB

Building Component	Octave Band Centre Frequency (Hz) transmission loss									
	31.5	63	125	250	500	1000	2000	4000	8000	Rw
Walls	35	42	41	42	50	58	65	70	70	54
Weather Louvre	5	5	5	5	5	5	5	5	5	5
Roller door	3	10	15	17	22	27	32	38	38	26
Door	13	20	25	28	31	32	35	38	38	33
Roof	8	11	14	16	20	25	29	23	56	25

The north end of Angle Crossing Beach is located 300 m from the HLPS and is in the ACT. Where there is no site boundary the ACT Environment Protection Regulation 2005 requires that the compliance point for unleased land is any point as near as practicable to 5m from the source of noise. Assessing noise 5 m from the HLPS is not at a sensitive location and could potentially lead to non-compliance due to its close

proximity. It is proposed that the northern end of Angle Crossing Beach be considered as the ACT compliance point.

Considering topography the most affected ACT residential receiver to the HLPS is located 1700 m to the west. However the ACT *Environment Protection Regulation 2005* requires the noise levels to be assessed at the compliance point which is on the property boundary. The nearest ACT residential property boundary to the HLPS is located 240 m to the north east. Considering topography, the most affected NSW residential receiver to the HLPS is located 1700 m to the south-west.

The HLPS is shown in Figure 4.1.

A worst-case scenario with all 3 centrifugal pumps operating along with all other noise generating equipment has been modelled. The HLPS noise predictions at the residential and recreational receivers detailed in Figure 4.6 have been made for the following scenarios:

- HLPS Meteorological Scenario 1 – Neutral meteorological conditions;
- HLPS Meteorological Scenario 2 – Noise enhancing F-Class temperature inversion coupled with a light breeze.

Table 4.6 Predicted operation noise from the HLPS at the ACT and NSW receivers, dB(A)

Receiver	HLPS Meteorological Scenario 1	HLPS Meteorological Scenario 2
Angle Crossing Beach, North End	26	29
Angle Crossing Beach, South End	24	27
Nearest ACT Residential property boundary	27	30
Most affected NSW residential receiver	8	14

Operational noise levels of the HLPS are expected to comply with noise criteria at the surrounding residence as the predicted noise levels for the worst-case scenario are below the ACT and NSW noise goal of 35 dB(A).

4.1.3 Pipeline Air Release Valves Assessment of Potential Impacts

Scour valves and air-valves are located along the pipeline. When the pipe is being emptied scour valves release water from low-lying sections of the pipeline. Their operation does not produce significant levels of noise and has therefore not been assessed. Air release valves release high velocity air during filling of the pipeline and entrained air under pressure during operation. During filling, the air release valves operate continuously. During operation the air release valves will only operate for a short duration i.e less than 1 minute at a time on the rising section of the main to Gibraltar Pass, and for longer periods on the falling section of main to Burra Creek.

Determination of the air-valve noise levels was conducted using conservative estimation calculations based on the following assumptions:

- Only sound propagating from the jet orifice were considered in the calculations i.e. noise transmitted through the pipe and upstream from the valve were not considered;
- Jet noise in the form of high pressure ejection of gas (air in this case) was modelled using mathematical equations given in *Engineering Noise Control – Theory and Practice*;
- The received noise level due to the airflow through the valve orifice was calculated for a direct travel path of sound from the orifice to the receiver i.e. no valve cover. This provides a measure of conservatism; and

- Furthermore, the orifice outlet was assumed to be perpendicular to the receiver location, which also provides a measure of conservatism.

The calculation parameters shown in Table 4.7 were utilised in the acoustic algorithms.

Table 4.7 Air valve noise level determination parameters

Parameter	Value
Speed of Sound at STP ¹ (c)	343 m/s ⁶
Exit velocity of jet (U)	20 – 400 ms ⁻¹
Jet temperature (T)	20 °C
Ambient Temperature (T ₀)	20 °C
Density of gas in jet (ρ)	1.2 kg/m ⁷
Density of ambient gas (ρ ₀)	1.2 kg/m ⁶
Diameter of jet exit at orifice (d)	DN100 = 0.1 m DN200 = 0.2 m
Strouhal Number ² (s _r)	0.2
Angle of observer from jet axis (θ)	0 degrees
Distance from orifice jet to receiver (l)	1 m

The calculations are based on the assumptions and approximated data parameters given above, therefore the results should only be used as a guide for comparative purposes. It should be noted that the algorithms utilised in this assessment are only valid for sub-sonic air flows i.e. less than the speed of sound. At flows above Mach 1, the formation of shock waves occurs which can radiate sound more efficiently than the jet.

The algorithms utilised in the calculations are as follows.

The acoustical power generated by the subsonic jet in free space is related to the mechanical stream power by the efficiency factor η as follows:

$$W_a = \eta W_m \quad (\text{W}) \quad \text{Equ.1}$$

The stream mechanical power, W_m is equal to the convected kinetic energy of the stream, which for a jet of circular cross section is:

$$W_m = \rho U^3 \pi d^2 / 8 \quad (\text{W}) \quad \text{Equ.2}$$

The acoustical efficiency of the jet is approximated by:

$$\eta = (T / T_0)^2 (\rho / \rho_0) K_a M^5 \quad \text{Equ.3}$$

Where K_a is the acoustical power coefficient and is approximately 5×10^{-5} , M is the stream Mach number relative to the ambient gas.

⁶ STP – Standard Temperature and Pressure (20 °C and 101.3kPa)

⁷ Usually set to 0.2 in the absence of specific information

The overall sound power level of the jet is given by:

$$L_w = 10 \log_{10} W_a + 120 \quad (\text{dB re } 10^{-12}W) \quad \text{Equ.4}$$

In a free field situation or close to the jet, the overall sound pressure level at the receiver is given by:

$$L_p = L_w + DI - 10 \log_{10}(4\pi r^2) \quad (\text{dB re } 10^{-12}W) \quad \text{Equ.5}$$

Where DI is the directivity index and r is the distance (m) from the jet orifice to the receiver. The DI in this case is given by the angle of the receiver to the jet orifice which is zero degrees.

The following graph provides the approximated sound pressure level at 1 m from the jet orifice versus the exit velocity of the air at the orifice.

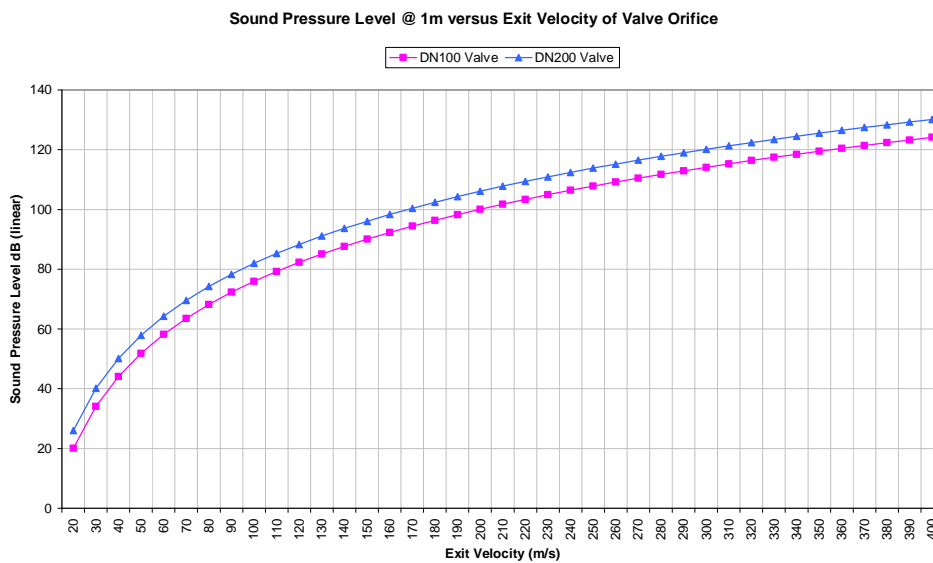


Figure 4.5 Sound Pressure Level at 1 m from orifice versus exit velocity

Based on the graphical results given in Figure 4.5, it is recommended that the exit velocities be reduced to less than 60 m/s.

The location of the air-valves and their proximity to the noise residential receivers are shown in Figure 4.6.

Based on information provided, the air valves between chainage 0 and 7000 are not expected to exceed 60 m/s exit velocity. Air valves between chainage 7000 and 13000 are not expected to exceed 30 m/s. The modeling results have been based on these exit velocities. The noise spectrum at an exit velocity of 30 and 60 m/s and an exit diameter of 150 mm is shown in Table 4.8.

Table 4.8 Air release valve sound power level spectrum dB(L)

	Octave Band Centre Frequency (Hz)									L _w
	31.5	63	125	250	500	1k	2k	4k	8k	
Air release valve at 30 m/s and 150 mm diameter	43	43	40	34	28	21	13	5	0	47
Air release valve at 60 m/s and 150 mm diameter	65	67	67	64	58	52	45	37	29	72

During filling the air-valves operate continuously and have therefore been modelled as a continuous noise source.

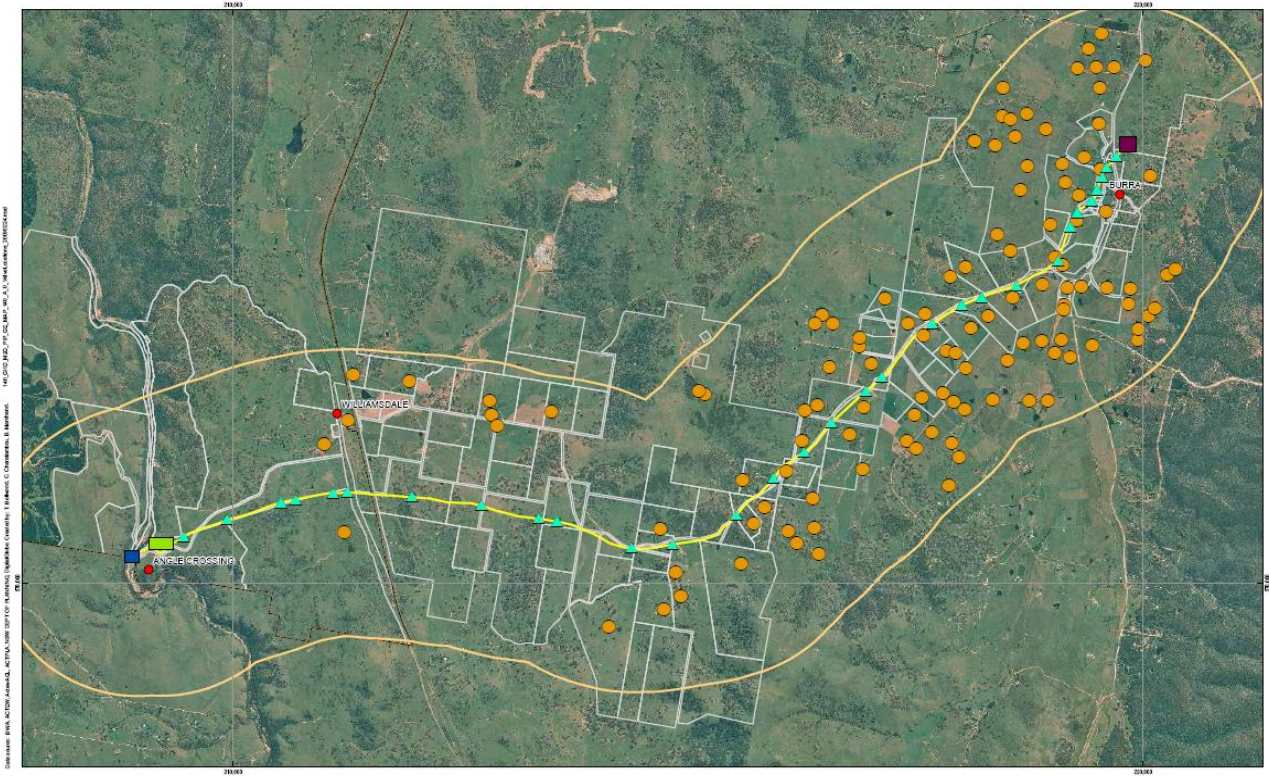
During operation the air release valve will only operate for a short duration of less than 1 minute. Operational capacity changes would not occur more than once in a 24 hour period therefore the Industrial Noise Policy short duration event modifying factor adjustment (INP Table 4.2) of 10 dB(A) has been applied to the noise source during the night time period.

The air valve noise predictions at the nearest residential receivers have been made for the following scenarios:

- Air-Valve Scenario 1 – During Filling Operation;
- Air-Valve Scenario 3 – During Night-Time Operational Capacity Changes with INP short duration event modifying factor adjustment.

Due to the close proximity of air release valves to residence adverse meteorological conditions do not increase noise level considerably and have therefore not been assessed for the air-release valve assessment.

Based on the model results, all residential receivers were predicted to be below the noise goal of 35 dB(A).



<ul style="list-style-type: none"> ● Locality ▲ Valve ● Sensitive receptor Proposed pipeline alignment Buffer (1600m) 	<ul style="list-style-type: none"> High lift pump station Low lift pump station Discharge point ACT & BSW border ACT & NSW cadastre (2008) 	<p>Map Projection: Transverse Mercator Horizontal Datum: Australian Geodetic Datum 1986 Grid: Australian Capital Territory Grid</p>	<p>BULK WATER ALLIANCE</p>	<p>Murrumbidgee to Googong Water Transfer Project</p> <p>Figure 4-6 Valves and sensitive receptors</p>	<p>Project Reference: GHD_M2G_PIP_GE_MAP_140_A_0 Revision: A Date: 24 February 2009</p>
---	---	---	-----------------------------------	---	---

Figure 4.6 Air valve locations and residential receivers

4.1.4 Discharge Structure Assessment of Potential Impacts

A graphical representation of the discharge structure is shown in Figure 4.8. Turbulence of the water exiting the discharge structure would generate noise, however quantifying the level of noise is difficult and no similar structure has been made available for noise measurement. It is estimated that the noise level generated by the discharge structure would be similar (or less than) the noise level generated by water flowing through a sluice gate. A sluice gate noise level measurement was undertaken for the Goulbourn to Campaspe Link Pump project of 67 dB(A) at 3 m, which has been used as a representative level for the discharge structure noise assessment. Upon completion of the project discharge structure noise levels should be checked to validate modelling outcomes.

The nearest NSW residential receivers are approximately 300 m to 400 m from the discharge structure and are shown in Figure 4.7.



Figure 4.7 Discharge structure location and surrounding residence

The discharge structure noise predictions at the residential receivers detailed in Table 4.9 have been made for the following scenarios:

- DS Scenario 1 – Neutral meteorological conditions and air-tight pump well cover seals; and
- DS Scenario 2 – Noise enhancing F-Class temperature inversion coupled with a light breeze

Table 4.9 Predicted operation noise from the discharge structure at the NSW residential receivers, dB(A)

Residential Receiver	DS Scenario 1	DS Scenario 2
400 m south east of discharge	10	12
300 m south west of discharge	14	16
400 m west of discharge	10	13
370 m north west of discharge	11	14

Operational noise levels of the discharge structure are expected to comply at the surrounding residence as the predicted noise levels for the worst-case scenario are below the NSW noise goal of 35 dB(A).



Figure 4.8 Graphical representation of discharge structure

4.2 Operational Traffic Noise

The volume of additional traffic during the operation of the pipeline is expected to be confined to operation and maintenance staff at the pumping stations and is expected to be minor and would have negligible traffic noise impacts.

It is proposed that Williamsdale Road will undergo some minor re-alignment upgrades, which are not expected to cause an increase in traffic noise levels.

Heavy vehicles attending the site should be restricted, where possible, to between 7:00 am and 6:00 pm to minimise the risk of sleep disturbance.

4.3 Operational Vibration

There are no operational sources of vibration identified that would be expected to cause ground vibrations external to the site.

4.4 Operation Mini-Hydro Noise

It is proposed that a 1.2 MW mini-hydro generator be installed at the discharge end of the pipeline. The location and noise emission levels of the generator are not yet known, therefore cannot be accurately assessed. The noise level from the generator should not exceed 35 dB(A) at the surrounding residential receivers, if this level is likely to be exceeded appropriate acoustic treatments should be incorporated into the design.

5 Construction Noise and Vibration Assessment

5.1 Construction Noise

Construction noise has been assessed for the Angle Crossing area and Pipeline route in the following section. Blasting noise is assessed in Section 5.5 however blasting related equipment use is covered in this section.

Acoustic modelling was undertaken using CadnaA to predict the effects of construction noise. Terrain topography, ground absorption, atmospheric absorption and relevant shielding objects are taken into account in the calculations. The noise predictions do not consider adverse meteorological effects as this is not a requirement of the DECC CNG.

5.1.1 Construction hours

Construction works will generally be undertaken during the following construction hours:

- Monday to Friday: 7:00 am to 6:00 pm
- Saturdays: 7:00 am to 1:00 pm

Early morning oversized deliveries may be required on occasion for some of the construction works and would occur outside the recommended construction hours.

No work would be intended on Sundays or Public Holidays.

5.1.2 Summary of Construction Noise Goals

In the ACT no specific construction noise goals are required to be met at the residential and recreational receivers during general construction hours, however it is a requirement when noise levels exceed the noise standard of 45 dB(A) that all relevant mitigation measures mentioned in AS 2436 – 1981 be implemented. Outside of general construction hours construction noise should not exceed the noise standard of 35 dB(A) at the residential and recreational receivers.

In NSW at residential receivers during general construction hours noise levels should not exceed the *noise affected level* of 40 dB(A) which represents a point at which there may be some reaction to noise. Additionally, the *highly noise affected level* of 75 dB(A) represents a point where there may be a strong reaction to noise. Outside of general construction hours construction noise should not exceed the *noise affected level* of 35 dB(A) at the residential receivers.

5.1.3 Construction equipment and noise levels

Noise levels have been obtained from Australian Standard, AS 2436 – 1981 “*Guide to Noise Control on Construction, Maintenance and Demolition Sites*”, GHD’s internal noise database and the UK DEFRA, “*Update of Noise Database for Prediction of Noise on Construction and Open Sites*”.

The magnitude of noise impact associated with construction will 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 will 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 will 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 will be present on site for only brief periods during construction.

Table 5.1 Estimated construction equipment program and noise levels, dB(A)

Construction Items	Location	Period	Noise Generating Equipment	Estimated Noise Levels at 10 m
Oversized Deliveries	All	Length of project	Truck	86
Excavation	LLPS HLPS Pipeline Discharge	9 – 12 months	30t Excavator	75
			20t Excavator	71
			8t Excavator	69
			3t Excavator	65
			2 Trucks	89
			Roller	75
			30t excavator with rock hammer	90
Piling	LLPS	2 months	Vibratory Sheet piling	88
			Diesel Water pump	78
			Truck	86
			3t Excavator	65
Blasting associated works	HLPS Pipeline	To be determined	Drilling Rig	82
			Truck	86
Building Services Traffic Delivery	LLPS Lay Down HLPS Compound	12 months	Generator	60
			Air Conditioner x 2	47
			Small water pump	63
			Pump truck	75
			Power tool - Circular Saw	74
			Power tool - Grinder	72
			Power tool - Drill	73
			Concrete Vibrator	76
			Crane	75
			Cars x 5	63

Construction Items	Location	Period	Noise Generating Equipment	Estimated Noise Levels at 10 m
	CH 650 Compound CH 2000 Compound CH 4800 Compound CH 6950 Compound CH 10800 Compound	12 – 18 months	Generator	60
			Air Conditioner x 2	47
			Small water pump	63
			Pump truck	75
			Cars x 5	63
			Crane	75
	Discharge Compound	9 months	Generator	60
			Air Conditioner x 2	47
			Small water pump	74
			Pump truck	75
			Cars x 5	63

5.1.4 Angle Crossing (LLPS and HLPS) Construction Noise

For the Angle Crossing area potential noise generating equipment for different stages of construction of the LLPS and HLPS are detailed in Table 5.1 with the estimated noise levels.

Considering topography the most affected ACT residential receivers to the Angle Crossing LLPS works are located 2200 m to the north-east. The residences to the west are shielded by steep terrain and are not as exposed to noise from the LLPS. The most affected ACT residential receivers to the Angle Crossing HLPS works are located 1700 m to the west. The Angle Crossing Beach is considered a recreational receiver which is located 300 m from the HLPS construction activities and 30 m from the LLPS construction activities.

Considering topography the most affected NSW residential receivers to the Angle Crossing LLPS works are located 2300 m to the east. The residence to the west are shielded by steep terrain and are not as exposed to noise from the LLPS. The most affected NSW residential receivers to the Angle Crossing HLPS works are located 1700 m to the south-west.

The predicted construction noise at the ACT and NSW receivers for each stage of the Angle Crossing works at the LLPS and HLPS is shown in Table 5.2.

Table 5.2 Predicted construction noise at the ACT and NSW receivers for each stage of Angle Crossing works at the LLPS and HLPS, dB(A)

Receivers	Excavation		Piling	Blasting	Oversized Deliveries	
	LLPS	HLPS	LLPS	HLPS	LLPS	HLPS
Angle Crossing Beach, North End	78	50	78	47	72	50
Angle Crossing Beach, South End	68	47	67	45	62	47
Most affected ACT Residence	29	26	31	22	20	25
Most affected NSW residential receiver	24	33	28	28	16	33

During the recommended construction hours construction noise generated by activities at the LLPS and HLPS are expected to comply with noise criteria at the surrounding residence as the predicted noise levels are below the noise goal of 40 dB(A).

Outside of the recommended construction hours there is the potential for oversized deliveries to occur however they are not predicted to exceed the noise goals at the most affected NSW or ACT residence.

Even though construction noise goals are likely to be met all mitigation measures detailed in Section 6.2.1 should be considered for construction works.

Noise levels at the Angle Crossing Beach are significant, however the ACT noise legislation does not require noise goals to be met for construction noise assuming activities are undertaken during the recommended construction hours and mitigation measure mentioned in Australian Standard 2436 are implemented. After hour oversized deliveries occur during the night-time period and early morning period when Angle Crossing beach is not expected to be in use for recreational activities, therefore there is not expected to be any noise impacts outside of the recommended construction hours.

5.1.5 Pipeline Construction Noise

Pipeline construction activities are detailed in Table 5.1 with their estimated noise levels.

The distance from the pipeline to residence varies along the route however at some locations it is less than 50 m. The predicted construction noise for each stage of the project has been estimated for different distances and is shown in Table 5.3. The estimations do not consider topography as it varies for each residence.

Table 5.3 Predicted pipeline construction noise for different distances, dB(A)

Construction Stage	Distance (m)						
	50	100	250	500	1000	2000	3000
Construction	73	65	56	49	42	33	27
Oversized deliveries	66	58	49	42	35	26	20
Blasting Associated Works	67	59	50	43	36	27	21

For receivers within the ACT, noise legislation does not require noise goals to be met for construction noise assuming activities are undertaken during the recommended construction hours and mitigation measure mentioned in Australian Standard 2436 are implemented.

For receivers within NSW, the *noise affected level* during recommended construction hours is 40 dB(A) therefore construction activities have the potential to exceed the NSW *noise affected level* when they are within approximately 1200 m of residential receivers for construction activities and 700 m for blasting associated activities.

The *highly noise affected level* of 75 dB(A) may be exceeded when construction activities are within 40 m of construction activities.

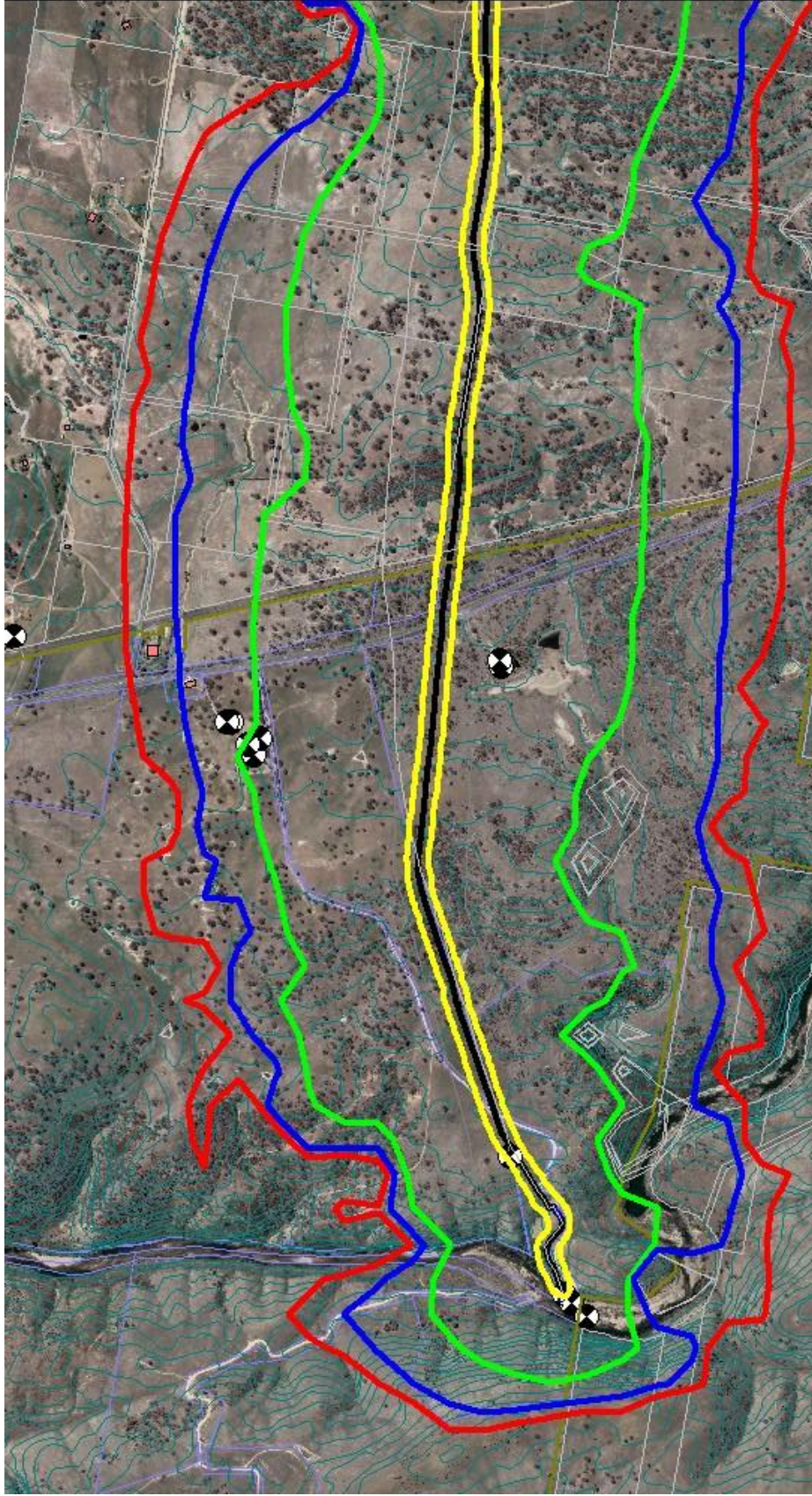
Outside of the recommended construction hours there is the potential for oversized deliveries to occur which could exceed the ACT and NSW noise goal of 35 dB(A) when residential receivers are within 1000 m.

The *noise affected level* of 40 dB(A) represents a point at which there may be some reaction to noise by the community. The *highly noise affected level* of 75 dB(A) represents a point where there may be a strong reaction to noise from the community. Therefore there is the potential for a strong reaction to noise for residential receivers in close proximity to construction activities i.e 40 m. The community reaction to noise will reduce with distance from the construction activities to a point where there is unlikely to be a reaction to construction noise at 1200 m.

The residential receivers that potentially exceed the *noise affected level* and *highly noise affected level* can be seen within the noise contours shown in Figure 5.1, Figure 5.2 and Figure 5.3. Up to 10 residential receivers have the potential to exceed the *highly noise affected level* where there is likely to be a reaction to construction noise. Approximately 100 residential receivers have the potential to exceed the *noise affected level* where there may be some reaction to construction noise though to a lesser extent.

Appendix C of the Construction Methodology states that in NSW the pipeline construction rate is approximately 5 pipe length per day which is equivalent to 65m per day. Based on this calculated rate of construction residential receivers should only be exposed to the *highly noise affected level* for less than 1 day, which is considered only a short duration and is likely to significantly mitigate the reaction to construction noise. Based on a 65 m/day rate of construction there is the potential for residential receivers to be exposed to the *noise affected level* (40 dB(A) to 75 dB(A)) for up to 37 days.

It is recommended that the mitigation measures detailed in Section 6.2.1 should be implemented and all potentially impacted residents should be informed of the nature of the works, expected noise levels, duration of works and a method of contact.



Noise Level Contours dB(A)

- 35 dB(A) Night-time Noise affected level for oversized delivery activities
- 40 dB(A) Day-time Noise affected level for blasting associated activities
- 40 dB(A) Day-time Noise affected level for construction activities
- 75 dB(A) Day-time Highly Noise affected level for construction activities

Figure 5.1 Pipeline construction noise contours and surrounding residential receivers (western end), dB(A)

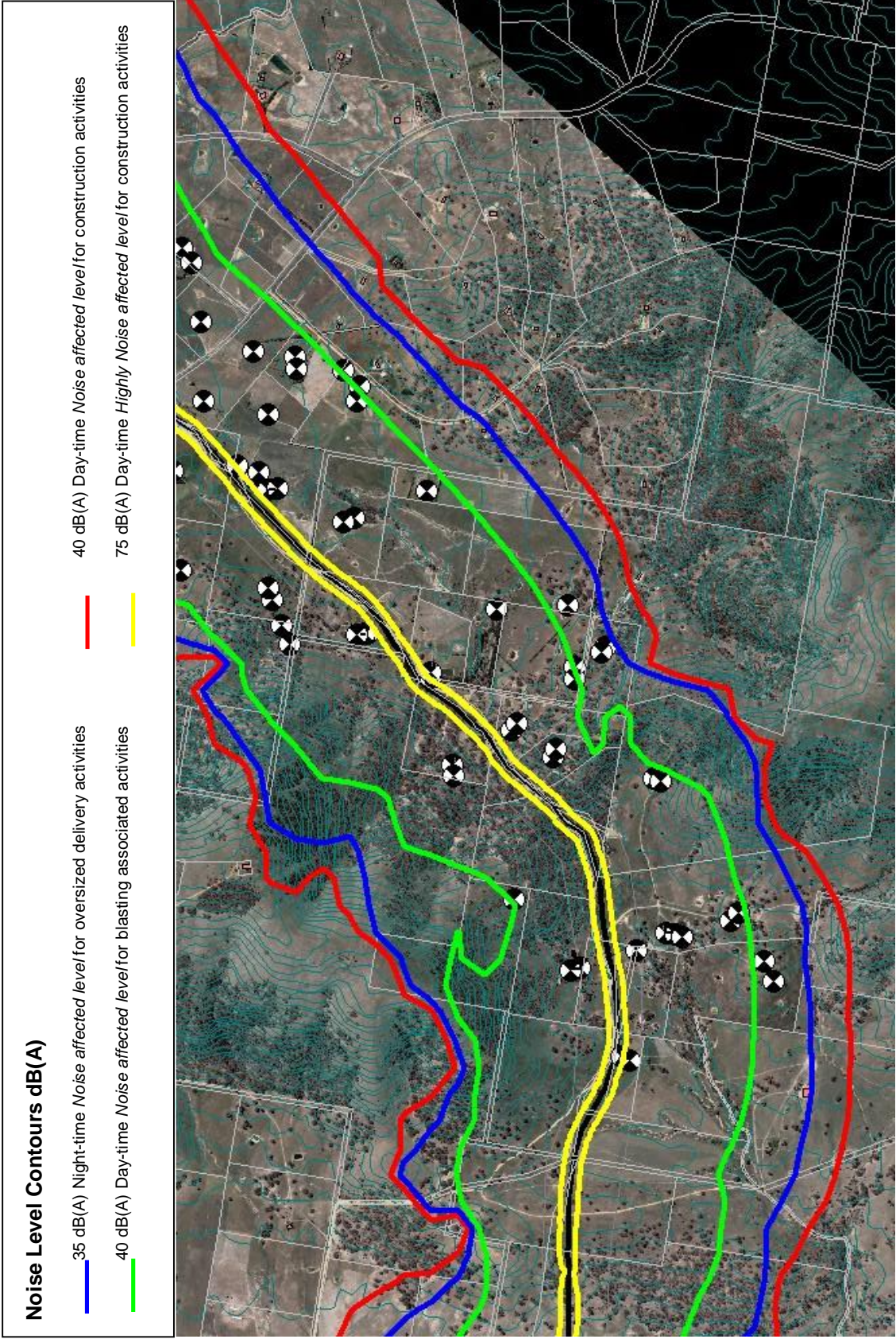


Figure 5.2 Pipeline construction noise contours and surrounding residential receivers (central), dB(A)

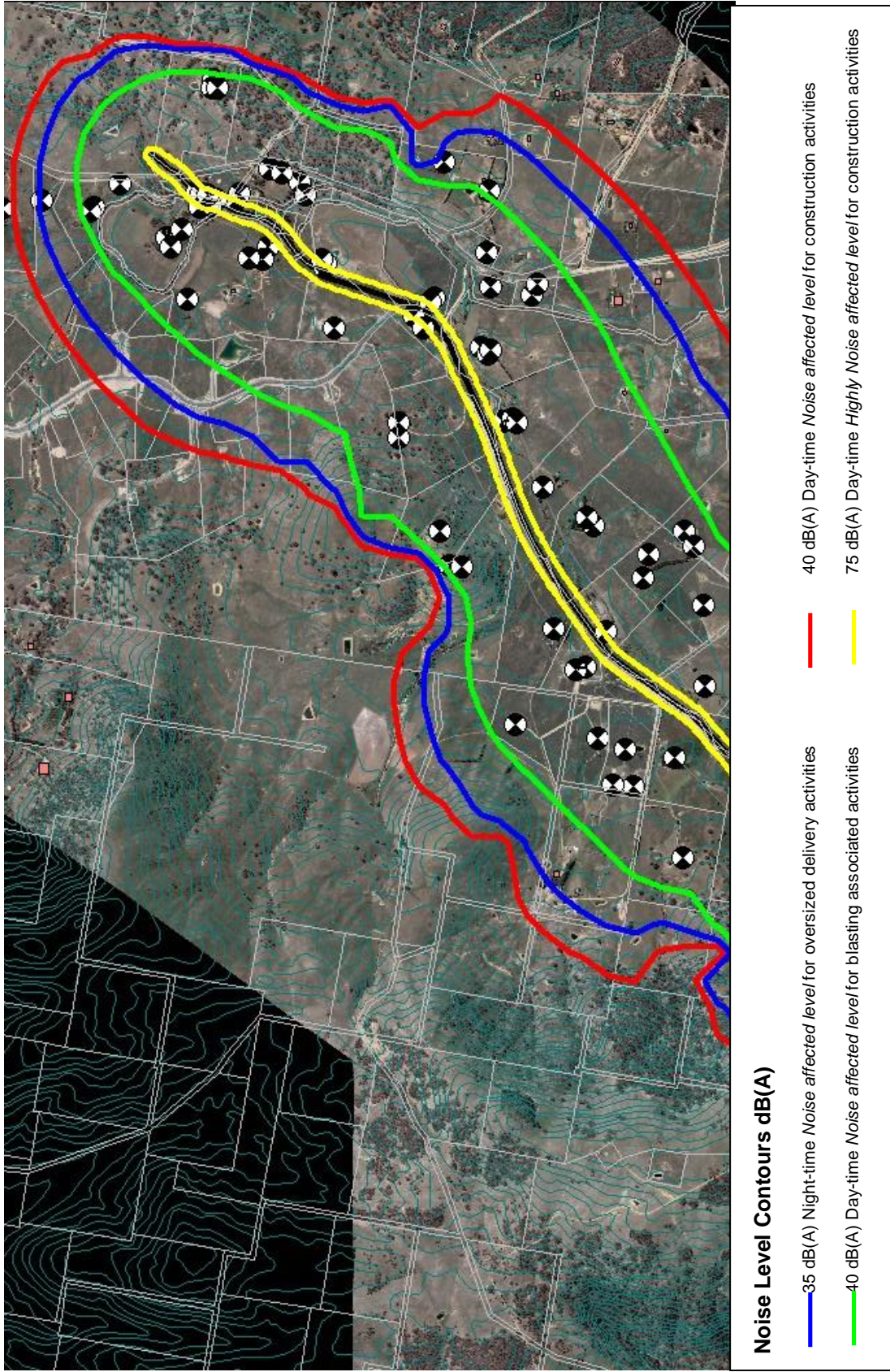


Figure 5.3 Pipeline construction noise contours and surrounding residential receivers (eastern end), dB(A)

5.1.6 Discharge Construction Noise

Potential noise generating equipment for different stages of construction of the discharge structure are detailed in Table 5.1 with the estimated noise levels.

The nearest NSW residential receivers are approximately 300 m to 400 m from the discharge structure and are shown in Figure 5.4.

The predicted construction noise levels for the discharge structure construction activities at the surrounding residences are shown in Table 5.4.

Table 5.4 Predicted construction noise at the discharge structure, dB(A)

Residential Receivers	Construction	Oversized delivery
400 m south east of discharge	56	49
300 m south west of discharge	58	51
400 m west of discharge	55	48
370 m north west of discharge	57	50

The *noise affected level* during recommended construction hours is 40 dB(A) therefore construction activities have the potential to exceed the NSW *noise affected level* at the surrounding residential receivers within the red contour line of Figure 5.4, which is up to 1200 m from the construction noise sources.

The *highly noise affected level* of 75 dB(A) is not expected to be exceeded.

The *noise affected level* outside of the recommended construction hours is 35 dB(A) therefore oversized delivery activities have the potential to exceed the NSW *noise affected level* at the surrounding residential receivers within the blue contour line of Figure 5.4, which is up to 1000 m from the construction noise sources.

The *noise affected level* of 40 dB(A) represents a point at which there may be some reaction to noise by the community. The *highly noise affected level* of 75 dB(A) represents a point where there may be a strong reaction to noise from the community. Therefore there is unlikely to be a strong reaction to discharge construction noise as the *highly noise affected level* is not expected to be exceeded at the surrounding residential receivers. The community reaction to noise will reduce with distance from the construction activities to a point where there is unlikely to be any reaction to construction noise at 1200 m.

The residential receivers that potentially exceed the *noise affected levels* can be seen within the noise contours shown in Figure 5.4. Approximately 20 residential receivers have the potential to exceed the *noise affected level* where there may be some reaction to construction noise.

The discharge construction period is expected to be approximately 9 months; therefore residential receivers will be potentially exposed to the *noise affected level* of construction activities within 1200 m of the discharge area during this period.

It is recommended that the mitigation measures detailed in Section 6.2.1 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.

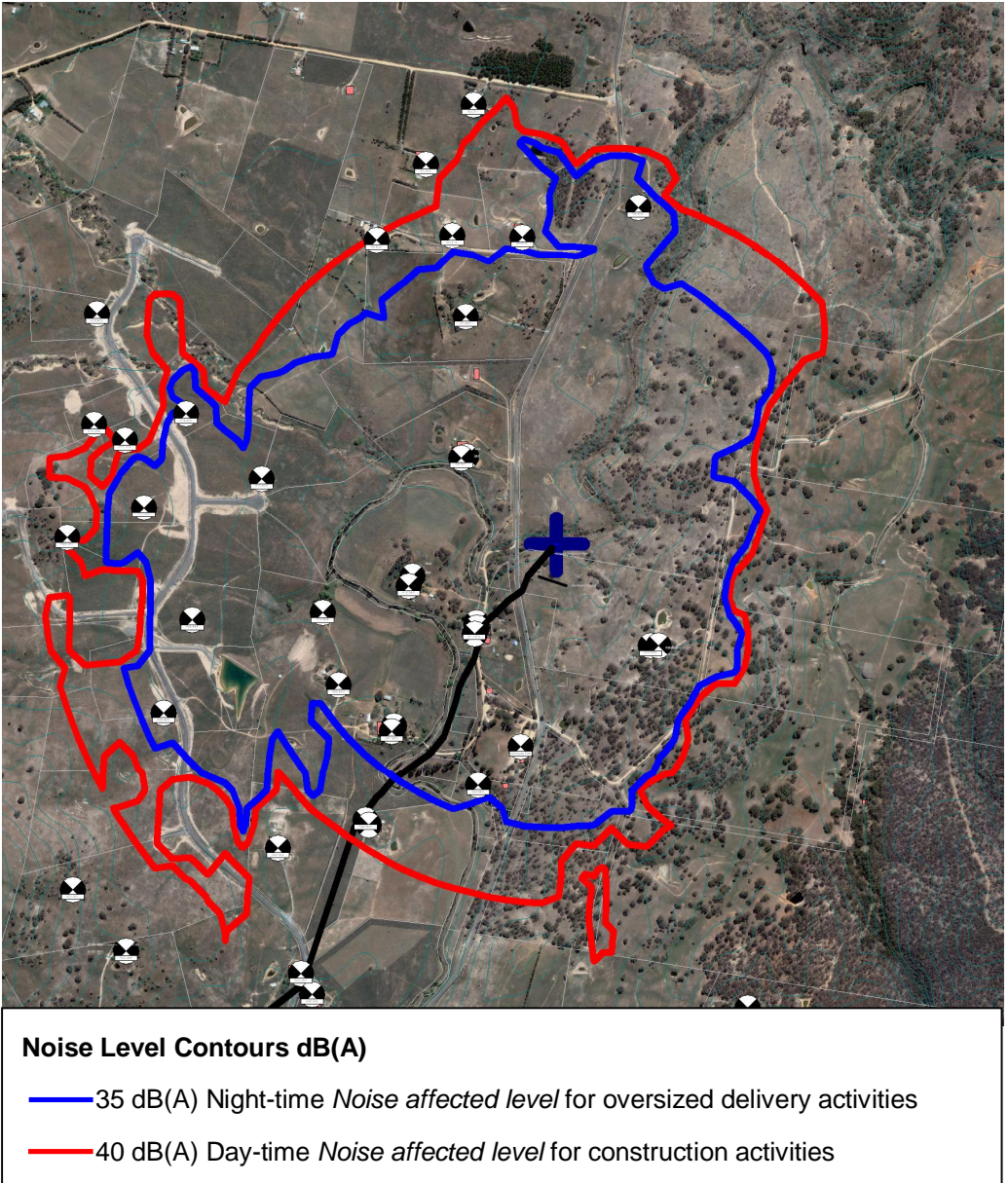


Figure 5.4 Discharge structure construction noise contours and surrounding residential receivers dB(A)

5.2 Construction compound noise

Potential noise generating equipment associated with the proposed construction compounds are detailed in Table 5.1 with the estimated noise levels.

The location of the construction compounds and proximity to residential and recreational receivers are shown in Figure 5.5.

The predicted construction noise levels for the compound areas at the nearest surrounding residence are shown in Table 5.4. The predicted received noise levels are based on the following operational times based on a 15-minute period. All other noise sources as shown in Table 5.1 are assumed to operate continuously:

- Heavy Vehicles – 5 minutes;
- Crane – 5 minutes;
- Circular Saw – 5 minutes;
- Drill – 5 minutes;
- Grinder – 5 minutes;
- Concrete vibrator – 5 minutes; and
- Car – 1 minute.

The predicted construction compound noise at the nearest receivers is shown below in Table 5.5.

The *noise affected level* during recommended construction hours is 40 dB(A) therefore compound activities have the potential to exceed the NSW *noise affected level* at 5 residences for a construction period of 18 months.

The *highly noise affected level* of 75 dB(A) is not expected to be exceeded.

It is recommended that the mitigation measures detailed in Section 6.2.1 should be implemented and all potentially impacted residents should be informed of the nature of the works, expected noise levels, duration of works and a method of contact.

Table 5.5 Predicted construction compound noise, dB(A)

Compound Area (Chainage)	Potentially Impacted Receiver	Noise Level
LLPS Lay Down	Angle Crossing Beach, North End	53
	Angle Crossing Beach, South End	48
	Other Receivers	< 35
HLPS Compound	Angle Crossing Beach, North End	39
	Angle Crossing Beach, South End	36
	Other Receivers	< 35
CH 650 Pipe Lay Down	All Receivers	< 35
CH 2000 Main Office	Residence	42
	Other Receivers	<35
CH 4800 Pipe Lay Down	All Receivers	< 35
CH 6950 Spoil and Pipe Storage	Residence	43
	Residence	37
	Other Receivers	< 35
CH 10800 Pipe Lay Down and Material Storage	Residence	51
	Residence	42
	Other Receivers	< 35
Discharge Compound	All Receivers	< 35

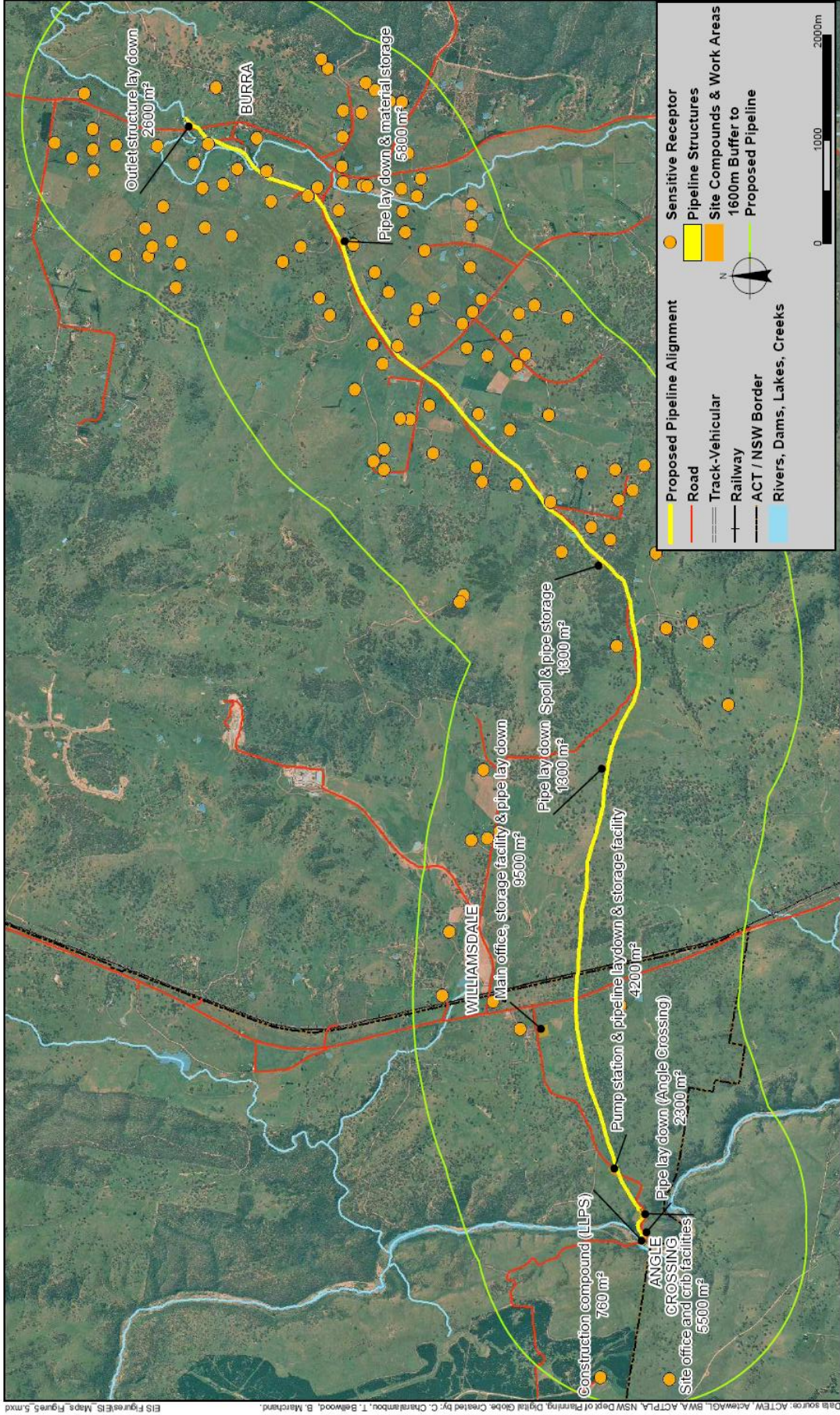


Figure 5.5 Construction site and sensitive receivers

Data source: ACTEW, ActewAGL, BWA, ACTPLA, NSW Dept of Planning, Digital Globe. Created by: C. Charalambou, T. Belwood, B. Marchand. EIS Figure/EIS Maps, Figure 5.mxd

5.3 Construction Traffic Noise

5.3.1 Existing Road Network

The construction traffic noise assessment has been based on the ACTEW, Murrumbidgee to Googong Pipeline Traffic Impact Assessment undertaken by GHD in December 2008.

The major routes taken by construction traffic to access the site are assumed to be:

- Monaro Highway/ Angle Crossing Road for equipment and materials delivered from Canberra to LLPS, HLPS and the section of the pipeline west of Monaro Highway as well as workforce and visitors to these locations;
- Monaro Highway/ Williamsdale Road for equipment and materials delivered from Canberra to the section of the pipeline east of Monaro Highway and a proportion of workers and visitors; and
- Burra Road/ Williamsdale Road for equipment and materials delivered from Queanbeyan and a proportion of workers or visitors.

The construction traffic counts and classifications shown in Table 5.6.

Table 5.6 Existing traffic counts

Road	Traffic Count Date	Average Daily Traffic (ADT)	Road Classification
Angle Crossing Road	August 2008	79	Local Road
Monaro Highway	June 2008	3162	Collector Road
Williamsdale Road	June 2006	200	Local Road
Badgery Road	June 2006	198	Local Road
Burra Road	August 2008	436	Local Road

5.3.2 Generated Construction Traffic

Heavy vehicles will be required for the following haulage tasks:

- Construction and mechanical equipment (semi-trailers);
- Ready mixed concrete (5m³ capacity trucks);
- Reinforcement steel (semi-trailers); and
- Pipes (semi-trailers).

Other construction-related traffic includes light vehicles used by the workforce and by visitors to the site.

The Traffic Impact Assessment assigned heavy vehicle traffic to the road network as shown in Table 5.7. This represents the expected maximum traffic volume during the construction period.

Table 5.7 Predicted construction traffic

Road	Location	Light Veh trips per day	Heavy Veh trips per day	Total Traffic
Monaro Highway	North of Williamsdale Road	140	127	267
Monaro Highway	Williamsdale Rd to Angle Crossing Rd	80	75	155

Road	Location	Light Veh trips per day	Heavy Veh trips per day	Total Traffic
Angle Crossing Rd	River crossing to Monaro Highway	80	75	155
Williamsdale Road	Monaro Highway to Burra Road	38	52	90
Burra Road	North of Williamsdale Road	29	32	61

5.3.3 Assessment of construction traffic impacts

An initial screening noise assessment, using CoRTN to calculate the $L_{A10(18hr)}$ emission level⁸ for existing and predicted construction traffic, to assess the potential increase in traffic noise was undertaken. Where construction traffic leads to an increase in existing noise levels of more than 2 dB(A) a more detailed assessment is undertaken. The predicted total traffic includes the generated construction traffic and the predicted existing traffic. The calculations have assumed an existing heavy vehicle percentage of 10% on all roads.

Table 5.8 Road $L_{A10(18hr)}$ Emission level, dB(A)

Road	Location	Existing traffic	Predicted total traffic	Increase
Monaro Highway	North of Williamsdale Road	64.8	65.7	0.9
Monaro Highway	Williamsdale Rd to Angle Crossing Rd	64.8	65.4	0.6
Angle Crossing Rd	River crossing to Monaro Highway	48.8	57.5	8.5
Williamsdale Road	Monaro Highway to Burra Road	52.8	55.6	2.8
Burra Road	North of Williamsdale Road	56.2	57.6	1.4

The construction traffic on the Monaro Highway and Burra Road should not lead to an increase in existing noise levels of more than 2 dB(A) therefore noise levels are expected to comply with noise criteria on these roads.

Construction traffic noise levels increase by more than 2 dB(A) for Angle Crossing Road and Williamsdale Road therefore traffic noise predictions have been made for the nearest receivers to these roads. The predictions include traffic noise from all roads and consider road gradient, traffic speed and topography. Austroad traffic noise descriptor corrections have been applied.

The closest ACT residence to Angle Crossing road is located approximately 130 m from Angle Crossing Road and 200 m from the Monaro highway. The predicted traffic noise is $L_{A10(18hr)}$ 52 dB(A) which is below the ACT road traffic noise criteria of $L_{A10(18hr)}$ 63 dB(A).

No other receivers are in close proximity to the construction traffic route on Angle Crossing Road. Therefore it is expected that construction traffic noise criteria will be met along Angle Crossing Road.

⁸ The emission level is taken at 10m and the calculations did not consider any variation in road surface type, gradient or traffic speed.

The closest residence to Williamsdale road is located approximately 50 m from the road. The predicted traffic noise at the closest residence is $L_{Aeq(1hr,peak)}$ 49 dB(A) which is below the NSW road traffic noise criteria of $L_{Aeq(1hr,peak)}$ 55 dB(A).

In general, heavy vehicles attending the site should be restricted, where possible, to between 7:00 am and 6:00 pm to minimise the risk of sleep disturbance. Early morning oversized deliveries may be required on occasion for some of the construction works and would occur outside the recommended construction hours. The mitigation measures detailed in Section 6.2.1 should be implemented to reduce the impact of sleep disturbance. All drivers should be sensitised to the potential for sleep disturbance on local residents and encouraged to take practical and reasonable measures to minimise the impact during the course of their delivery activities.

5.4 Construction Vibration

Blasting normally generates the highest levels of ground vibration, however construction equipment such as pile driving can also lead to high vibration levels and therefore needs to be assessed to minimize potential adverse impacts on the surrounding residential receivers. Ground vibration caused by blasting is covered in Section 5.5.

Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- The efficiency of the energy transfer mechanism of the equipment (i.e impulsive; reciprocating, rolling or rotating equipment);
- The frequency content;
- The impact medium stiffness;
- The type of wave (surface or body); and
- The ground type and topography.

Due to the above factors, there is inherent variability in ground vibration predictions without site-specific measurement data. The NSW RTA Environmental Noise Management Manual provides typical construction equipment ground vibration levels at 10m. The rate of vibration attenuation can be calculated from the following regression analysis formula;

$$V = kD^{-n}$$

where

$$V = PPV;$$

$D =$ Distance; and

$n =$ attenuation exponent. The value of n generally lies between 1 and 2 with a relatively common value of 1.5⁹.

The predicted ground vibrations at various distances are shown in Table 5.9 for typical construction equipment.

⁹ Construction Vibrations: State of the Art, John Wiss, 1981

Table 5.9 Predicted construction equipment vibration levels (mm/s PPV)

Plant Item ¹⁰	Preferred Criteria (Maximum Criteria)		Predicted Ground Vibration				
	Day	Night	10 m	30 m	50 m	100 m	300 m
Pile Driving (Impulsive)	8.6 (17.0)	2.8 (5.6)	21.0	4.0	1.9	0.7	0.1
15t Roller	0.28 (0.56)	0.2 (0.4)	7.5	1.4	0.7	0.2	<0.1
Dozer	0.28 (0.56)	0.2 (0.4)	3.3	0.6	0.3	0.1	<0.1
7t compactor	0.28 (0.56)	0.2 (0.4)	6.0	1.2	0.5	0.2	<0.1
Rock Breaking	0.28 (0.56)	0.2 (0.4)	7	1.3	0.6	0.2	<0.1
Backhoe	0.28 (0.56)	0.2 (0.4)	1	0.2	0.1	<0.1	<0.1

Pile driving is to be undertaken at the LLPS, which is located at a distance greater than 300 m from residence, therefore not expected to be perceptible.

The majority of construction activities along the pipeline will not 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. Ten residential receivers have the potential to exceed vibration goals.

Appendix C of the Construction Methodology states that in NSW the pipeline construction rate is approximately 5 pipe length per day which is equivalent to 65m per day. Based on this calculated rate of construction residential receivers should only be exposed to vibration for less than 1 day, which is considered only a short duration and is likely to significantly mitigate the reaction to construction vibration.

The expected magnitude of ground vibrations will not be sufficient to cause damage, however because the vibration will potentially be perceptible and intrusive, residents' awareness may result in the perception that damage is being caused. Residents should be informed that the vibration levels are minimal and should not give rise to structural damage.

It is recommended that vibration mitigation measures detailed in Section 6.2.2 should be considered when construction works are within 50 m of residents.

5.5 Construction Blasting

There is the potential for blasting to be required for excavations of the LLPS, HLPS, sections of the pipeline and discharge structure. Blasting will be used in areas where hydraulic excavators with hammer attachments are ineffective due to large formations of hard rock. Areas of rock that potentially require blasting have been identified at the following pipeline chainages and areas:

¹⁰ NSW RTA Environment noise management manual

- ▶ CH387 – CH950;
- ▶ CH1892 – CH1985;
- ▶ CH6850 – CH6921;
- ▶ CH12713 – CH13013; and
- ▶ LLPS for construction of the base.

A general assessment of construction blasting has been undertaken to assess potential adverse impacts on the surrounding residential receivers. Blasting estimations have been undertaken with consideration to AS2187 and have been based on available information. Blasting is non-linear in nature and variability in ground type and meteorological conditions makes it difficult to accurately predict ground vibration and airblast overpressure without site specific measurement data therefore the blasting predictions should only be used as a guide.

Blasting should only occur from 9:00 am to 5:00 pm (Monday to Friday) and 9:00 am to 1:00 pm (Saturday).

5.5.1 Estimation of Airblast overpressure

Airblast overpressure can be estimated using the following equation:

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a$$

Where:

P is the pressure (kPa)

R is the distance from charge (m)

Q is the charge mass (kg)

K_a is the site constant. AS2187.2 recommends for confined blasthole charges values are commonly in the range of 10 to 100. A value of 50 has been adopted for this assessment.

a site exponent. AS2187.2 recommends for confined blasthole charges a good estimate of *a* = -1.45.

Airblast overpressure propagation can be increased with unfavourable meteorological conditions and decreased with topographic shielding. Unconfined surface charges would considerably increase the airblast overpressure propagation.

5.5.2 Estimation of Ground Vibration

Ground vibration has been estimated using the following equation:

$$V = K_G \left(\frac{R}{Q^{1/2}} \right)^{-1.6}$$

Where:

V is the peak vector sum ground vibration ppv (mm/s)

R is the distance from charge (m)

Q is the maximum instantaneous charge (MIC) (kg)

K_G is the ground constant AS2187.2 gives a site constant for a free face in average field conditions of 1140 which has been used for the predictions. This value can vary from 1/5 times – 4 times depending on ground conditions and other factors.

5.5.3 Blasting predictions

Reducing the charge mass or increasing the distance reduces the airblast overpressure and ground vibration. Airblast overpressure and ground vibration has been predicted for a range of charge masses and are shown in Figure 5.6 and Figure 5.7 for varying distances and assuming average conditions.

Charge mass estimates to achieve the construction airblast overpressure criteria of 120 dB(L) and ground vibration criteria of and 10 mm/s PPV are shown in Table 5.10.

No details of the blast configuration and design have been supplied. A MIC of greater than 100 kg should not be required and a charge of 50 kg or less is likely to be appropriate. Therefore blasting at distance greater than 200 m would not be restricted with consideration to ground vibration. However ground vibration generally attenuates faster than airblast overpressure, hence airblast overpressure is generally the critical factor which controls the distance in which blasting can occur. Therefore blasting at distances to receivers of less than 800m would be restricted by the MIC.

The following chainages and area have been identified where there is the potential for blasting and the surrounding residential receivers have been identified:

- For CH 387 – CH 950 the nearest residential receiver is 1400 m therefore restrictions on blasting should not be required.
- For CH 1892 – CH 1985 there are 3 residential receivers within 800 m of the blast area the nearest being 500 m. Therefore appropriate mitigation measures should be considered in the blast design;
- For CH 6850 – CH 6921 there are 7 residential receivers within 800 m of the blast area the nearest being 250 m. Therefore appropriate mitigation measures should be considered in the blast design;
- For CH 12713 – CH 13013 there are 12 residential receivers within 800 m of the blast area the nearest being 250 m. Therefore appropriate mitigation measures should be considered in the blast design;
- The nearest residential receiver to the LLPS is 1400 m therefore restrictions on blasting should not be required.

Once the exact location of blasting is known the distance to the receiver should be used for the charge mass estimate. Blast monitoring should be undertaken to assess compliance, determine the site constants and confirm the predictions.

Adverse meteorological conditions such as temperature inversions and wind direction can significantly increase airblast overpressure levels. Temperature inversions are most common during night and early morning periods, therefore should not effect blasting during the recommended standard hours.

It is recommended that all residential receivers be informed when blasting is to be undertaken. Reducing charge mass and increasing distance is the most effective way of reducing blasting impacts. The most likely impact of blasting is airblast overpressure. Methods to reduce the impact of airblast overpressure are detailed in mitigation Section 6.3, though the blast contractor would determine their effectiveness and practicability.

GHD acknowledge that the design of blast would be up the blast contractor and that the above information has been assumed for this assessment only, in the absence of specific information regarding blasting along the pipeline route.

Table 5.10 Charge mass estimates to achieve the construction criteria at varying distances to the receivers

Distance to receiver (m)	MIC (kg) to meet 120 dB(L)	MIC to meet 10 mm/s PPV
1000	93	>100
900	68	>100
800	48	>100
700	32	>100
600	20	>100
500	12	>100
400	6	>100
300	3	>100
200	1	>100
100	<1	25

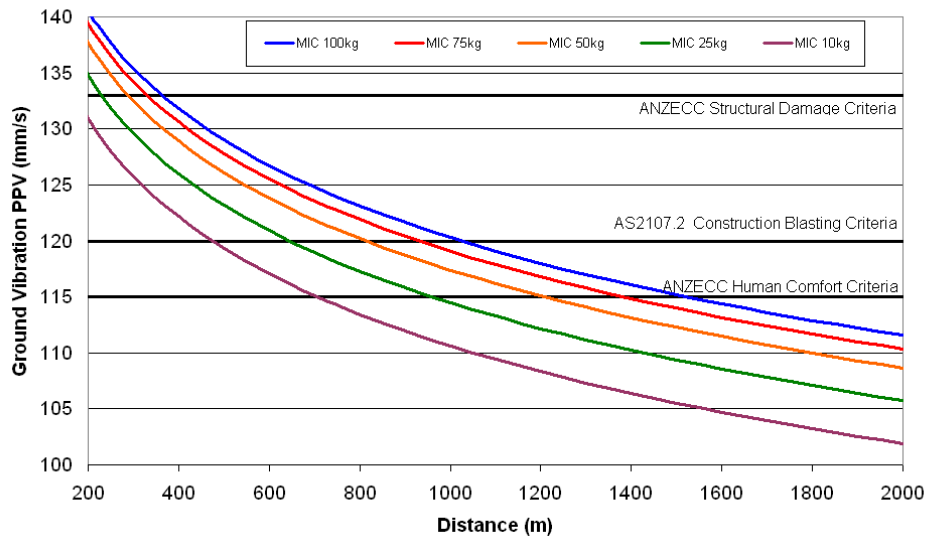


Figure 5.6 Airblast overpressure predictions for different charge masses and distances

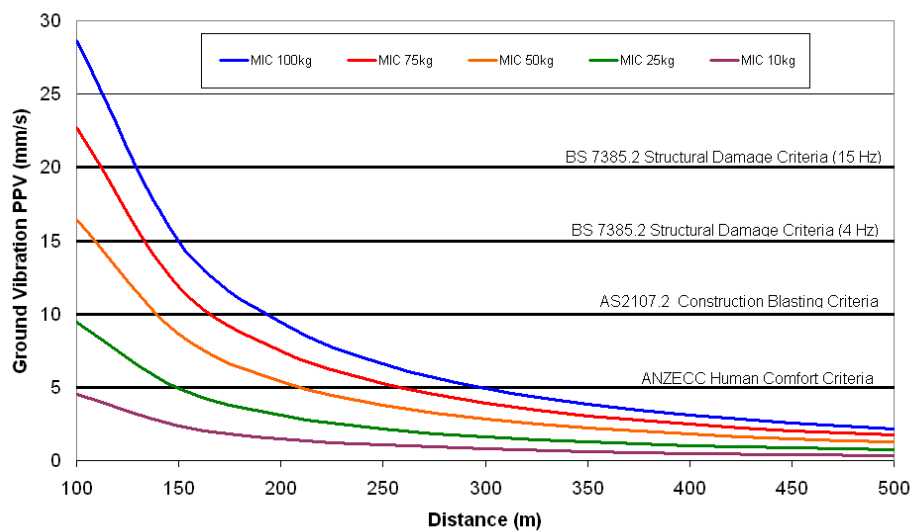


Figure 5.7 Ground vibration predictions for different charge masses and distances

6 Proposed Mitigation Measures

6.1 Operational Noise and Vibration

The operations of the LLPS, HLPS and discharge structure are expected to comply with noise and vibration criteria at the surrounding receivers therefore no operational noise and vibration mitigation measures have been recommended.

Operational noise due to air valve operation is predicted to be below the noise goal of 35 dB(A) at identified residential receivers. It should be noted that the air valve noise calculations are based on exit velocities outlined in this report. If the design or operation of air valves deviates from this information, it is recommended that the valve noise predictions be checked to confirm compliance with the noise criteria.

6.1.1 Vibration in the HLPS

It is important to emphasize the requirement to minimise plant vibration transfer into the building structure to reduce the risk of structure-borne noise emissions. Site equipment with a potential to generate vibration such as pumps and mechanical equipment must be designed to incorporate requirements for vibration isolation. Appropriate vibration isolation details can generally be obtained from the plant manufacturer to ensure minimal vibration is transmitted to the supporting structure. Vibrating plant items should not be directly mechanically affixed to the walls of the surrounding structure. For this assessment predicted impacts at residential receivers have been based on the assumption that the design incorporates requirements for vibration isolation.

6.2 Construction Noise and Vibration

The potential exists for construction activities to exceed the noise and vibration goals for the project in some circumstances. Construction activities will move from one area to another as the construction of the pipeline progresses. Consequently, construction noise at receivers will occur on a temporary basis. Ongoing consultation with affected landholders during the construction phase of the Project will help to mitigate against any potential noise impacts. The impact of the construction activities can be minimised through the implementation of the following mitigation measures.

6.2.1 Noise Mitigation Measures

In the ACT to comply with the *ACT Environment Protection Regulation 2005*, Schedule 2, Part 2.3, Table 2.3, Section 6 (c) condition all relevant noise reduction measures mentioned in Australian Standard 2436; as in force from time to time, are implemented. The NSW CNG also provides a summary of potential noise mitigation measures. It is recommended that the following construction noise mitigation measures be implemented for pipeline works to reduce the impact on the surrounding receivers:

- Where possible, without interference to safe and efficient operation, equipment should be oriented away from receivers. Shielding from terrain and objects should be considered in equipment location;
- Where practical, machines should be operated at low speed or power and will be switched off when not being used rather than left idling for prolonged periods;
- Where possible equipment should be selected to minimise noise emissions, be fitted with appropriate silencers and be in good working order;
- Machines found to produce excessive noise compared to normal industry expectations should be removed from the site or stood down until repairs or modifications can be made;
- Reversing alarms noise emissions should be minimised, though satisfactory to achieve occupational health and safety requirements;
- Limit noise intensive activities to between 9:00 am - 4:30 pm;
- Noise intensive activities should not be undertaken outside of daytime construction hours; and
- Traffic due to deliveries construction should be limited to 7am to 6 pm.

6.2.2 Vibration mitigation measures

The following construction site vibration mitigation measures should be considered:

- Choose low Impact equipment and methods 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 should be implemented through scheduling these activities during the least sensitive time periods;
- Sequence operations so that vibration intensive activities do not occur simultaneously; and
- Where possible locate vibration intensive activities as far away from sensitive areas as possible.

6.2.3 Complaints, Work Ethics and Community Relations

- All site workers should be sensitised to the potential for noise and vibration impacts on local residents and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities;
- An ACTEW representative should make contact with affected local residents and communicate the construction program and progress on a regular basis;
- Liaise with the potentially affected residence prior to the start of construction so that they are aware of the mechanism to lodge a complaint or feedback. All complaints lodged by nearby residents are logged on a complaints register, which would also document the investigation into the source of the emission giving rise to the complaint and any corrective actions taken to rectify the cause of complaint.

6.3 Blasting Mitigation Measures

It is recommended that all residential receivers be informed when blasting is to be undertaken. Reducing charge mass and increasing distance is the most effective way of reducing blasting impacts. The most likely impact of blasting is airblast overpressure. Methods to reduce the impact of airblast overpressure are detailed in this section, though the blast contractor would determine their effectiveness and practicability. These include the following:

- Optimising blast design by altering drilling patterns and adjusting the effective charge mass per delay (discussed above);
- Using a combination of appropriate delays;
- Keeping face heights to a practicable minimum;
- Ensuring stemming type and length is adequate;
- Making extra efforts to eliminate the need for two shots;
- Considering delaying or cancelling the blast by not loading if the weather is unfavourable;
- Allowing for the effects of temperature inversion and wind speed and the direction on the propagation of airblast to surrounding areas; and
- Orientating faces where possible so that they do not face directly towards residential receivers.

7 Conclusion

This report provides an assessment of the potential construction and operational noise and vibration impacts on the surrounding environment from the infrastructure to transfer water from the Murrumbidgee River to Googong Reservoir.

The operations of the LLPS, HLPS and discharge structure are expected to comply with noise and vibration criteria at the surrounding receivers. Based on the information provided regarding the proposed development, surrounding area and detailed noise modelling, project-specific operational noise and vibration goals should be met and no mitigation measures are required. Therefore the operations of the project should be acceptable from an acoustic perspective with consideration to the ACT and NSW guidelines and legislation.

Operational noise due to air valve operation is predicted to be below the noise goal of 35 dB(A) at identified residential receivers. It should be noted that the air valve noise calculations are based on exit velocities outlined in this report. If the design or operation of air valves deviates from this information, it is recommended that the valve noise predictions be checked to confirm compliance with the noise criteria.

The construction of the LLPS and HLPS is expected to comply with noise and vibration criteria at the surrounding receivers. Based on the information provided regarding the LLPS and HLPS, surrounding area and detailed noise modelling, project-specific construction noise and vibration goals should be met and no mitigation measures are required. Therefore the construction of the LLPS and HLPS should be acceptable from an acoustic perspective with consideration to the ACT and NSW guidelines and legislation.

The construction of the pipeline may potentially exceed construction noise goals at residential receivers. There is the potential for a strong reaction to noise for residential receivers in close proximity to construction activities i.e 40 m. The community reaction to noise will reduce with distance from the construction activities to a point where there is unlikely to be a reaction to construction noise at 1200 m. Up to 10 residential receivers have the potential to exceed *the highly noise affected level* where there is likely to be a reaction to construction noise. Approximately 100 residential receivers have the potential to exceed the *noise affected level* where there may be some reaction to construction noise though to a lesser extent. Residential receivers should only be exposed to the *highly noise affected level* for less than 1 day, which is considered only a short duration and is likely to significantly mitigate the reaction to construction noise. There is the potential for residential receivers to be exposed to the *noise affected level* for up to 37 days. It is recommended potentially impacted residents be informed of the nature of the works, expected noise and vibration levels, duration of works and a method of contact. Possible noise mitigation measures are detailed in Section 6.2.1 and should be considered;

The construction of the pipeline may potentially exceed the vibration criteria at the surrounding residential receivers. The majority of construction activities along the pipeline will not 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. Ten residential receivers have the potential to exceed vibration goals. Residential receivers should only be exposed to vibration for less than 1 day, which is considered only a short duration and is likely to significantly mitigate the reaction to construction vibration. It is recommended potentially impacted residents be informed of the nature of the works, expected noise and vibration levels, duration of works and a method of contact. Possible vibration mitigation measures are detailed in Section 6.2.2 and should be considered.

The construction of the discharge structure may exceed noise goals at residential receivers. There is unlikely to be a strong reaction to discharge construction noise as the *highly noise affected level* is not expected to be exceeded at the surrounding residential receivers. Approximately 20 residential receivers have the potential to exceed the *noise affected level* where there may be some reaction to construction noise. The community reaction to noise will reduce with distance from the construction activities to a point where there is unlikely to be any reaction to construction noise at 1200 m. All potentially impacted residents should be

informed of the nature of the works, expected noise levels, duration of works and a method of contact. Recommended noise mitigation measures are detailed in Section 6.2.1 and should be considered.

The construction of the discharge structure is expected to comply with the vibration criteria at the surrounding residential receivers. Based on the information provided regarding the discharge structure, surrounding area and vibration predictions, project-specific vibration goals should be met and no mitigation measures are required. Therefore the construction of the discharge should be acceptable with consideration to the vibration standards.

Construction traffic is expected to comply with the noise criteria at the surrounding residential receivers however in general, heavy vehicles attending the site should be restricted, where possible, to between 7:00 am and 6:00 pm to minimise the risk of sleep disturbance. Early morning oversized deliveries may be required on occasion for some of the construction works and would occur outside the recommended construction hours. The mitigation measures detailed in Section 6.2.1 should be implemented to reduce the impact of sleep disturbance. All drivers should be sensitised to the potential for sleep disturbance on local residents and encouraged to take practical and reasonable measures to minimise the impact during the course of their delivery activities.

Construction compound noise may potentially exceed the noise criteria at the following residential receivers:

- ▶ One residence in close proximity to CH 2000 Main Office Compound Area;
- ▶ One residence in close proximity to CH 6950 Spoil and Pipe Storage Compound Area; and
- ▶ Two residents in close proximity to CH 10800 Pipe Lay Down and Material Storage Area.

As stated above, the potential exists for construction activities to exceed the noise and vibration goals for the project in some circumstances. Construction activities will move from one area to another as the construction of the pipeline progresses. Consequently, construction noise at receivers will occur on a temporary basis. Ongoing consultation with affected landholders during the construction phase of the Project will help to mitigate against any potential noise impacts. The impact of the construction activities can be minimised through the implementation of the following mitigation measures.

Areas along the pipeline have been identified where blasting is likely to be required. There are up to 22 residents within 800 m of the blast location, where there is the potential to exceed the ANZECC blasting criteria. Details of blasting requirements are not yet known, once these become available detailed ground vibration and airblast overpressure estimates should be undertaken and appropriate control measures be implemented by the blast contractor. 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.

Bibliography

Australian Standard, AS 2670 – 1990, “Evaluation of Human Exposure to Whole-Body Vibration – Part 2: Continual and Shock Induced Vibration in Buildings (1Hz to 80 Hz)”.

Australian Standard AS 2436 – 1981 “Guide to Noise Control on Construction, Maintenance and Demolition Sites”

Australian Standard AS1055.1, “Acoustics – Description and measurement of environmental noise – Part 1: General Procedures”.

Australian Standard, AS2187.2 – 2006 Appendix J, “Ground Vibration and Airblast Overpressure”.

British Standard, BS 6472 – 1992, “Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)”

British Standard, BS 7385 – 1993, “Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Groundbourne Vibration”.

Australian and New Zealand Environment Council, “Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration”, September 1990.

NSW Department of Environment and Climate Change, “Construction Noise Guideline”, Draft August 2008.

NSW Department of Environment and Climate Change, “Industrial Noise Policy”, January 2000.

NSW Department of Environment and Climate Change, “Environmental Criteria for Road Traffic Noise”, May 1999.

NSW Department of Environment and Climate Change, “Assessing Vibration: A technical Guideline, 2006”.

NSW Department of Environment and Climate Change, “Environmental Noise Control Manual”, 1994.

NSW Roads and Traffic Authority - Version 1.0, 2001 , “Environmental Noise Management Manual”.

ACT, “Environment Protection Regulation” 2005.

John Wiss, “Construction Vibrations – State of the Art”, 1981.

Charles H Dowding, “Construction Vibrations”, 2000.

US Federal Transit Administration’s Transit Noise and Vibration Impact Assessment 1995.

UK DEFRA, “Update of Noise Database for Prediction of Noise on Construction and Open Sites”, 2005.

KSB, “Questions on acoustics when using centrifugal pumps, 1.4.86 issue”.

Heckl and Müller, “Pocket book of technical acoustics”, Berlin 1995.

Schmidt, “Technical sound pocket book”, VDI publications, Düsseldorf 1996.

VDI 3739, “Emission benchmarks for acoustic sources, transformers”, February 1999

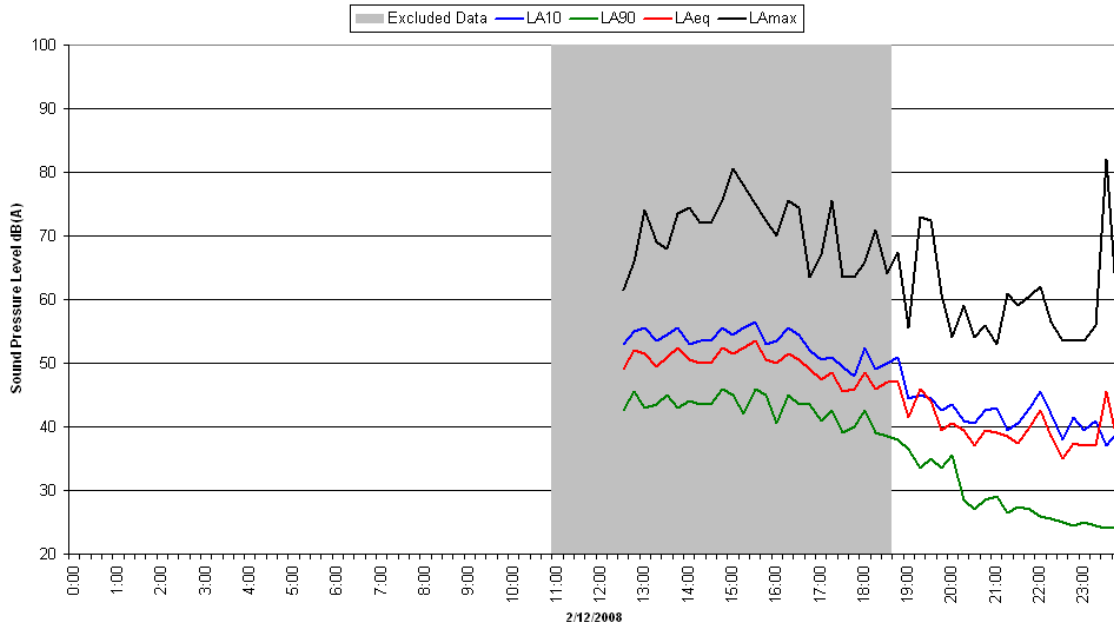
ACTEW, “Murrumbidgee to Googong Pipeline Traffic Impact Assessment” undertaken by GHD, December 2008.

Austrroads, “AP-R277 05 Modelling, Measuring and Mitigating Road Traffic Noise”, 2005.

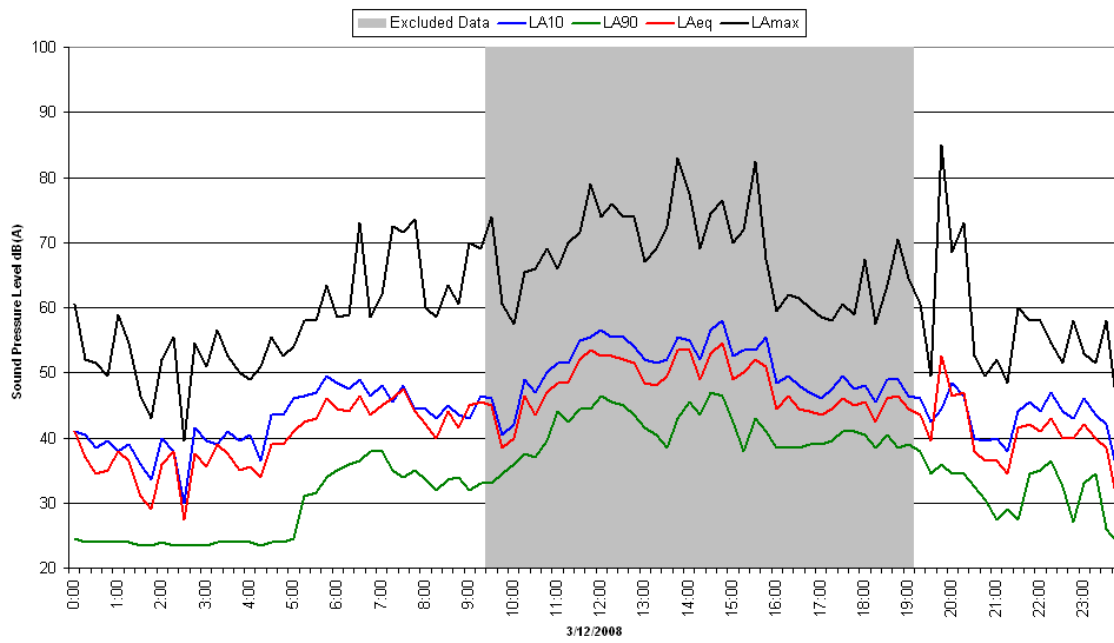
Engineering Noise Control – Theory and Practice, Bies and Hansen.

Appendix A Noise Monitoring Charts

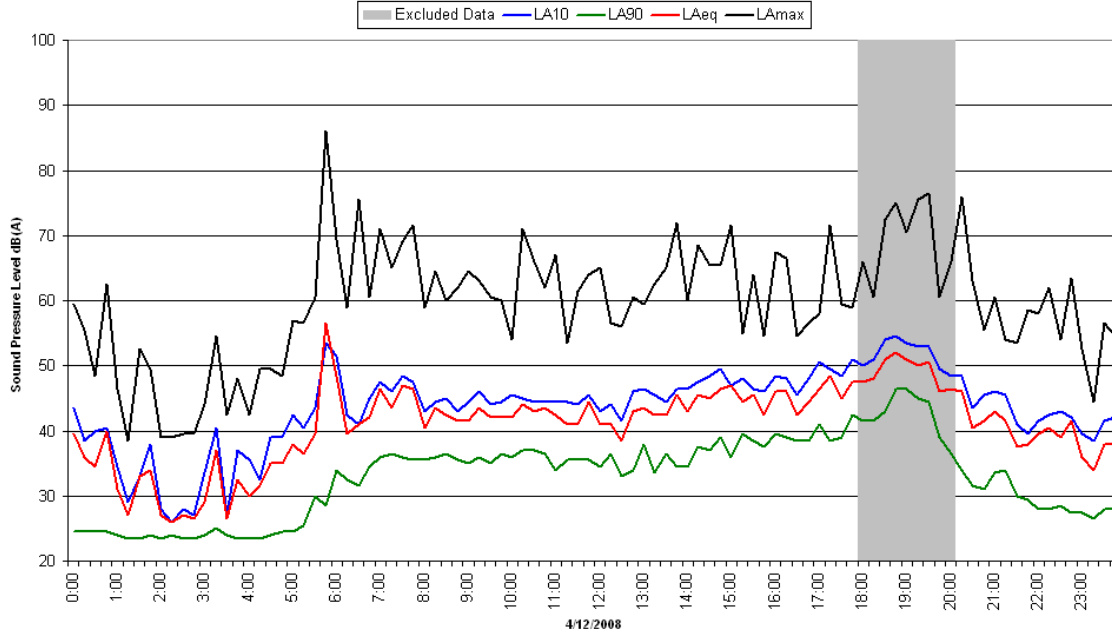
Noise Monitoring Location 1 - 7845 Monaro Highway



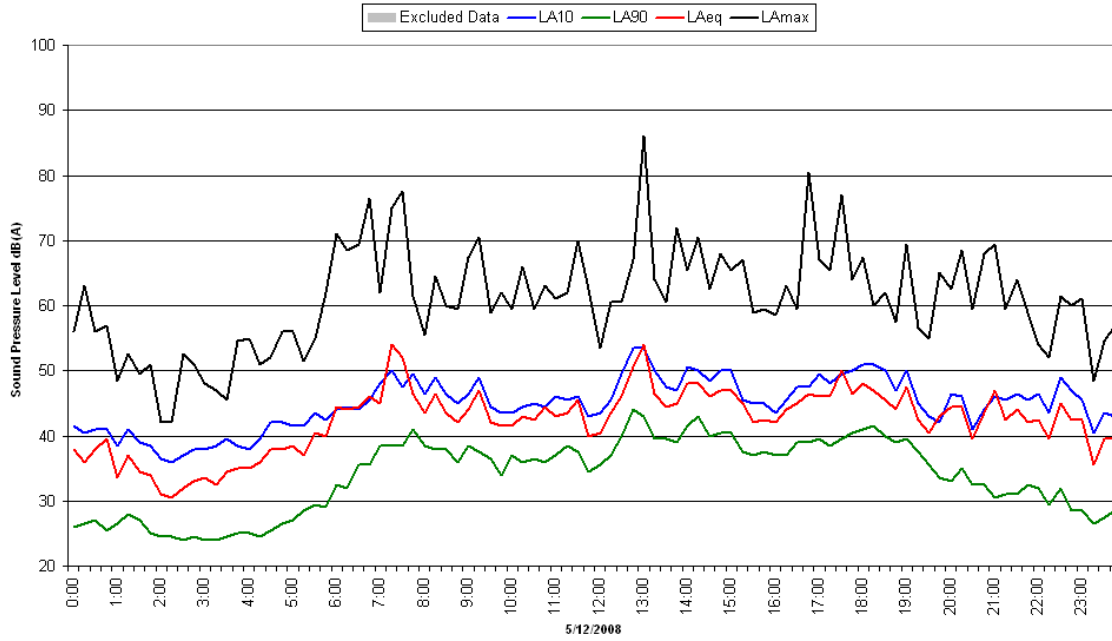
Noise Monitoring Location 1 - 7845 Monaro Highway



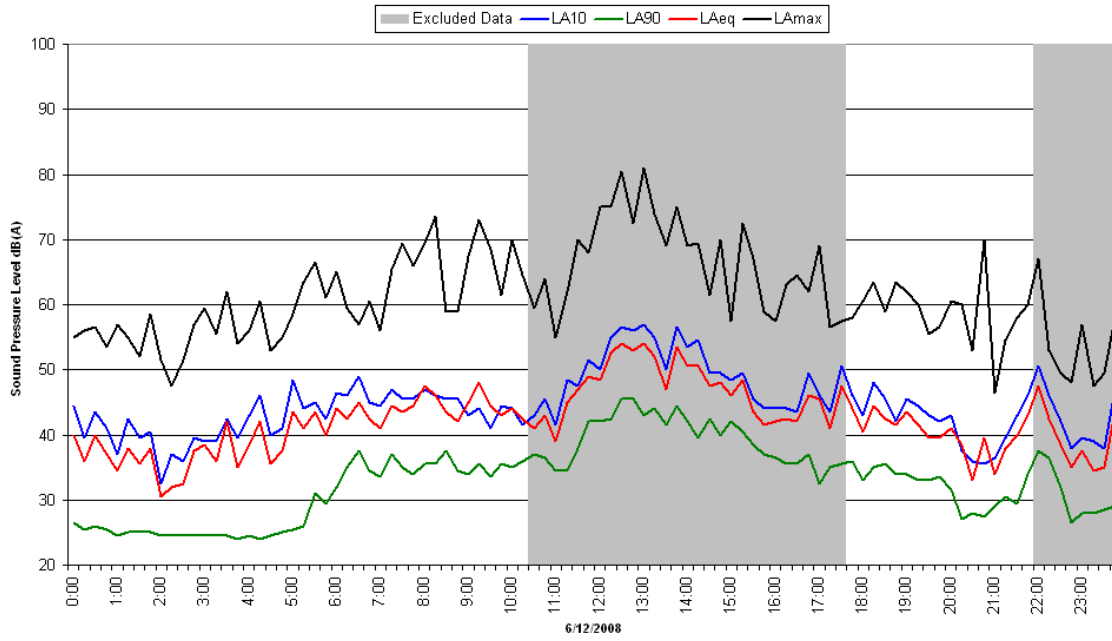
Noise Monitoring Location 1 - 7845 Monaro Highway



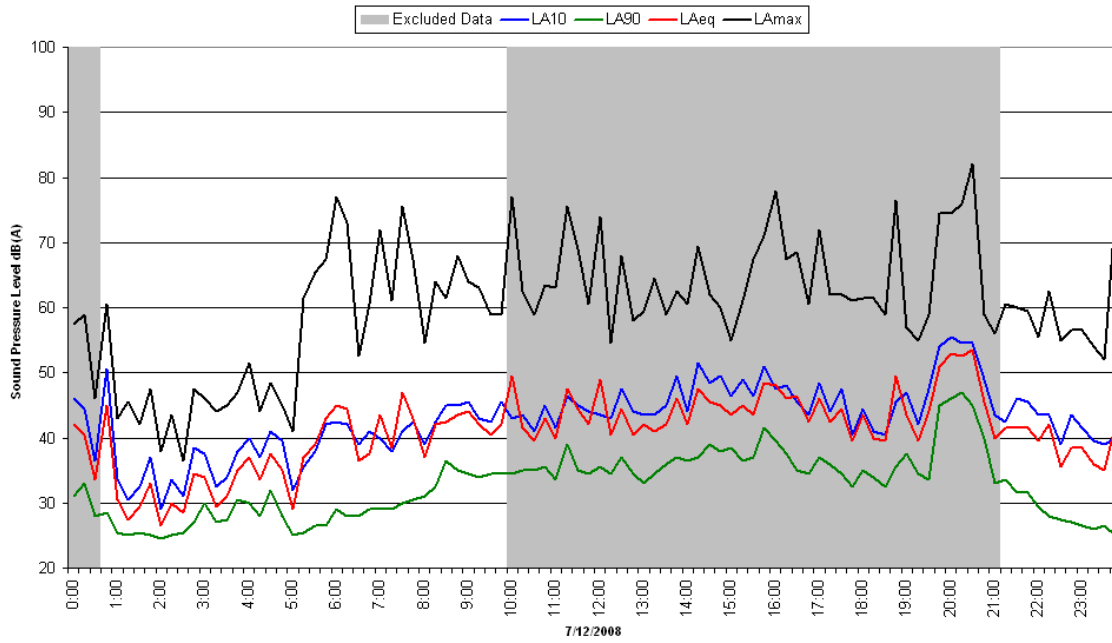
Noise Monitoring Location 1 - 7845 Monaro Highway



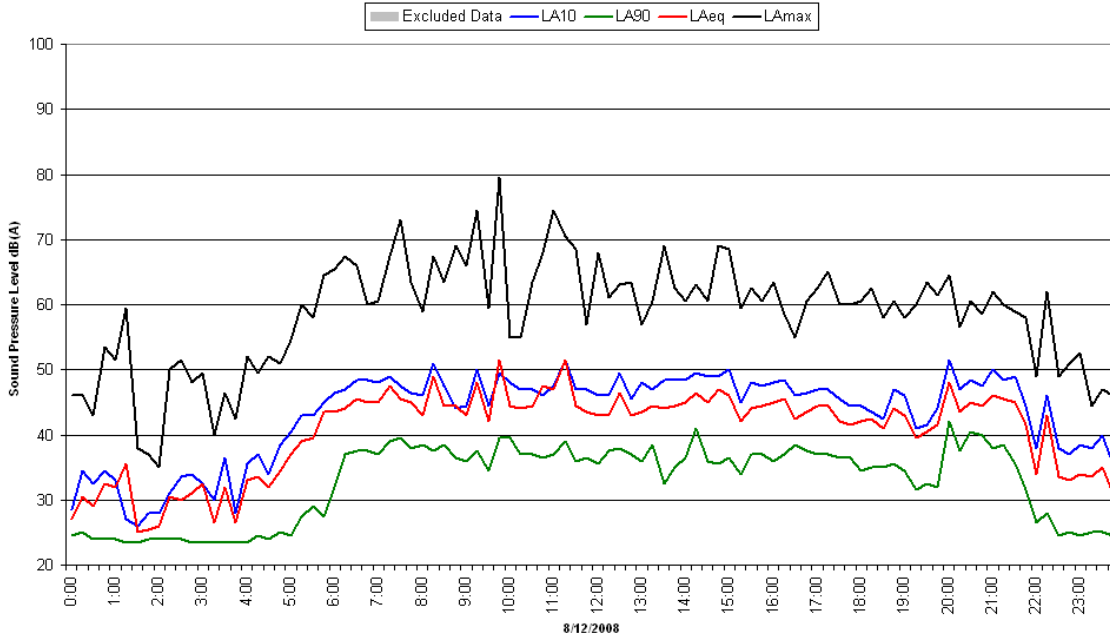
Noise Monitoring Location 1 - 7845 Monaro Highway



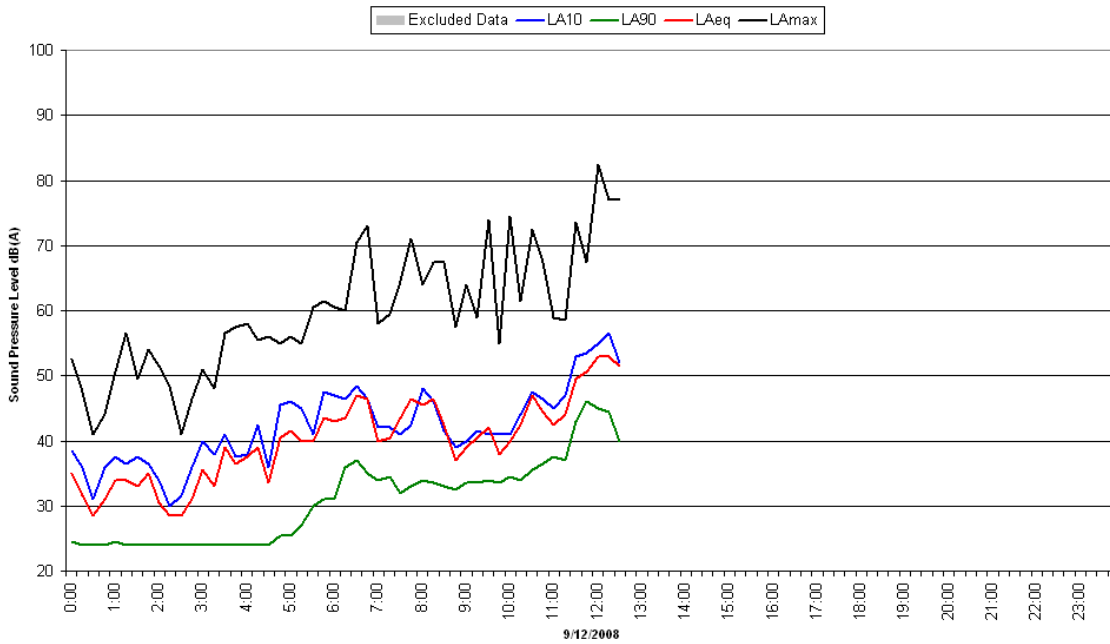
Noise Monitoring Location 1 - 7845 Monaro Highway



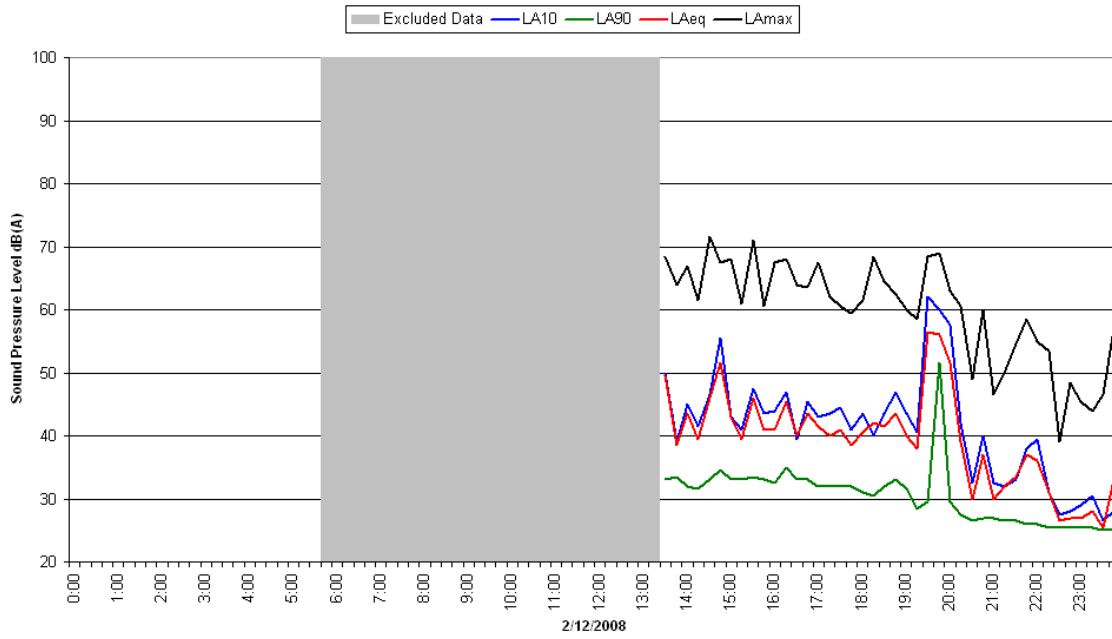
Noise Monitoring Location 1 - 7845 Monaro Highway



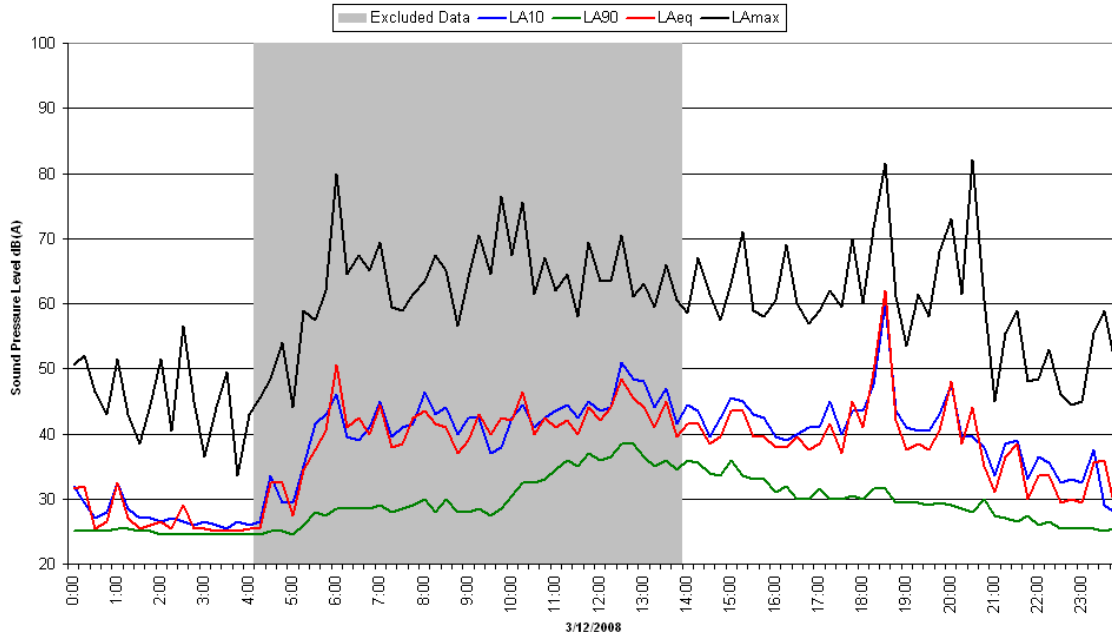
Noise Monitoring Location 1 - 7845 Monaro Highway

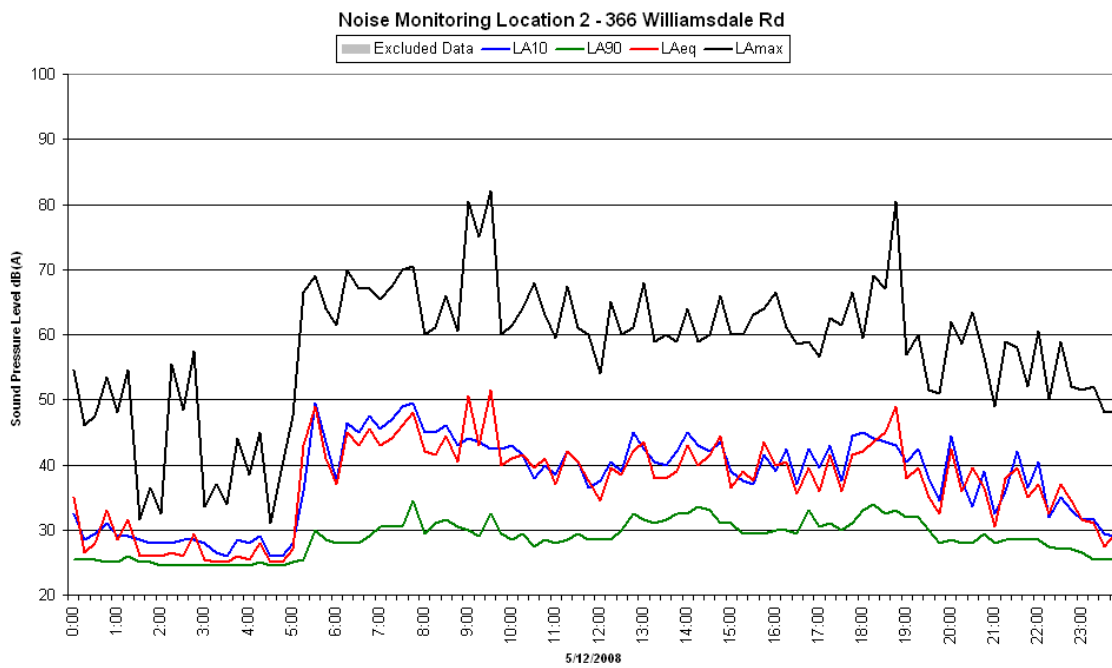
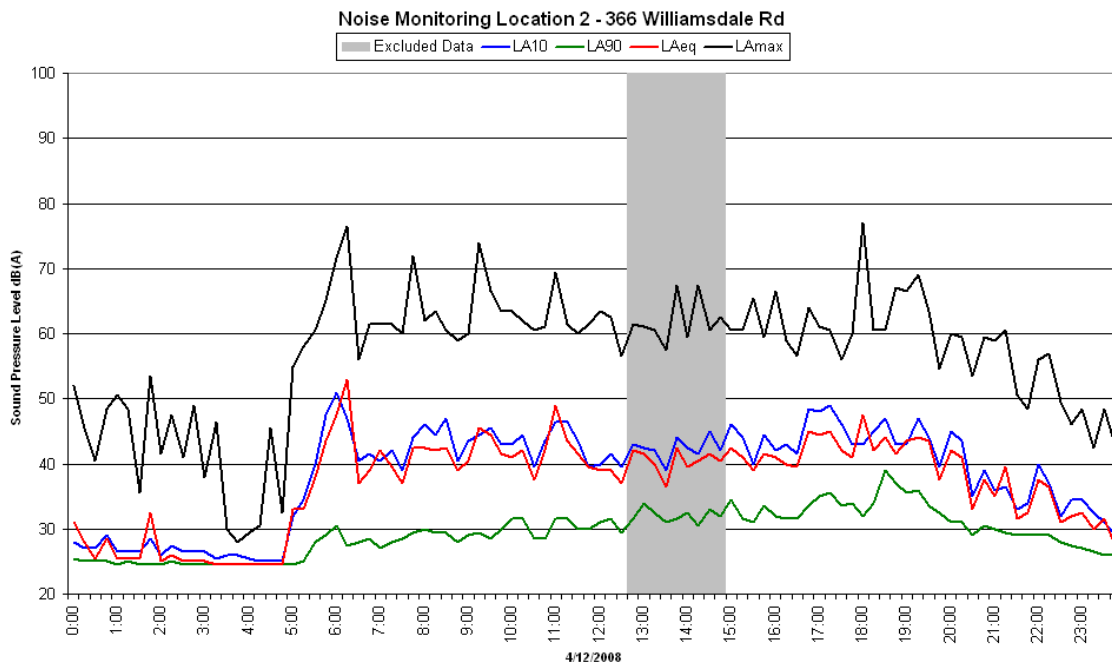


Noise Monitoring Location 2 - 366 Williamsdale Rd

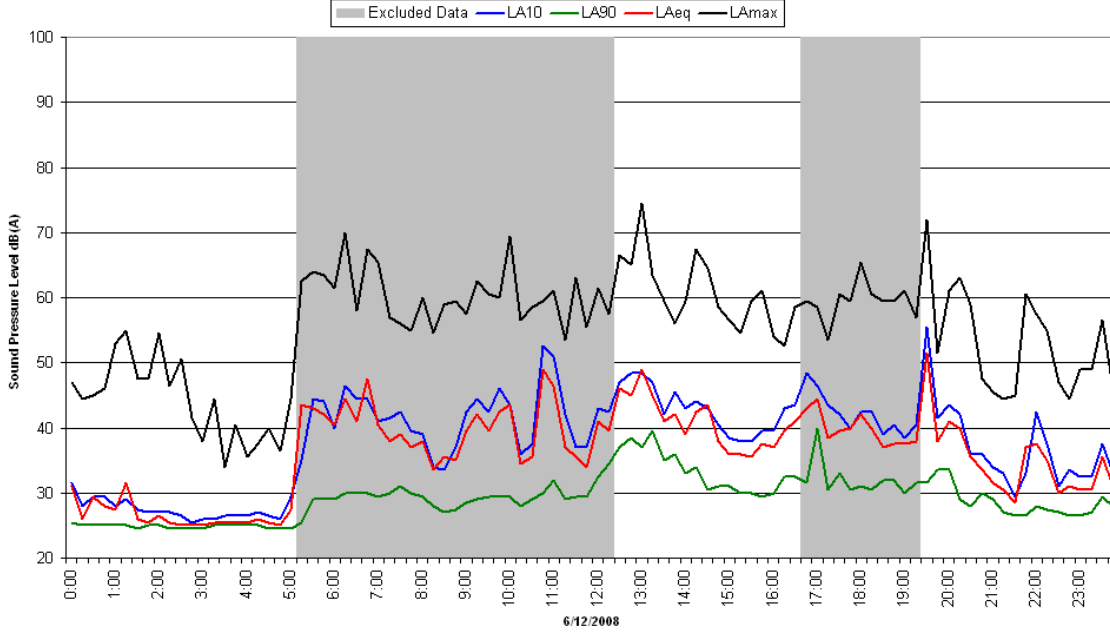


Noise Monitoring Location 2 - 366 Williamsdale Rd

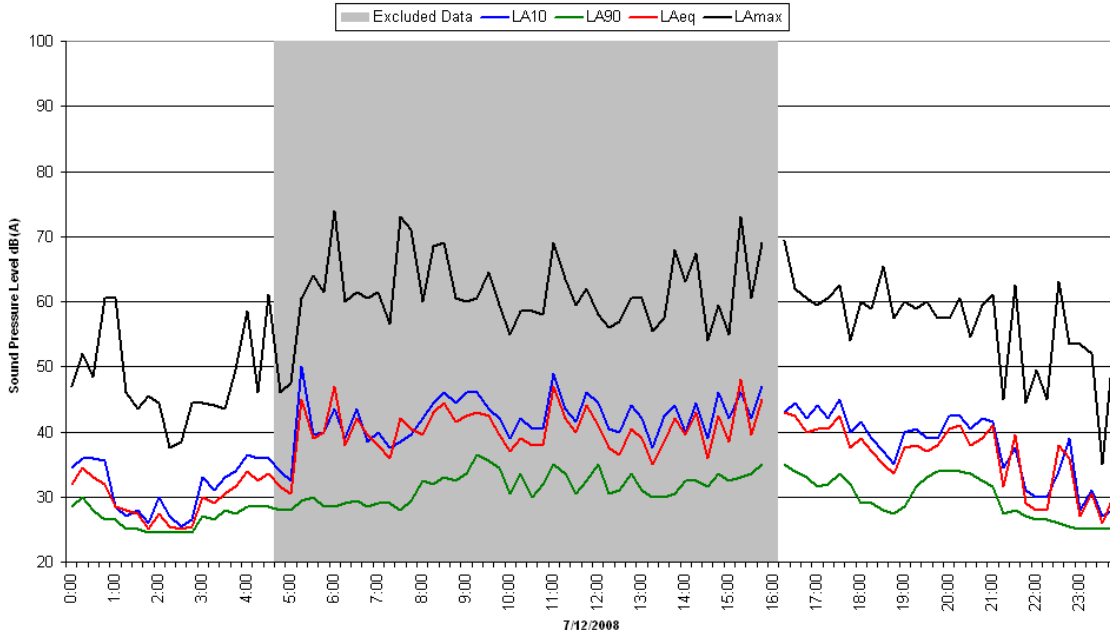


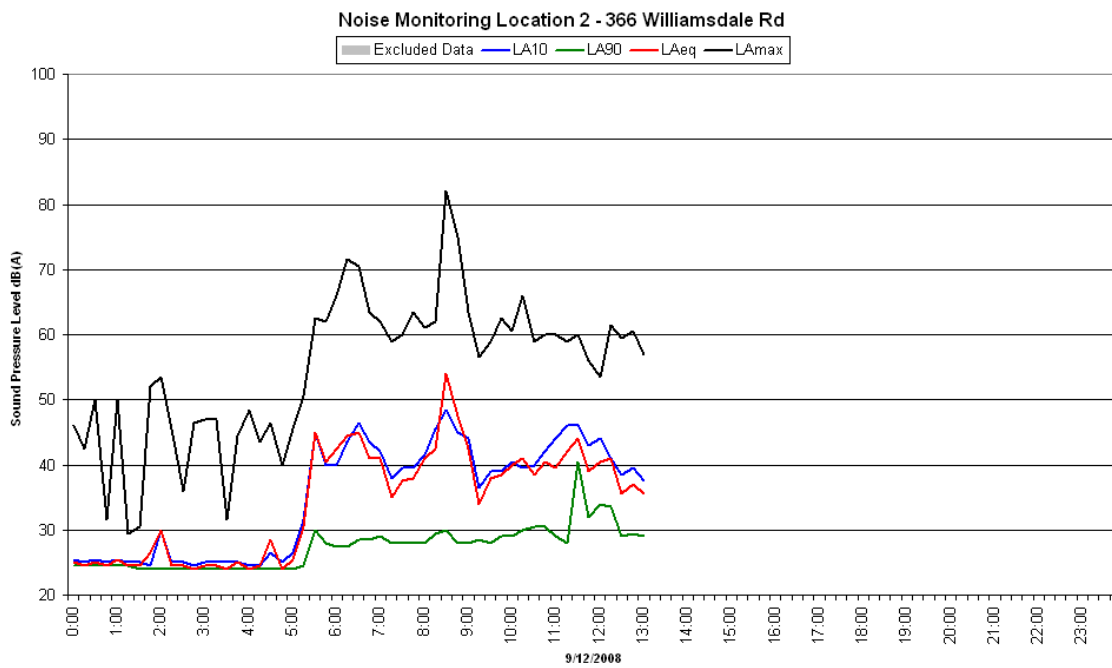
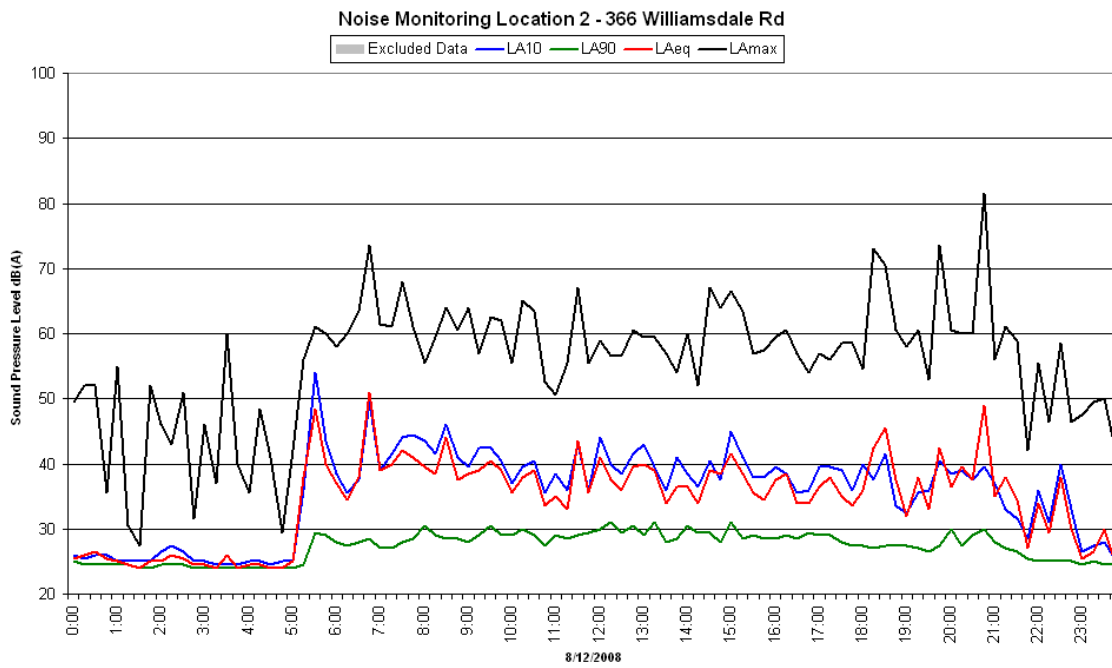


Noise Monitoring Location 2 - 366 Williamsdale Rd

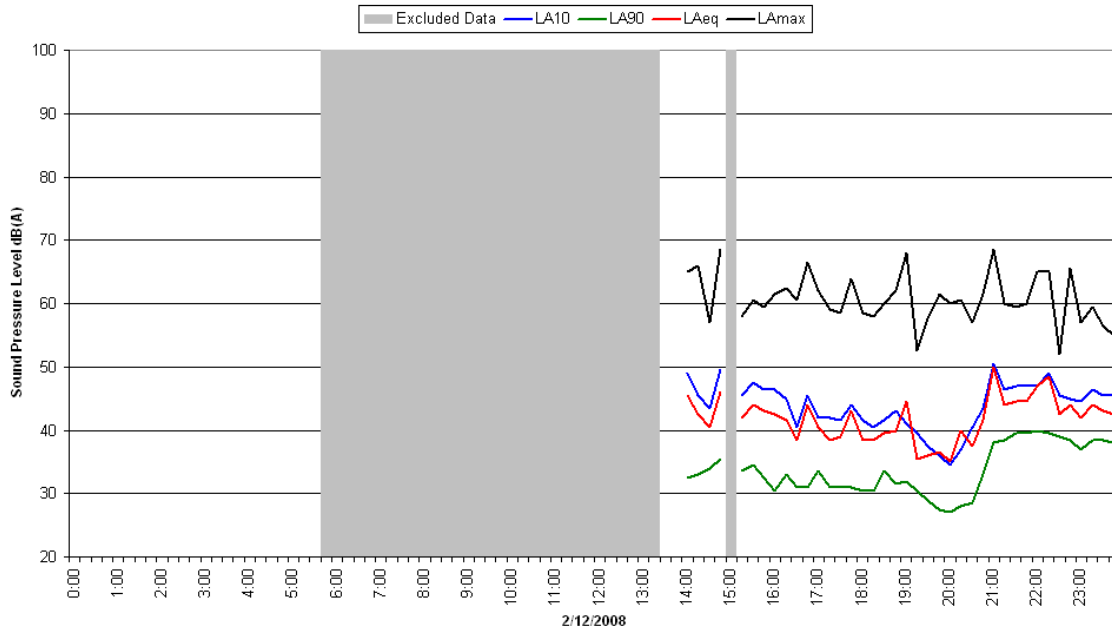


Noise Monitoring Location 2 - 366 Williamsdale Rd

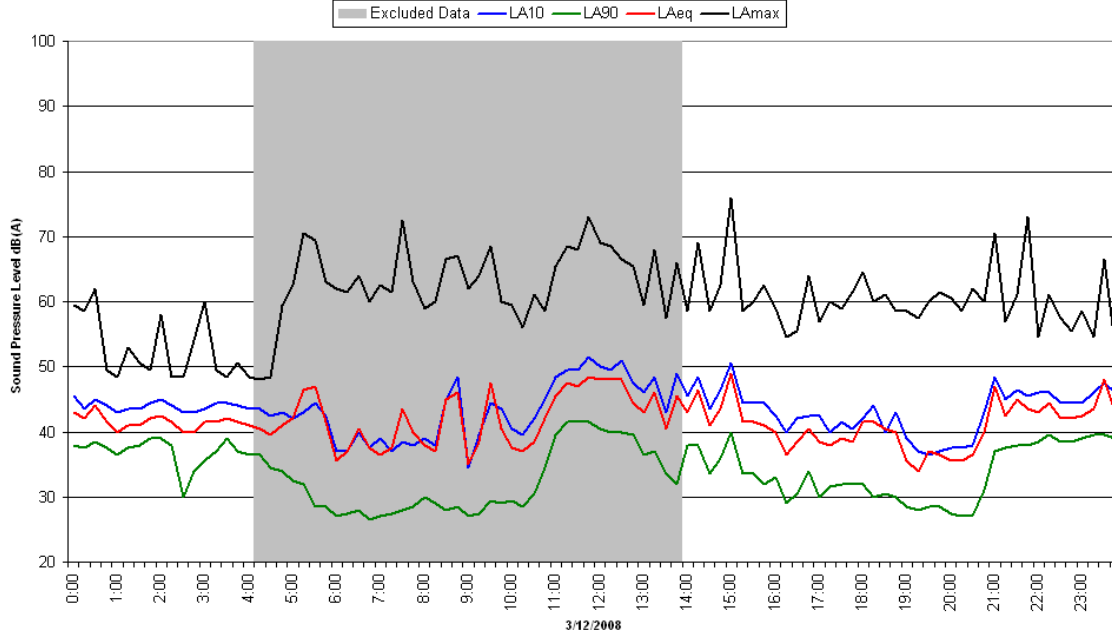


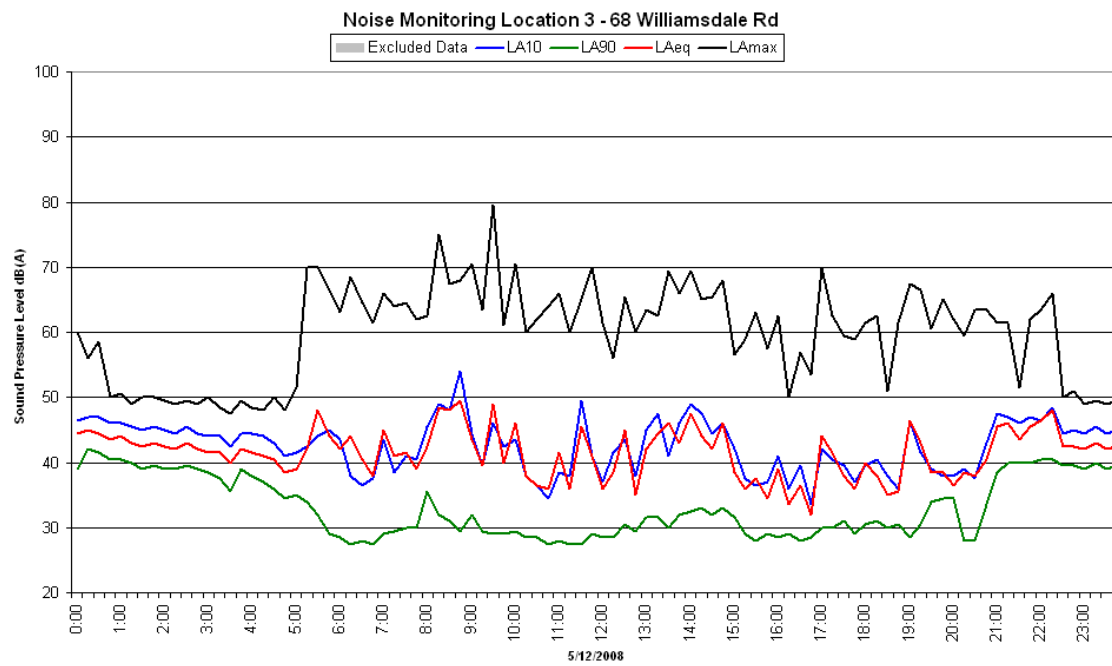
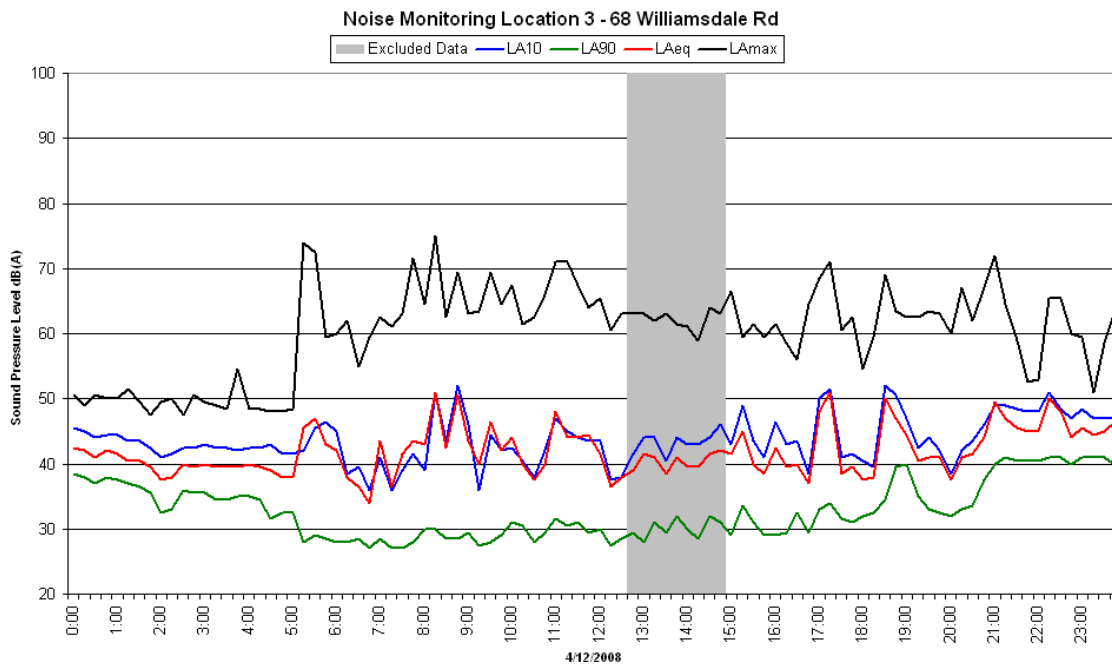


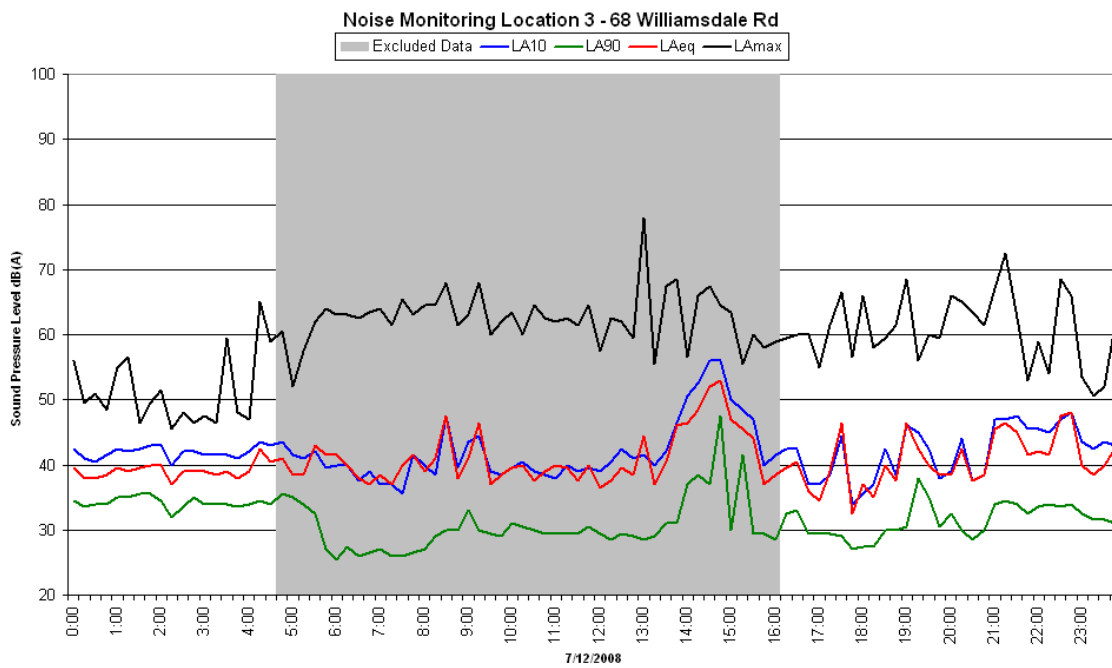
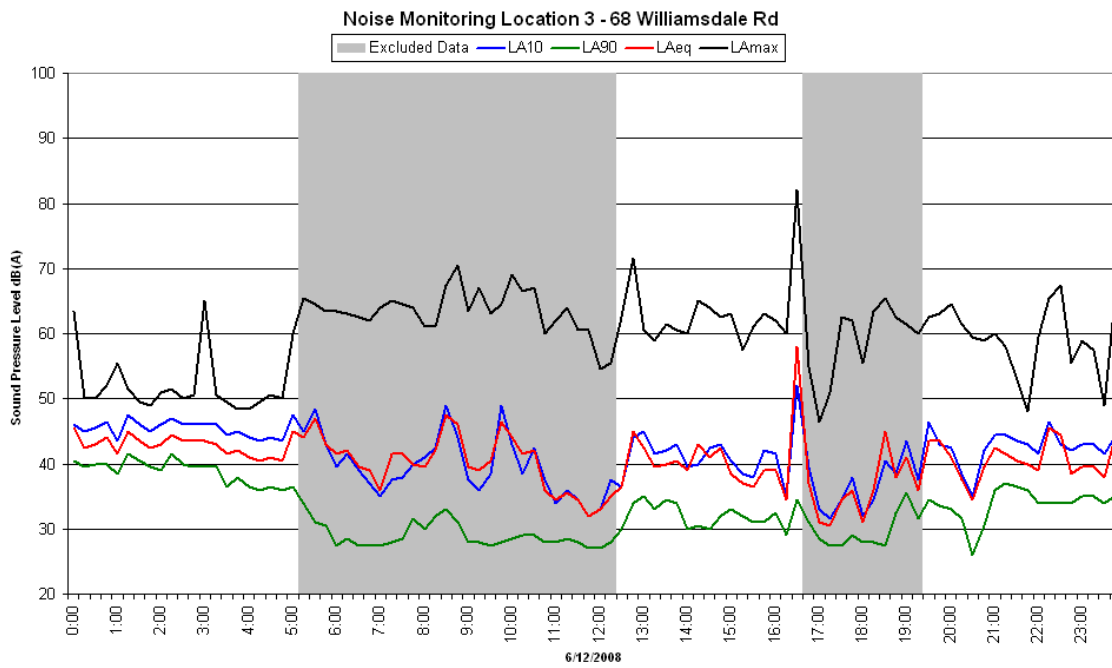
Noise Monitoring Location 3 - 68 Williamsdale Rd

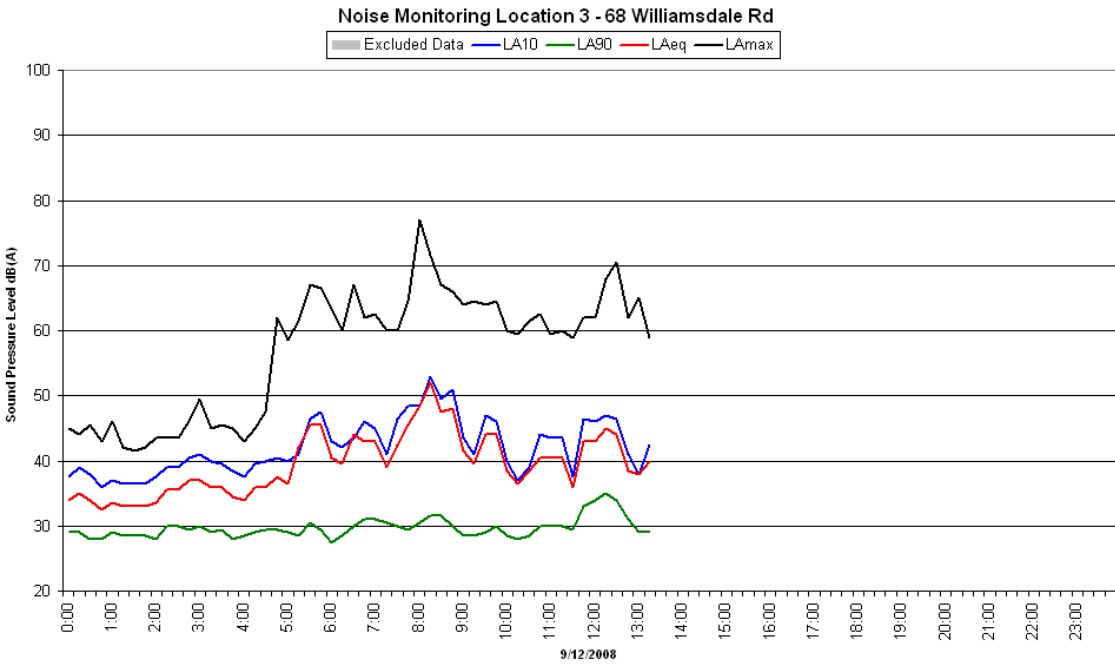
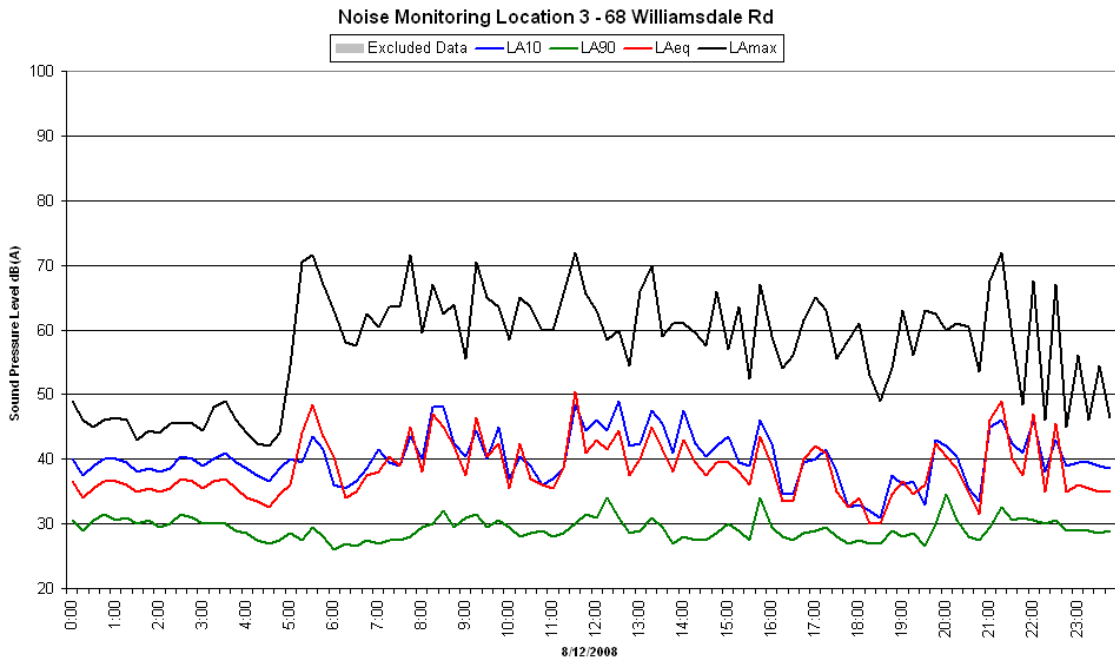


Noise Monitoring Location 3 - 68 Williamsdale Rd

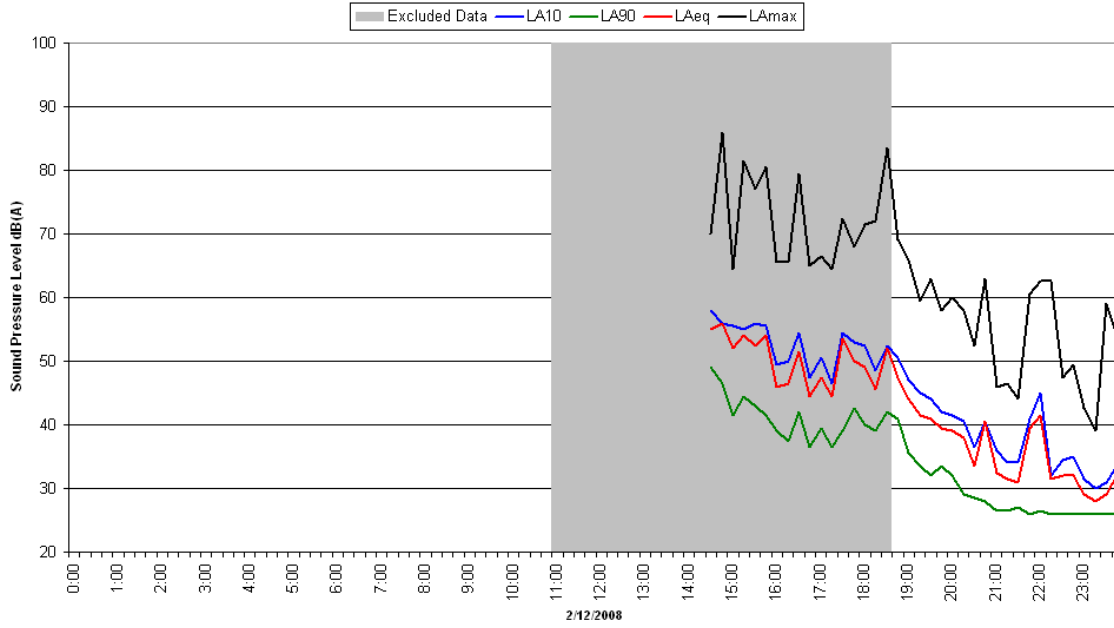




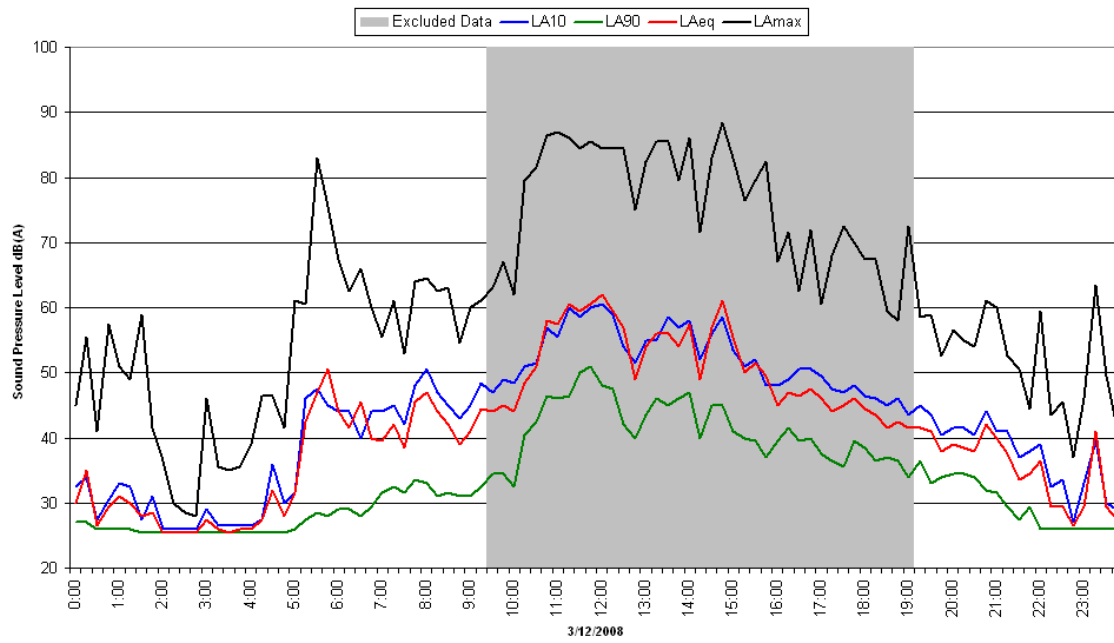


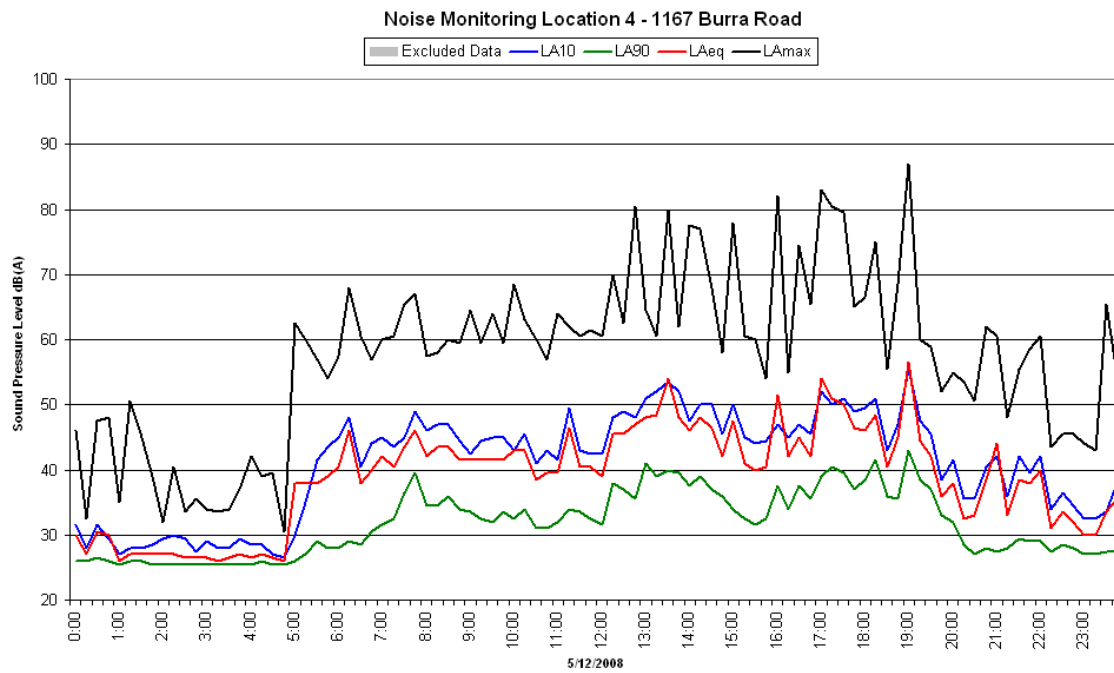
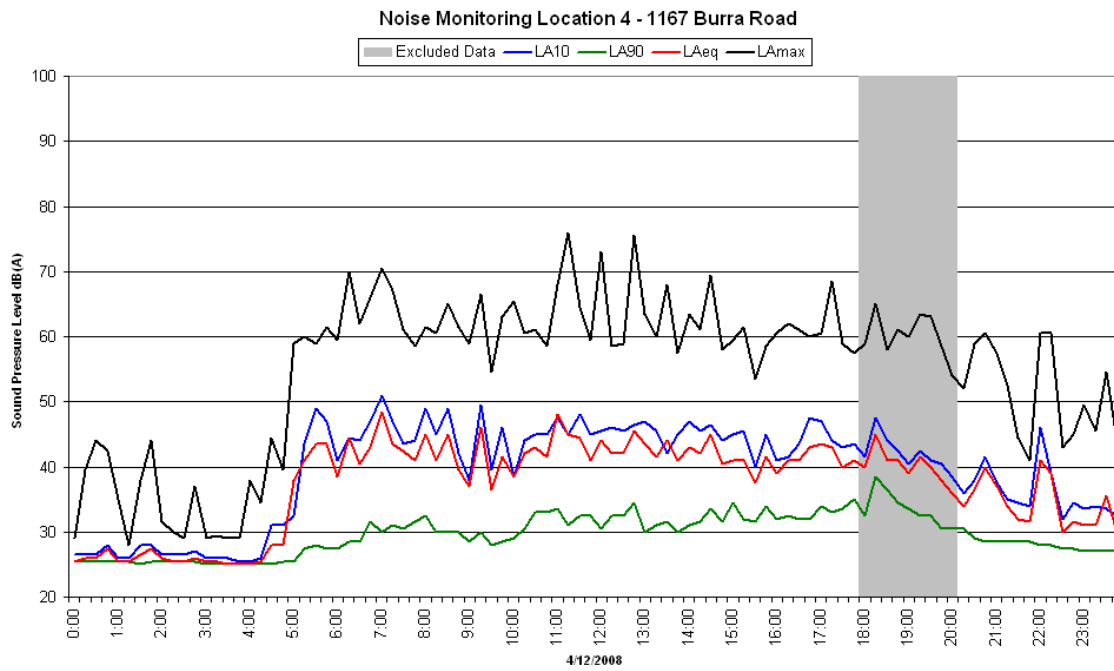


Noise Monitoring Location 4 - 1167 Burra Road

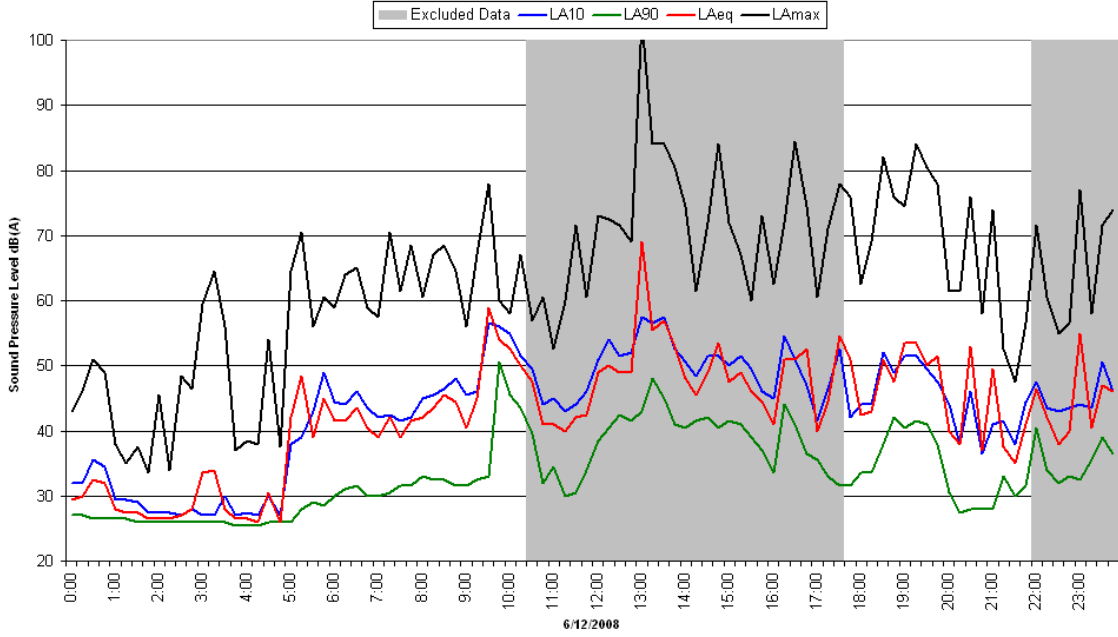


Noise Monitoring Location 4 - 1167 Burra Road

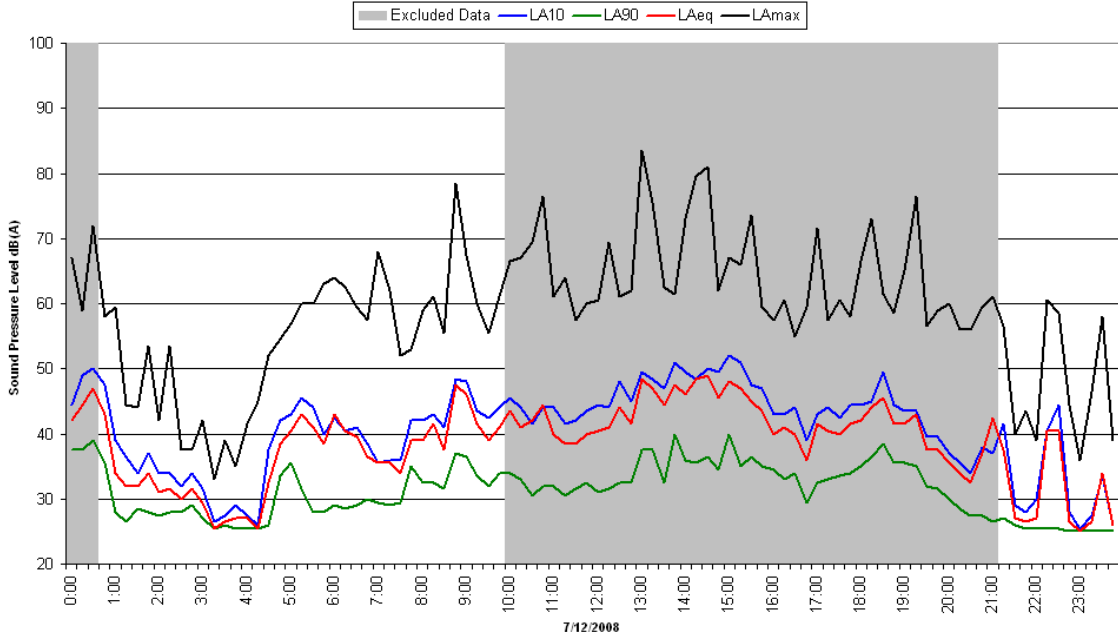


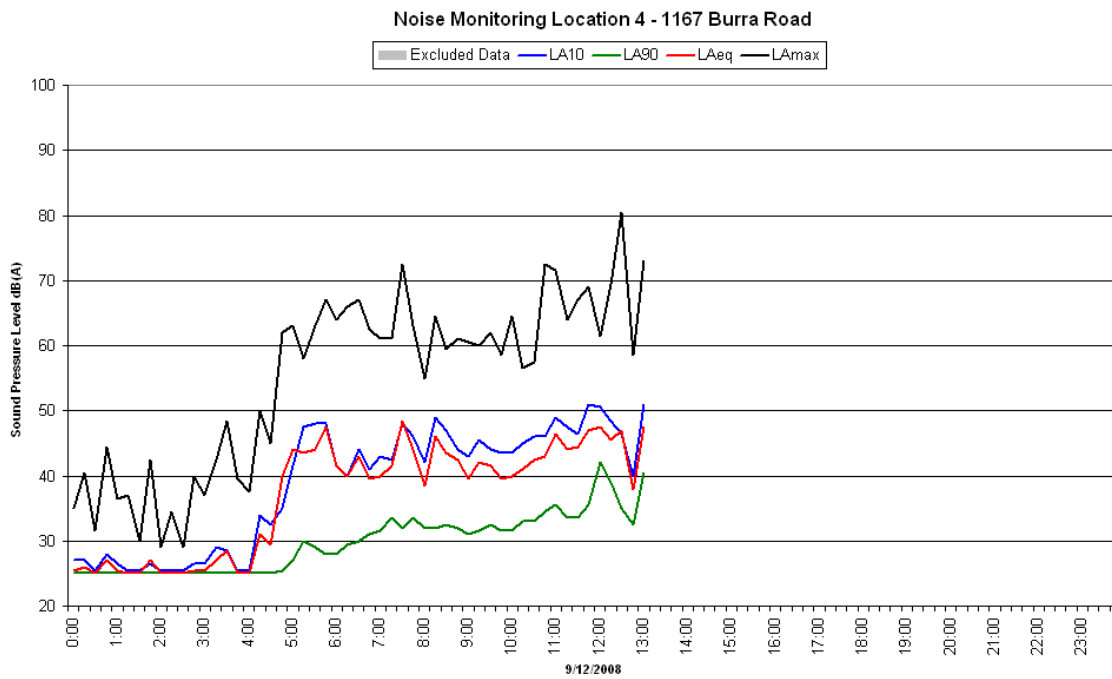
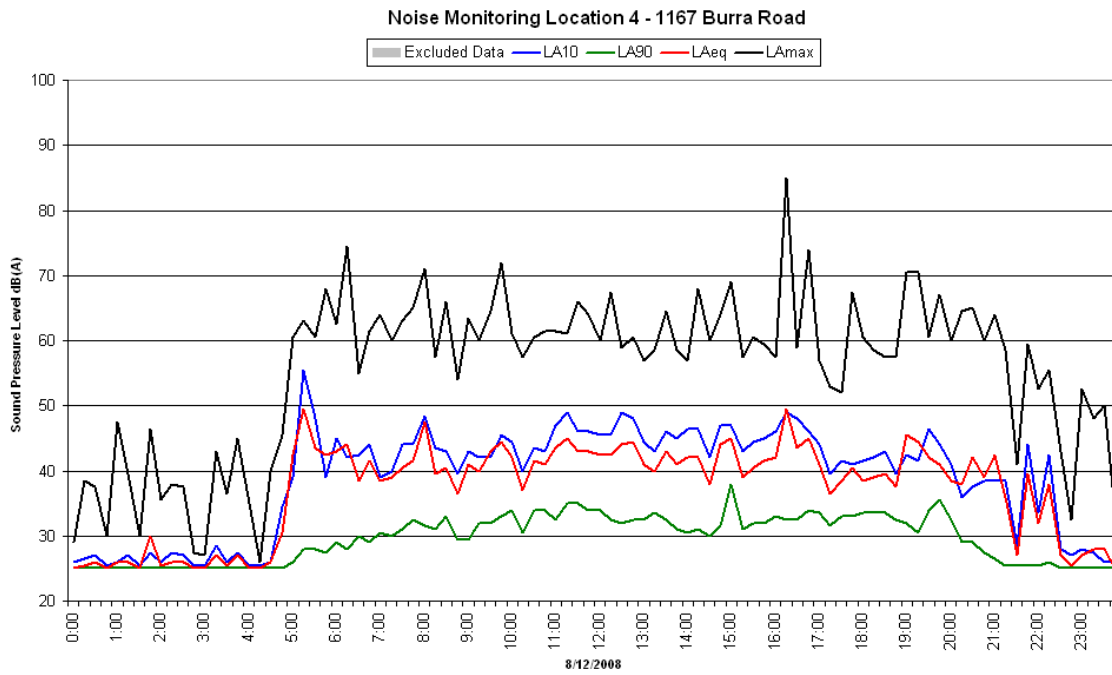


Noise Monitoring Location 4 - 1167 Burra Road



Noise Monitoring Location 4 - 1167 Burra Road





Noise and Vibration Assessment Addendum

December 2009

Contents

1	INTRODUCTION	1
1.1	Background	1
1.2	Upstream outlet overview	1
1.3	Purpose and scope of the report	2
1.4	Structure of the report	2
2	CHANGES TO PROJECT DESCRIPTION	3
2.1	Low Lift Pump Station Noise	3
2.2	High Lift Pump Station Noise	4
2.3	Discharge Structure	4
2.4	Mini-Hydro Power Facility	4
2.5	Pipeline Construction Corridor	4
3	RESPONSE TO SUBMISSIONS	5
3.1	Construction Noise and Vibration	5
3.2	Blasting	7
3.3	Air and Scour Valves	8
3.4	Mini-Hydro	11
3.5	Influence of Meteorology	11
4	RESPONSE TO ACTPLA SUBMISSIONS	12
4.1	Air and Scour Valves	12
4.2	Plant Vibration	12
4.3	Construction Noise Mitigation	12
4.4	Construction and Operation Related Traffic Noise on Williamsdale Road	12
4.5	Blasting during Pipeline Construction	13
5	REFERENCES	14
	Appendix A Discharge Structure – Noise Contours	15
	Appendix B Pipeline Construction – Noise Contours	19
	Appendix C Blasting – Approximate Buffer Distance Contour	23
	Appendix D Air Valves 8 and 9 – Noise Contours	27

1 Introduction

1.1 Background

ACTEW Corporation Limited (ACTEW) proposes to transfer water from the Murrumbidgee River through an underground pipeline to Burra Creek in New South Wales (NSW) which flows into Googong Reservoir. This proposed project is known as the Murrumbidgee to Googong Water Transfer.

In order to obtain community feedback and satisfy statutory approval requirements a series of community meetings and a period of public exhibition of the Environmental Assessment (NSW) and Draft Environmental Impact Statement (ACT) (referred to as the EA/Draft EIS) were undertaken. In response to community feedback received before and during the public exhibition period, ACTEW has modified the location at which the pipeline would discharge into Burra Creek.

This report addresses the noise impacts associated with the following:

- The proposed upstream outlet location into Burra Creek;
- The low lift pump station (LLPS) and high lift pump station (HLPS) locations;
- Identified potentially noisy air valves;
- The mini-hydro power facility; and
- The modified pipeline construction alignment within the construction corridor.

1.2 Upstream outlet overview

The project involves construction and operation of infrastructure required to transfer approximately 100 ML/day of water a distance of approximately 12 km from the Murrumbidgee River to Burra Creek which flows into Googong Reservoir. The infrastructure required to transfer the water includes an intake/low lift pump station; a high lift pump station; an underground pipeline; an outlet structure and a power supply.

The original outlet location outlined in the EA/Draft EIS proposed that the pipeline would discharge just downstream of an existing flow measuring station near Burra Road, approximately 10 km south of Googong Reservoir. The original outlet structure was located east of Burra Road within land known as the Googong Foreshores, which is Commonwealth owned land within NSW.

The modified outlet location is 3.2 km upstream from that previously proposed in the EA/Draft EIS. The new outlet location is located in the vicinity of the low level crossing on Williamsdale Road, near the junction of Burra and Williamsdale Roads.

The transferred water would discharge through a concrete structure located on the banks of Burra Creek. The outlet structure has been modified to suit this alternative Burra Creek location where the channel is only approximately 1 m deep. It would be a concrete topped structure stretching approximately 12 m along the creek bank with a 250 mm grated opening.

A mini-hydro power facility would be located close to the Burra Creek discharge location, but above flood level. The mini-hydro power facility would largely be housed underground and would recover almost 20% of the total electricity used for pumping water.

The upstream outlet proposed by the community submissions would reduce a number of adverse environmental and social impacts of the original project including:

- Project footprint reduced as follows:
 - Pipe length reduced by one km;
 - One less pipeline creek crossing;

- Five landholders no longer affected by easement requirements;
- An estimated 10 landholders no longer indirectly impacted by construction works;
- An estimated five air valves, four scour valves and associated potential impacts reduced;
- Four less road crossings;
- Less disruption to flora and fauna (habitats within this area are mostly highly disturbed but includes a small area of box-gum grassy woodland close to the original proposed outlet site);
- Outlet location not on Commonwealth land;
- Greenhouse gas emissions would be reduced by at least 3% during construction.

Additional targeted consultations are also underway with major stakeholders and those landholders located near the new outlet location or abutting the additional length of creek that would be affected by increased flows.

1.3 Purpose and scope of the report

The purpose of this study is to discuss:

- The low lift pump station and high lift pump station locations;
- The new upstream outlet structure location;
- The mini-hydro power facility;
- Identified potentially noisy air valves;
- Modified pipeline construction alignment within the construction corridor;
- Potential impacts associated with the changes; and
- Mitigation recommendations.

1.4 Structure of the report

This report will address:

- The impact of the changes mentioned above; and
- Submissions received as a result of the public exhibition period.

This report should be read in conjunction with “Murrumbidgee River to Googong Dam Water Transfer Pipeline: Noise and Vibration Assessment” (BWA, July 2009).

2 Changes to Project Description

2.1 Low Lift Pump Station Noise

Original noise modelling was based on 300 kW submersible pumps with airtight steel grate cover (well sealed and degraded seals scenarios).

The pump station design is basically unchanged but that the location of the pump station has been moved approximately 10 metres north. This relocation moves the low lift pump station further away from the Angle Crossing Beach, which will result in a decrease in predicted noise levels at this location. Angle Crossing Beach had the highest predicted noise levels of all the receiver locations modelled, including the nearest ACT and NSW residential premises.

Operational noise levels of the low lift pump station are expected to still comply with noise criteria at the surrounding residence as the predicted noise levels for the worst-case scenario were below the ACT and NSW noise criteria of 35 dB(A)¹. Day-time and night-time noise standards at the north end of Angle Crossing Beach would also be met.

2.1.1 Affected Occupiers

In the assessment, Angle Crossing Beach was classified as the nearest affected occupier with consideration to Section 5.2 of the Environment Protection Policy (Noise) – 1998 which states the following:

An affected occupier is the occupier of land which is being subjected to noise which exceeds the zone noise standard applying to that land. To be an affected occupier, a person must:

- in the case of leased or privately owned land, be the legal occupier of that land and the noise must originate from an activity being undertaken outside that land; or
- in the case of unleased or public land (excluding roads, footpaths and cycleways), be legally present on that land. The noise may originate from an activity being undertaken on or outside that land.

This definition of affected occupier excludes people who are in a position to control the activity causing the noise or who have other means available to them to address the problem. The following are not affected occupiers:

- The occupier of a parcel of land who is affected by noise from an activity being undertaken on that parcel of land (because the occupier is in a position to control the activity).
- The occupier of a sole-occupancy unit in a multi-unit complex, such as a person living in an apartment block, who is affected by noise from common areas of the complex (because that person is, through the body corporate, in a position to control the activity). (Such people are, however, considered to be affected by noise from activities being undertaken in another unit in the complex).
- Any person who is, on private land but is not the legal occupier. Examples include:
 - - customers on commercial premises, as they can ask the proprietor (who is the legal occupier) to take action or they can take their custom elsewhere; and
 - - employees, who are protected by the provisions of the Occupational Health & Safety Act 1989.
- Any person on a road, footpath or cycleway, as they are in transit or can readily move elsewhere.

In the context of the above, potential receivers walking past the LLPS on a footpath for example are not considered affected occupiers since they are in transit and can readily move elsewhere.

¹ "Murrumbidgee River to Googong Dam Water Transfer Pipeline: Noise and Vibration Assessment" (BWA, July 2009) – NSW Industrial Noise Policy and ACT Environment Protection Regulation 2005 – Part 3: Noise.

2.2 High Lift Pump Station Noise

The pump station design is basically unchanged but the location of the pump station has been moved approximately 5 metres west.

Given the distance to the nearest sensitive receiver is approximately 300 m away, a change by only 5 m will not affect the received noise level. Operational noise levels of the high lift pump station are expected to still comply with noise criteria at the surrounding residence as the predicted noise levels for the worst-case scenario were below the ACT and NSW noise criteria of 35 dB(A). Day-time and night-time noise standards at the Angle Crossing Beach would also be met.

2.3 Discharge Structure

The revised location of the discharge structure reduces the number of receivers potentially affected by the discharge structure in terms of construction and operation noise.

Based on the revised location of the discharge structure, preliminary model results indicate the predicted received noise level due to operation of the discharge structure at the nearest affected receiver is expected to be approximately 28 dB(A), which is below the NSW noise criteria of 35 dB(A).

Revised construction and operation noise level contours are provided in Appendix A.

2.4 Mini-Hydro Power Facility

The noise emission level of the proposed 1.2 MW mini-hydro generator is still not known, therefore, cannot be quantitatively assessed. The noise level from the generator would be designed not to exceed the allowable NSW Industrial Noise Policy (INP) Project Specific operational noise criteria which is 35 dB(A) during all time periods. As stated in the INP, *this is to be assessed at the most-affected point on or within the residential property boundary— or, if that is more than 30 m from the residence, at the most-affected point within 30 m of the residence.*

If this level is found to be exceeded during the detailed design stage, appropriate acoustic treatments would be incorporated into the design.

The program and equipment associated with the construction of the mini-hydro plant is expected to be similar to that used for the other construction activities and as such, likely to have similar construction impacts. Ongoing consultation with affected landholders during the construction phase of the Project will help to mitigate against potential noise impacts. The impact of the construction activities would be minimised through the implementation of the noise and vibration mitigation measures provided in Section 6 of the Noise and Vibration Impact Assessment report (BWA, July 2009).

2.5 Pipeline Construction Corridor

Due to a previous change in the pipeline alignment in the vicinity of the Monaro Highway to avoid significant vegetation, the revised pipeline alignment would bring the pipeline approximately 280 metres closer to the receiver located approximately 2300 metres east of Angle Crossing. However, the subject receiver will still remain outside the highly noise affected criteria.

Due to the change in the location of the outlet structure, a pipeline realignment was required and as such the noise levels associated with the construction corridor have changed.

This revised route would also take the pipeline 280 metres away from receivers at Williamsdale, thereby reducing the noise impacts at these receivers to well below the highly noise affected criteria.

Revised pipeline construction noise level contours are provided in Appendix B.

Construction noise and vibration mitigation measures are provided in Section 6 of the Noise and Vibration Impact Assessment report (BWA, July 2009).

3 Response to Submissions

A number of issues have been raised during the EA/Draft EIS exhibition period. Further clarification is provided in the following sub-sections on issues related to the noise and vibration impact assessment submission, namely:

- Noise impact associated with the pipeline construction;
- Noise impact from blasting during pipeline construction;
- Noise impacts associated with the operation of the pipeline air and scour valves;
- Noise impacts associated with the relocation of mini-hydro plant; and
- Influence of local meteorological conditions on predicted noise impact.

3.1 Construction Noise and Vibration

A report on assessment of construction noise and vibration impacts was included as part of the draft EIS (BWA, July 2009). It is understood that the DECCW supports this noise and vibration assessment report and advises that it should make up part of a Construction Noise Management Plan for the Project.

The BWA is committed to the application of a pro-active Construction Noise Management Plan for potential sources of noise and vibration in order to minimise impacts. This would be achieved by the application of specific mitigation measures and noise monitoring, coupled with a community consultation strategy and noise complaint handling procedure as described below.

Noise Mitigation Measures

In practice, practical and reasonable measures would be implemented to minimise the noise and vibration impacts of construction activities on local sensitive receivers.

AS 2436-1981 “*Guide to Noise Control on Construction, Maintenance and Demolition Sites*” sets out numerous practical recommendations to assist in mitigating construction noise emissions. Examples of strategies that could be implemented on the project are listed below, including the typical noise reduction achieved, where applicable.

The construction noise and vibration mitigation measures are also provided in Section 6 of the Noise and Vibration Impact Assessment report (BWA, July 2009).

- Particularly important will be adherence to standard DECC and EPP[Noise] recommended hours for any blasting activities required.
- Avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers would also result in reduced noise emissions.
- 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 used for the project would indicate whether noise emissions from plant items were higher than predicted.
- In cases where construction activities are carried out in close proximity to sensitive receptors or where there is potential for adverse impact, a project specific construction noise and vibration management plan may be prepared to detail how construction noise and vibration impacts would be minimised and managed.

Construction Site Configuration / Equipment Use and Siting

- 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 should be operated in accordance with the manufacturer's instructions.

- Fixed equipment (i.e. pumps, generators, compressors) should be located as far as possible from the nearest residences.
- Material dumps should be located as far as possible from the nearest residences.
- Whenever possible, loading and unloading areas should be located as far as possible from the nearest residences.
- Equipment which is used intermittently should be shut down when not in use.
- All engine covers should be kept closed while equipment is operating.
- As far as possible, materials dropped from heights into or out of trucks should be minimised.
- Engines and exhausts are typically the dominant noise sources on mobile plant such as graders, excavators, trucks, etc. Residential grade mufflers fitted on this mobile plant would minimise noise emissions from these sources.
- Regular maintenance of all plant and machinery used for the project will assist in minimizing noise emissions.
- In particular as the chain/wheel trenchers have been identified as a dominant source during trenching contractual specifications for maximum noise emission should be considered.

Noise Barrier Control Strategies

- Temporary noise barriers may be incorporated where feasible, between the noise sources and nearby potentially affected noise sensitive receivers. Typically, 7 dBA to 15 dBA of attenuation can be achieved with a well constructed barrier.

Vibration Mitigation Strategies

- Building condition surveys would be undertaken at all potentially impacted dwellings prior to commencement of vibration generating works (such as pile-driving). These would be repeated at works completion.
- 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 metres 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.
 - Upon receipt of complaint from sensitive receivers.

Community Consultation

The community would be informed about the timing and scope of site establishment works, the following activities and procedures are proposed:

- Prior to commencement of the site establishment, the nature of the works, the areas in which the works will occur, the hours and duration of construction and details of how further information can be obtained (i.e. contact phone number, website) should be advertised in relevant local newspapers.
- Leaflets / flyers will be prepared and letterboxed to surrounding residents to describe the scope and timing of the works and to provide contact details for further information.
- The local community would be advised in advance of traffic disruptions and controls, noisy works activities e.g. piling or rock breaking, construction of temporary detours and work required outside the nominated working hours prior to such works being undertaken.

Complaints

Any complaints received from Government Department Officers, interest groups or the general public would be managed in a professional manner and be recorded on the established Complaints Register. All complaints received would be referred to a nominated Community Relations and Environmental Representative who will adopt an appropriate course of action to manage and address the complainant's concerns in a timely manner.

Should complaints be received regarding the effect of noise or vibration from the construction activities, the complaint is to be investigated by the Environment Representative. The investigation should take the form of:

- Inspection of the location from which the complaint originated;
- Measurement of noise or vibration levels (as relevant);
- Comparison of the measured levels with the relevant targets;
- Identification of engineering control or management procedures to be adopted to reduce the levels at the complainant location;
- Monitoring after implementation of the control or procedure to establish the level of reduction obtained; and
- Details of the complaint, including the date received, complainant and address and nature of complaint, are to be recorded in a complaints log and the investigation taken and results obtained should also be recorded.

3.2 Blasting

Construction blasting impacts were assessed as part of the draft EIS Noise and Vibration Assessment report (BWA, July 2009) – refer to Section 5.5.

As outlined in that report, there is the potential for blasting to be required for excavations of the low lift pump station, high lift pump station, sections of the pipeline and discharge structure. Blasting will be used in areas where hydraulic excavators with hammer attachments are ineffective due to large formations of hard rock. Areas of rock that potentially require blasting have been identified at the following pipeline chainages and areas:

- CH387 – CH950;
- CH1892 – CH1985;
- CH6850 – CH6921;
- CH12713 – CH13013; and
- Low lift pump station for construction of the base.

The assessment of blasting noise and vibration impacts (refer to Section 5.5) revealed that there are up to 22 residents within 800 m of the potential blast locations, where there is the potential to exceed the ANZECC blasting criteria. The approximate 800-metre buffer distance surrounding the pipeline is shown in Appendix C. It should be noted that the buffer distance is based on assumptions regarding charge mass and as such are indicative only. Therefore, once the exact location of blasting and the blasting details are known, the distance to the receiver should be used for the charge mass estimate. Blast monitoring should be undertaken to assess compliance, determine the site constants and confirm the predictions.

The report recommended that all residential receivers be informed when blasting is to be undertaken. Reducing charge mass and increasing distance is the most effective way of reducing blasting impacts. The most likely impact of blasting is airblast overpressure. Methods to reduce the impact of airblast overpressure are detailed in Section 6.3 of the Noise and Vibration Assessment report (BWA, 2009), though the blast contractor would determine their effectiveness and practicability.

Blasting Mitigation Measures

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

- 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.
- Use minimum practicable sub-drilling which gives satisfactory toe conditions.
- Investigate alternative rockbreaking 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 prior to commencement of vibration generating works (such as blasting). These would be repeated at works completion.

3.3 Air and Scour Valves

3.3.1 Background

Scour valves will be located on each of the low points of the pipeline and are used if there is ever a need to repair the pipeline or perform maintenance work. If needed, they enable crews to drain water from the pipeline before work is undertaken. There will not be any significant levels of noise associated with the operation of these scour valves.

Air valves automatically release air which can accumulate in water transfer pipelines. This is for efficient operation of the pipeline and to minimise damage to the pipes in the event of an emergency shutdown of the pumps. The air valves will sit approximately 600 mm above ground, enclosed in a circular concrete pit, with an open steel grate on top.

Under normal operation of the pipeline, these air valves will not be required to function, hence, there will not be audible noise generated by the air valves. However, the air valves would be required to operate during special maintenance operations, pipeline filling and emergency conditions, which may lead to noise being generated by air released from the valves.

The frequency of noise emissions from the air valves is considered to be low for the following reasons:

- Non-return flow valves at Angle Crossing and the mini-hydro electric generator at Burra Creek keeps the pipeline full of water so air valves rarely operate.
- Special maintenance operations on the pipeline would only be a rare event.
- Emergency shutdowns would be rare, and typically result from infrequent incidents such as a major power failure or a lightning strike.

The air release valves would only operate for a short duration, that is, less than approximately 30 seconds. Air release, and hence noise emission, would be gradual under controlled maintenance conditions but could occur suddenly under emergency conditions.

The determination of the actual air-valve noise levels is difficult because the level of noise emitted is a function essentially of the pressure and the volume that has to be released, which, for any given pipeline or section of pipeline, is different at each of the air valves where column separation is occurring. Hence, the measurement of actual air-valve noise levels associated with other existing pipelines was considered to be of limited value.

3.3.2 Air Valve Locations and Sensitive Receivers

Air-valve noise levels used in the draft EIS were calculated based on specific air-valve design parameters, in particular, air exit velocities. The design of the air valves have changed since the submission of the draft EIS and there are 3 valves that have been identified as potentially generating elevated noise due to high exit velocities. The 3 valves identified are as follows:

Table 1 Air Valves Locations and Nearest Sensitive Receivers

Valve	Chainage	Nearest Sensitive Receiver	Distance from Nearest Receiver to Valve
Valve 8	CH 2851	Lot 1653, ACT	800
Valve 9	CH 3586	Lot 8 DP 754889 (Lonergan) NSW	1700
Valve 15	CH 7272	Lot 1 DP 056284 (Blinksell) NSW	60

Based on information provided by ACTEW, Air Valves 8 and 9 which are located between the Monaro Highway and the high point at Gibraltar pass on Williamsdale Rd will probably require some attenuation treatment based on the fact that these may operate at the high noise levels several times a year – i.e. emergency shut downs from power failures or similar systems induced failures.

In the case of Air Valve 15 which is located several hundred metres along Williamsdale Road to the east of the high point, this is only expected to operate at such high noise levels in response to an equipment failure on the hydro unit. This is an unlikely event and may have a recurrence interval of not less than 20 years or not at all. This corresponds to a failure of the "wicket" gates in the hydro unit which from operational histories is most unlikely. If any valve is found to be exceeding statutory noise limits then attenuation would be provided.

On that basis it would be difficult to justify the provision of attenuation facilities on Air Valve 15.

Therefore, valves 8 and 9 been identified as potentially exhibiting high exit velocities and hence high noise levels, possibly in the order of 120 dB(A) at 1m.

3.3.3 Air Valve Operational Noise Criteria

As shown in Table 1 above, there are receivers located in both NSW and ACT. As such, the noise criteria vary between states with NSW utilising the Industrial Noise Policy (INP) and ACT utilising the Environment Protection Policy (EPP) – Noise and Environment Protection Regulations 2005 – Noise.

The INP indicates that adjustment for duration is applied where a single noise event is continuous for a period of less than two and a half hours in any 24-hour period. The acceptable noise level may be increased by the adjustment shown in the extracted Table 2. This adjustment is designed to account for unusual and one-off events, and does not apply to regular high-noise levels that occur more frequently than once per day.

Table 2 Adjustments for duration

Duration of noise (one event in any 24 hour period)	Increase in acceptable noise level at receptor, dB(A)	
	Daytime and evening (0700h – 2200h)	Night-time (2200h – 0700h)
1.0 to 2.5 hours	2	Nil
15 minutes to 1 hour	5	Nil
6 minutes to 15 minutes	7	2
1.5 minutes to 6 minutes	15	5
Less than 1.5 minutes	20	10

The table above indicates that for a single event in a 24-hr period with a duration of less than 1.5 minutes such as an air valve event, the acceptable noise level can be increased by 10 to 20 dB(A). As such, the noise criteria of 35 dB(A) becomes 45 dB(A) during night-time.

On the other side, the INP guidelines provide a mechanism in the assessment process that accounts for characteristics of noise that has the potential to result in increased annoyance. Where a noise contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low frequency content, there is evidence to suggest that it can result in greater annoyance than other noise at the same level. As such, 'modifying factors' are applied where noise sources exhibit these characteristics. Where two or more of these characteristics are present, the maximum correction is limited to 10 dB.

The ACT criteria based on the subject zoning is defined as 35 dB(A) during night-time assessed at the compliance point.

Table 3 Air Valve Noise Criteria

Valve	Nearest Sensitive Receiver	Noise Criteria dB(A)Leq(15min)
Valve 8	Lot 1653, ACT	35
Valve 9	Lot 8 DP 754889 (Lonergan) NSW	$35 + 10^1 = 45$

¹ Minimum noise criteria assessed under the INP.

Based on the estimated sound pressure level of 120 dB(A) at 1m, noise from valves 8 and 9 have been modelled to ascertain the predicted received noise levels at sensitive receivers and whether noise attenuation is required. The modelling assumes both valves operate simultaneously at this sound pressure level for 1 minute which provides a measure of conservatism.

Since the valve noise is potentially tonal, a 5 dB correction has been added to the predicted received noise levels.

The subject valves and the predicted noise contours at nearest surrounding sensitive receivers are shown in Appendix D.

The model results indicate received noise levels potentially exceed the criteria at the nearest ACT receiver (Lot 1653) by approximately 4 dB(A) and comply with the NSW criteria at all receivers.

As such, these valves would require noise attenuation to minimise the noise levels at the nearest sensitive receivers. The attenuation design may take the form of a fully enclosed concrete pit to house the valves with an underground pipe leading to another pit lined with perforated absorptive material.

It should be noted that the noise goals are based on human response and annoyance factors and, as such, are not applicable to live stock or other non-human receivers. However, it is recognised that sudden noise has the potential to startle or upset domestic livestock and pets. Heggies Pty Ltd conducted a literature review as part of their assessment of blasting noise impacts on livestock for the proposed Caval Ridge Coal Mine Project (Heggies, 2009). Heggies cites results from a study on the response of farm animals to sonic booms, which indicated that reactions of sheep, horses and cattle to sonic booms (125 dB to 136 dB) was considered slight to mild, as evidenced by temporary cessation of eating, rising heads or slight startle effects in a few of those animals being milked. It is recognised that even though the overall sound levels may be similar, the frequency content of sonic booms and air valves are different i.e. sonic booms are typically low frequency dominant whereas air valves is typically high frequency noise.

Nonetheless, where possible (i.e. prior to scheduled pipeline maintenance operations), it is recommended that community consultation or notification (e.g. letter box drop) be undertaken prior to pipeline maintenance involving air valve operation being undertaken. Landowners should be provided with details of the time and date at which the maintenance event is to be conducted, so that domestic livestock and pets can be restrained or housed appropriately.

3.4 Mini-Hydro

Refer to Section 2.4 above.

3.5 Influence of Meteorology

Acoustic modelling was undertaken using CadnaA, which is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to ISO 9613-2, "Acoustics – Attenuation of sound during propagation outdoors". Ground absorption, reflection, terrain, meteorology (temperature inversion and adverse wind) and relevant shielding objects can be taken into account in the calculations.

Noise enhancing temperature inversions coupled with a light breeze in the direction of source to receiver were taken into account for in the operational noise model as outlined in Section 4 of the Noise and Vibration Assessment report (BWA, July 2009).

4 Response to ACTPLA Submissions

Submissions from the ACTPLA have identified a number of issues. Further clarification is provided below on issues related to the noise and vibration impact assessment submission, namely:

- Noise impacts associated with the operation of the pipeline air and scour valves;
- Plant vibration transfer into the building structure of high lift pump station;
- Construction noise mitigation measures;
- Impacts of traffic noise on residents along Williamsdale Road; and
- Noise impact from blasting during pipeline construction.

4.1 Air and Scour Valves

Refer to Section 3.1 above.

4.2 Plant Vibration

Vibration in the Pump stations is addressed in Section 6.1.1 of the Noise and Vibration Assessment report (BWA, July 2009). Further clarification on the requirements for vibration isolation is provided below.

At the detailed design stage, 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 15000 rpm when measured in situ*", which provides maximum vibration velocity limits for centrifugal pumps and motors.

If vibration levels in the equipment are found to be outside the range of acceptable levels vibration isolation mitigation measures would be incorporated into the pump station design. Appropriate vibration isolation details can generally be obtained from the equipment manufacturer so that minimal vibration is transmitted to the supporting structure. In-principle, vibrating plant items should not be directly mechanically affixed to the walls of the surrounding structure.

4.3 Construction Noise Mitigation

Construction noise mitigation measures are based on the level of noise mitigation required at the most exposed sensitive receiver. The recommended noise mitigation measures are outlined in Section 6 of the Noise and Vibration Assessment report (BWA, July 2009).

4.4 Construction and Operation Related Traffic Noise on Williamsdale Road

4.4.1 Construction

Heavy vehicles will be required for the following haulage tasks:

- Construction and mechanical equipment (semi-trailers);
- Ready mixed concrete (5m³ capacity trucks);
- Reinforcement steel (semi-trailers); and
- Pipes (semi-trailers).

Other construction-related traffic includes light vehicles used by the workforce and by visitors to the site.

The closest residence to Williamsdale road is located approximately 50 m from the road. The predicted construction traffic noise at the closest residence is $L_{Aeq(1hr,peak)}$ 49 dB(A) which is below the NSW road traffic noise criteria of $L_{Aeq(1hr,peak)}$ 55 dB(A). Refer to Section 5.3 in the Noise and Vibration Assessment report (BWA, July 2009).

In general, heavy vehicles attending the site should be restricted, where possible, to between 7:00 am and 6:00 pm to minimise the risk of sleep disturbance. Early morning oversized deliveries may be required on occasion for some of the construction works and would occur outside the recommended construction hours. All drivers should be sensitised to the potential for sleep disturbance on local residents and encouraged to take practical and reasonable measures to minimise the impact during the course of their delivery activities.

4.4.2 Operation

The volume of additional traffic during the operation of the pipeline is expected to be confined to operation and maintenance staff at the pumping stations, which is expected to be minor and would have negligible traffic noise impacts.

Again, heavy vehicles attending the site should be restricted, where possible, to between 7:00 am and 6:00 pm to minimise the risk of sleep disturbance.

4.5 Blasting during Pipeline Construction

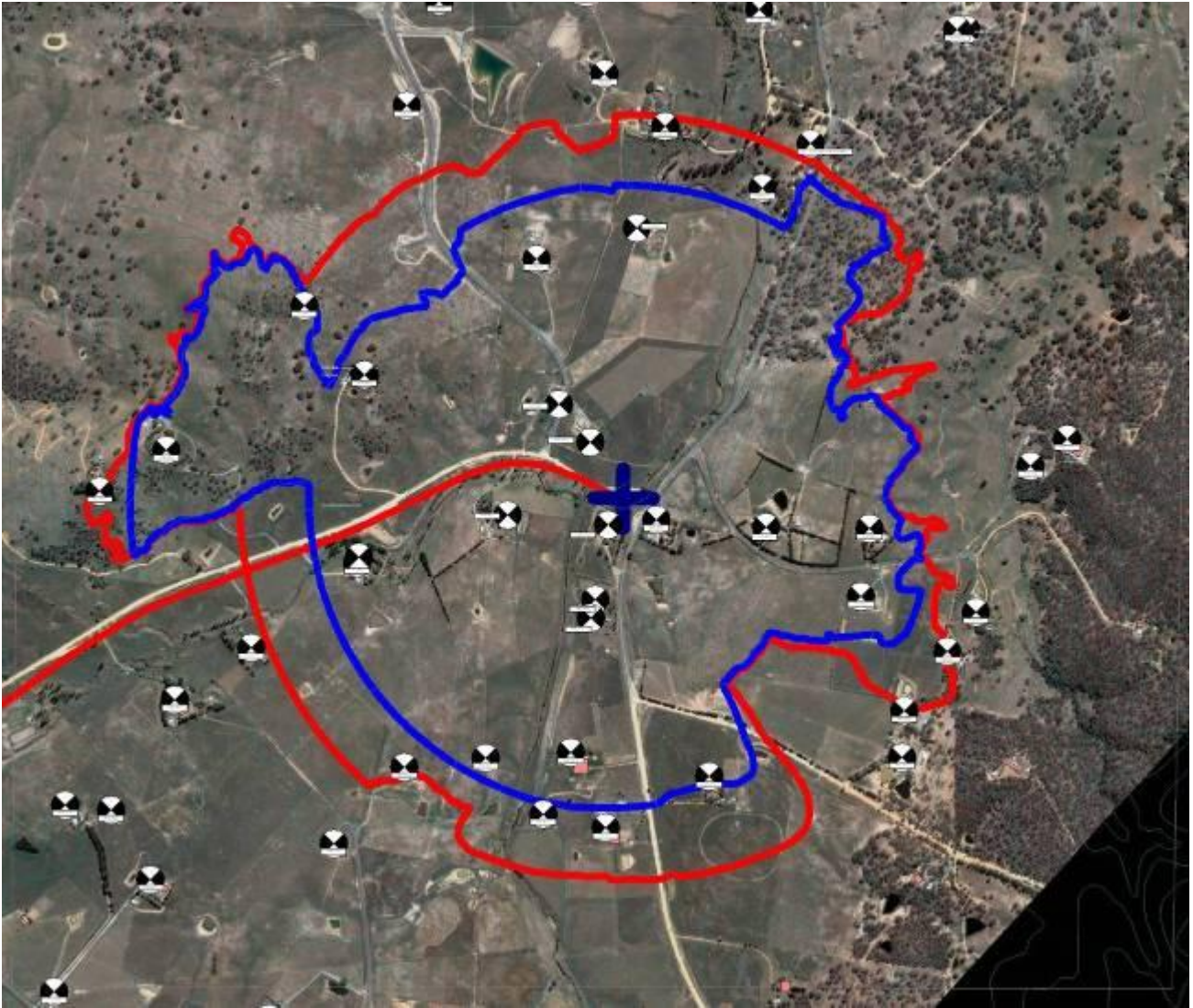
Refer to Section 3.2 above.

5 References

In preparing these responses, the following documents were referenced:

- Murrumbidgee to Googong Water Transfer – Noise and Vibration Assessment report, Bulk Water Alliance (BWA), July 2009.
- Caval Ridge Coal Mine Project – Noise and Vibration Impact Assessment, BHP Billiton Mitsubishi Alliance. Heggies report 20-2028-R2 Revision 3, 19 May 2009. <http://www.bhp.com.au/bbContentRepository/docs> (accessed 24 November 2009).
- ACT Government Environment Protection Policy (Noise) – 1998.

Appendix A Discharge Structure – Noise Contours



Noise Level Contours dB(A) with sensitive receivers denoted by black and white circle symbols

— 35 dB(A) Night-time *Noise affected level* for oversized delivery activities

— 40 dB(A) Day-time *Noise affected level* for construction activities

Figure 1 Revised discharge structure location - construction and delivery noise contours dB(A)

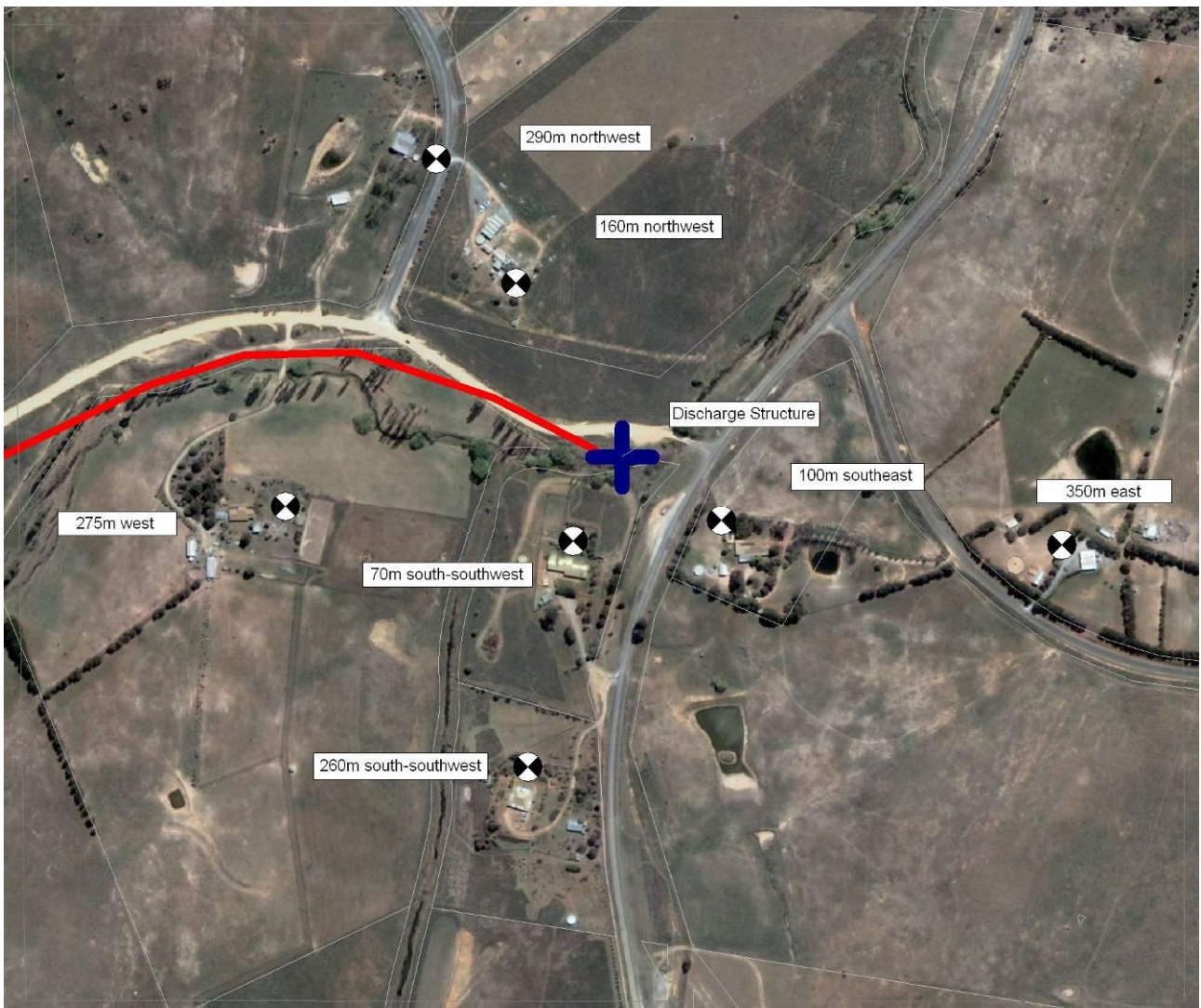


Figure 2 Revised discharge structure location - surrounding residences (shown as black and white symbols)

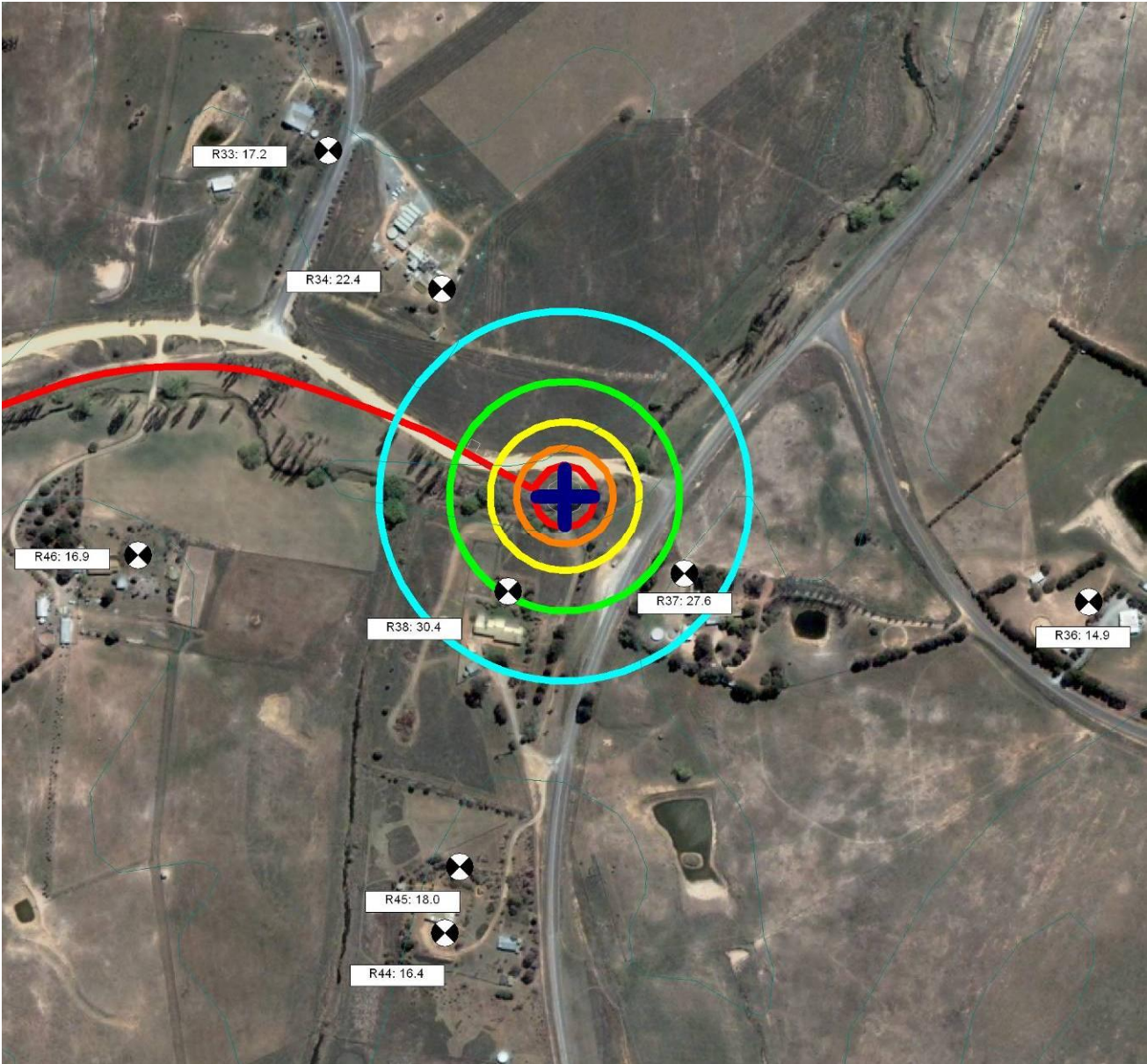
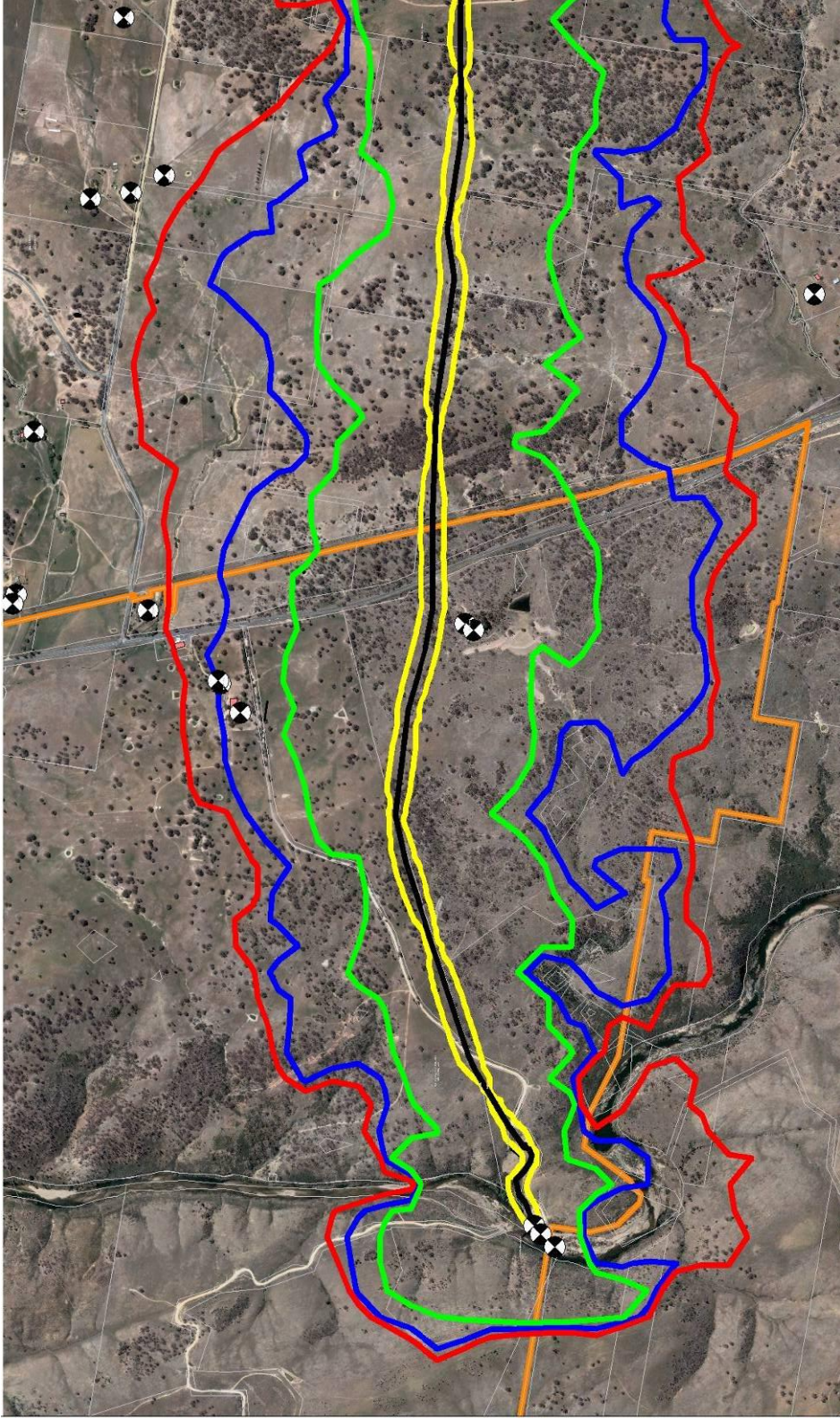


Figure 3 Revised discharge structure location - operation noise levels at surrounding residential receivers denoted by the black and white circle symbols in dB(A)

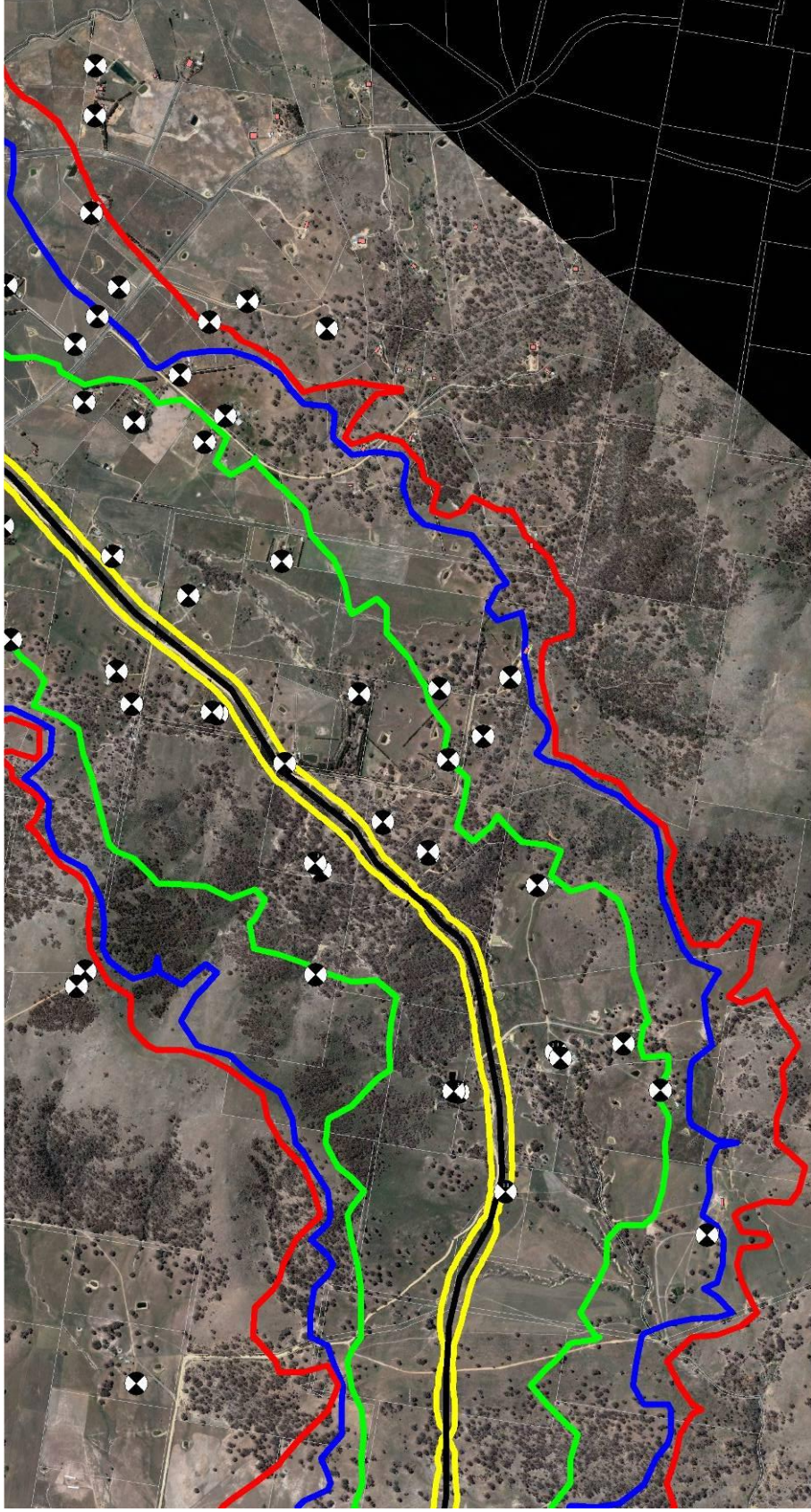
Appendix B Pipeline Construction – Noise Contours



Noise Level Contours dB(A) with sensitive receivers denoted by black and white circle symbols

- 35 dB(A) Night-time Noise affected level for oversized delivery activities
- 40 dB(A) Day-time Noise affected level for blasting associated activities
- 40 dB(A) Day-time Noise affected level for construction activities
- 75 dB(A) Day-time Highly Noise affected level for construction

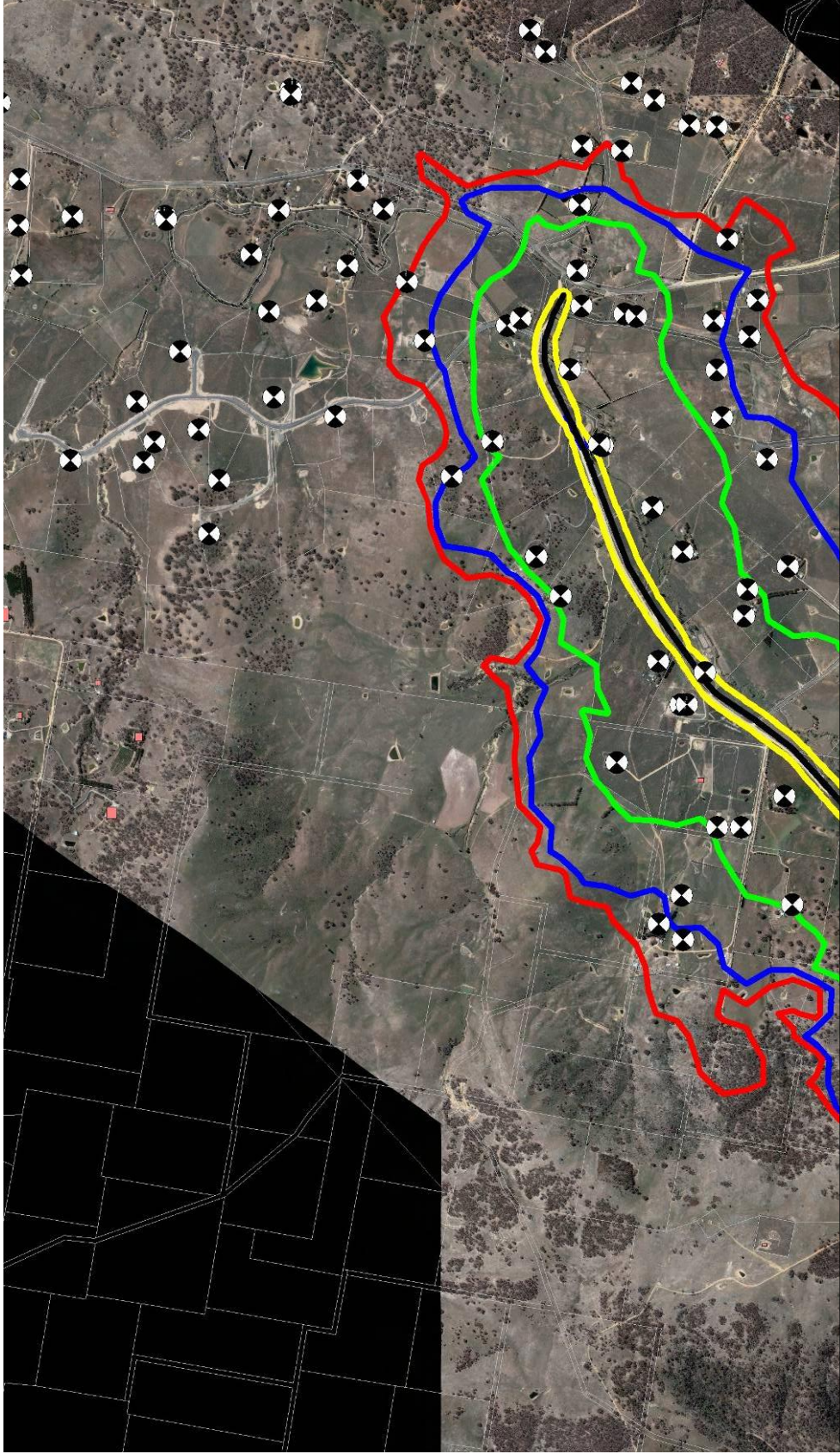
Revised Figure 5.1 Revised Pipeline construction noise contours and surrounding residential receivers (western end), dB(A)



Noise Level Contours dB(A) with sensitive receivers denoted by black and white circle symbols

- 35 dB(A) Night-time Noise affected level for oversized delivery activities
- 40 dB(A) Day-time Noise affected level for blasting associated activities
- 40 dB(A) Day-time Noise affected level for construction activities
- 75 dB(A) Day-time Highly Noise affected level for construction activities

Revised Figure 5.2 Revised pipeline construction noise contours and surrounding residential receivers (central), dB(A)

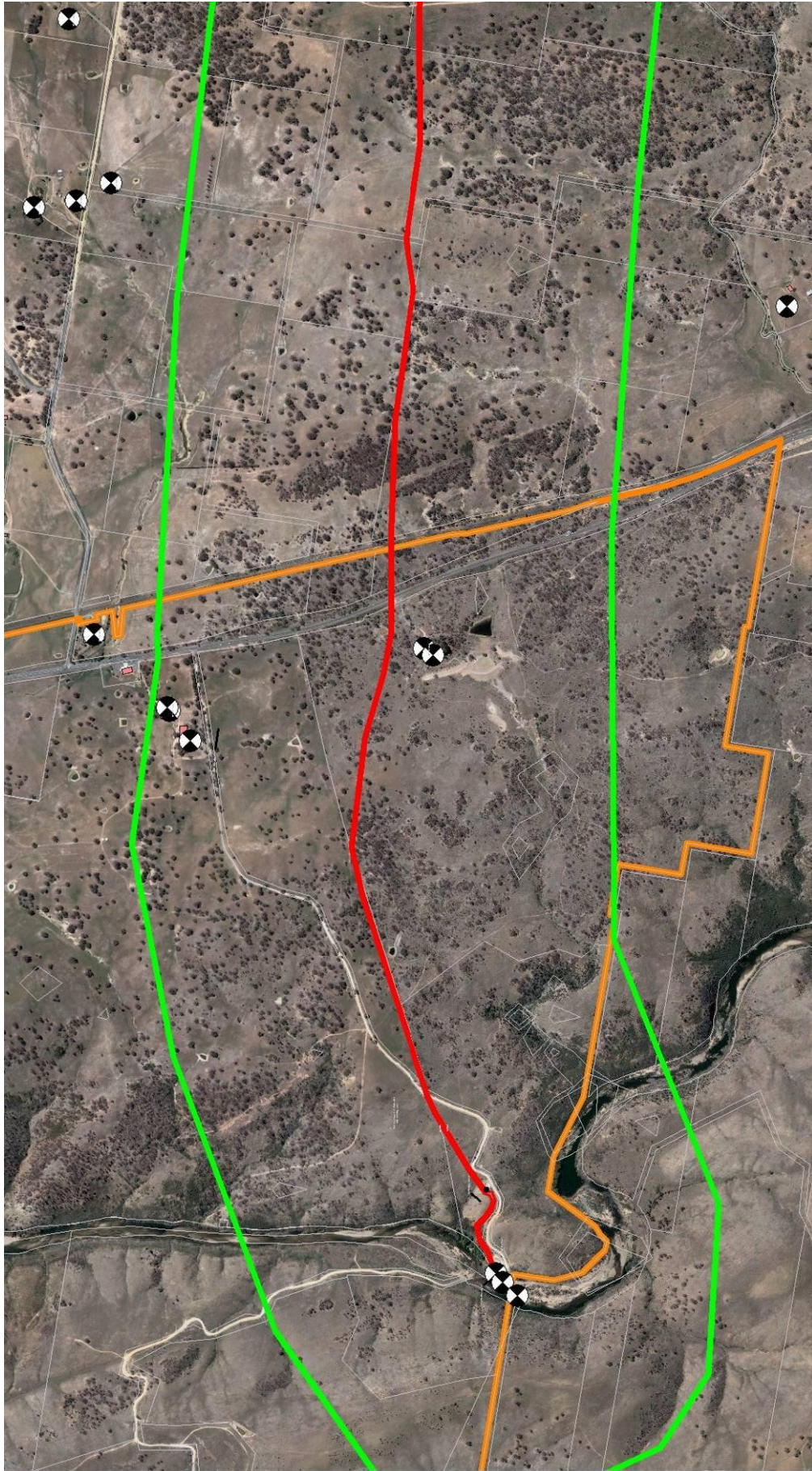


Noise Level Contours dB(A) with sensitive receivers denoted by black and white circle symbols

- 35 dB(A) Night-time Noise affected level for oversized delivery activities
- 40 dB(A) Day-time Noise affected level for blasting associated activities
- 40 dB(A) Day-time Noise affected level for construction activities
- 75 dB(A) Day-time Highly Noise affected level for construction activities

Revised Figure 5.3 Revised pipeline construction noise contours and surrounding residential receivers (eastern end), dB(A)

Appendix C Blasting – Approximate Buffer Distance Contour

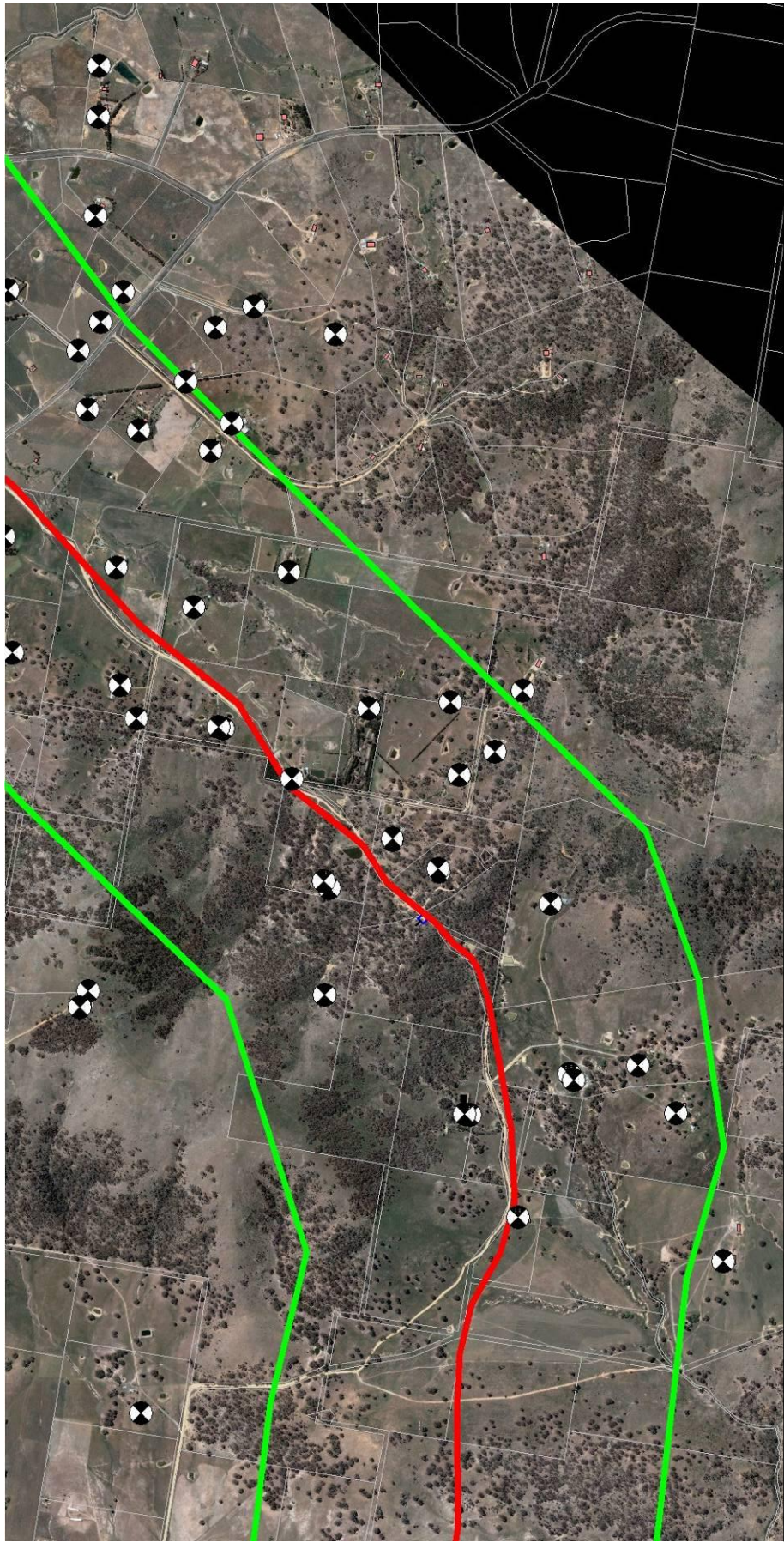


800 metre Blasting Buffer Contour with sensitive receivers denoted by black and white circle symbols

— 800 metre blasting buffer zone — ACT/NSW Border

— Proposed pipeline route

Figure 4 Approximate Blasting Buffer Distance (800-metre contour) – Western End



800 metre Blasting Buffer Contour with sensitive receivers denoted by black and white circle symbols

- 800 metre blasting buffer zone
- Proposed pipeline route
- ACT/NSW Border

Figure 5 Approximate Blasting Buffer Distance (800-metre contour) – Middle Section

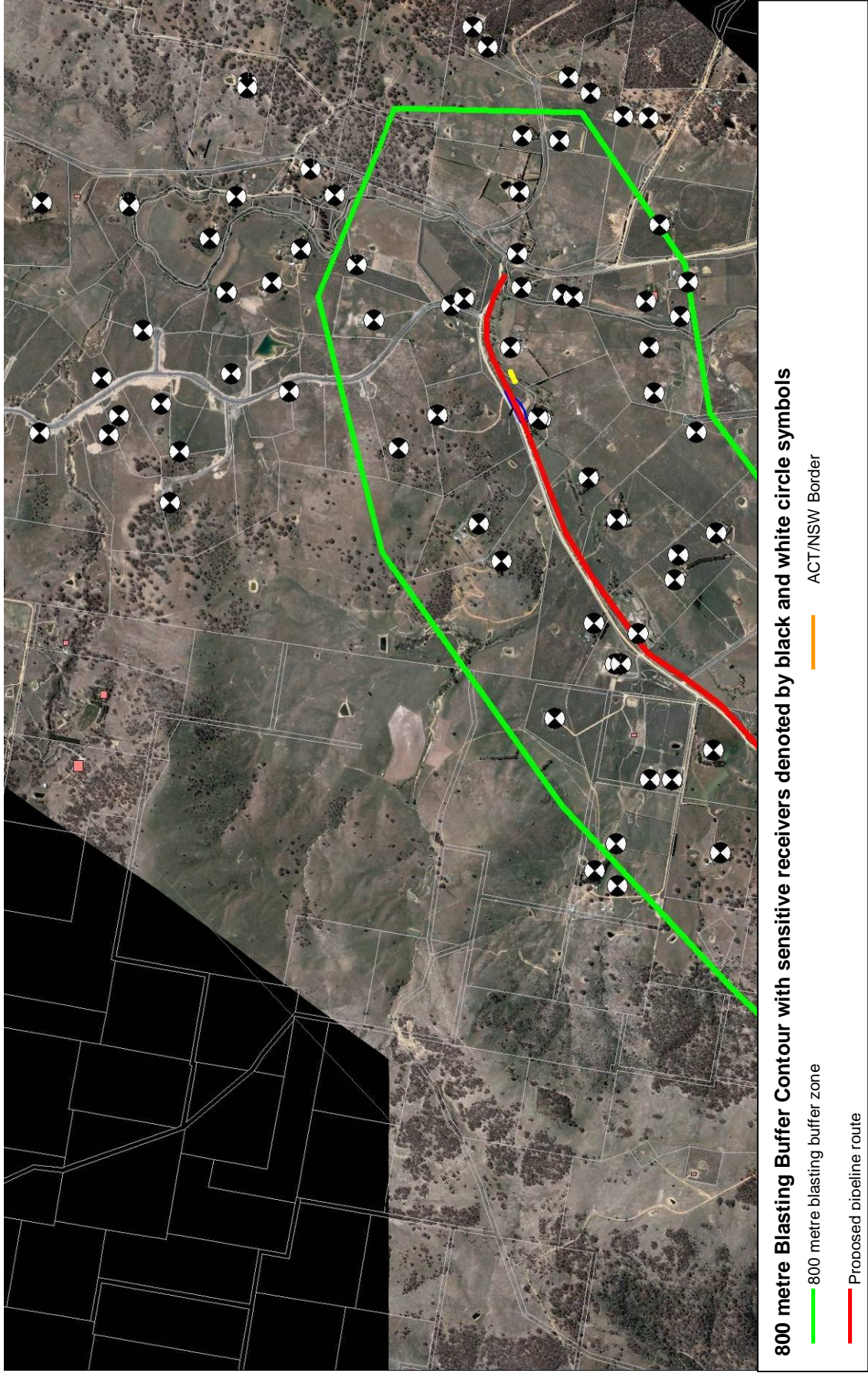


Figure 6 Approximate Blasting Buffer Distance (800-metre contour) – Eastern End

Appendix D Air Valves 8 and 9 – Noise Contours

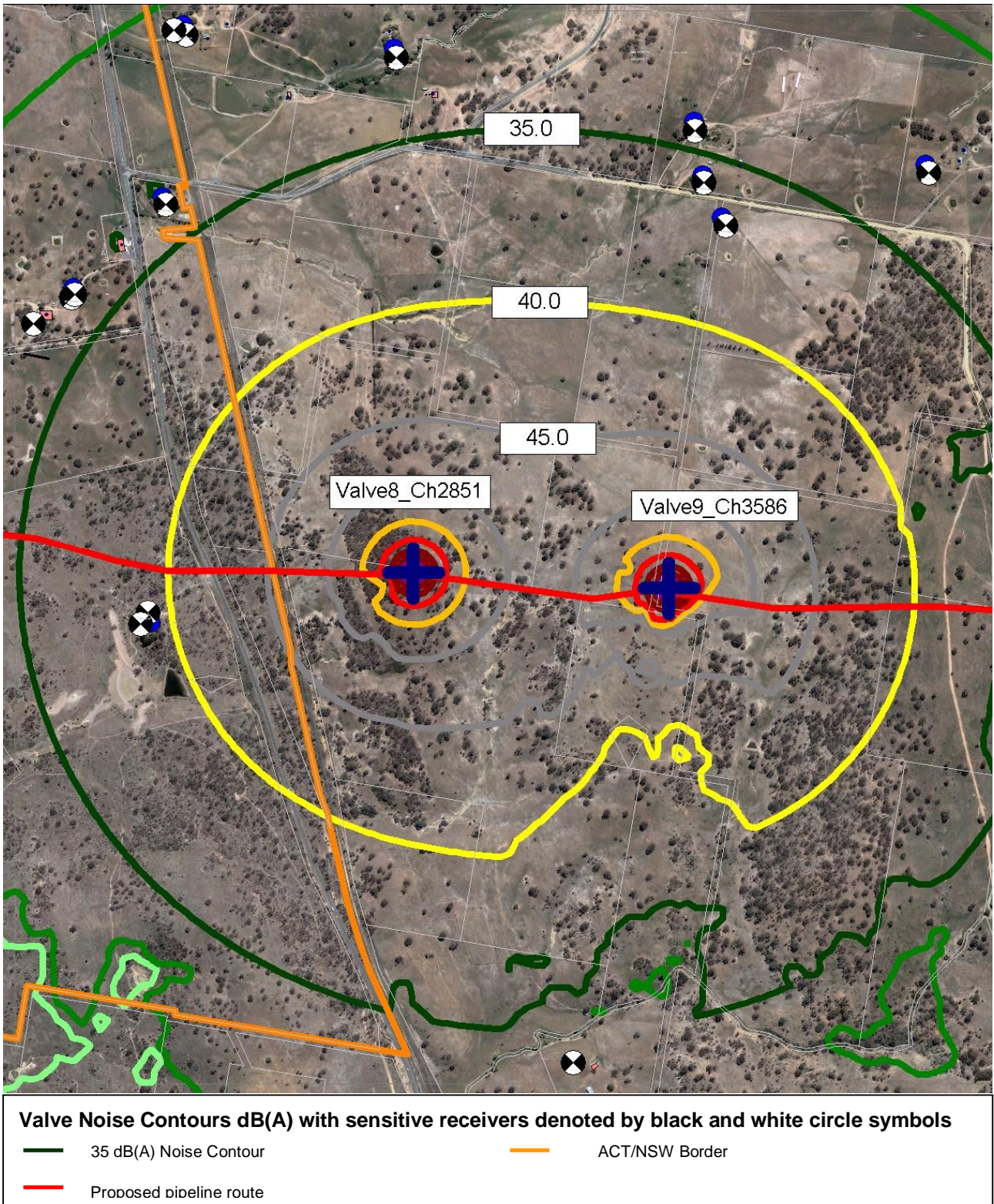


Figure 7 Air Valves Operation (1-minute operating time in 15 minutes) – Noise Contours